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UNIVERSITY OF CALGARY

In Our Hands: Designing for Mobile Devices

by

Belina Marie Caissie

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

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Abstract

Two significant impacts on K–12 learning environments are the increasing diversity of learners and one-to-one learning environments. Over the last two decades, several large-scale, provincially-funded projects have supported one-to-one technology in education and equity in Alberta's education system. For example, the iPad was appropriated by education at an unprecedented rate.

This participatory action research study engaged fifth-grade students and their teacher in an exploration of their science learning and teaching with iPads as the one-to-one mobile device used. Two main types of action research cycles occurred: 1) technology and 2) teaching and learning. Multiple action research cycles were carried out concurrently to investigate: In what ways does the design of technology-enabled, inclusive learning environments impact teacher and student learning and agency in middle school? Data collection methods included focus groups, individual interviews, observations, researcher journaling, a survey, documents, and artifacts. Three process findings emerged through the student focus groups: challenges, customization, and choice. Seven impact findings were evident from the classroom observations and individual interviews: increased collaboration, improved student engagement, student empowerment, teacher empowerment, technology-enhanced learning environment, shifts in teachers' perceptions of learners, and shifts in students' perceptions.

This study revealed that a technology-rich classroom does not automatically create a technology-enhanced learning environment. Systemic barriers mute the potential of one-to-one access. When the design of technology integration at both the school and school authority level creates significant barriers to effective student and teacher use of mobile devices as pedagogical tools, the ability of both teachers and students to *act* in new and innovative ways is thwarted. The inability to *act* in new and innovative ways makes it difficult for teachers and students to develop and exert their agency. The findings of this study imply that the potential of

iPads is not being fully realized in the context of learning and teaching as well as provides insight on how iPads can be leveraged as pedagogical devices. Ten recommendations for educational stakeholders, including the Department of Education, educational leaders, teachers, and Faculties of Education, are presented to support a shift from technology-rich classrooms to technology-enhanced learning environments.

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Dedication

For Nathella: Becoming a mother changed me as an educator. Your curiosity, love of learning, strong sense of justice and equity, and unique perspective on emergent technology continues to inspire me.

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CHAPTER ONE

IN OUR HANDS: DESIGNING FOR MOBILE DEVICES

Equity in education, more specifically equity for students with special needs, has remained a contentious issue since it entered the education landscape. “The ideal of educational equality is fundamentally grounded in the egalitarian principle that social and institutional arrangements should be designed to give equal consideration to all” (Terzi, 2007, p. 757). However, after half a century, there is still much heated debate centred on inclusion. Although current Canadian classrooms are more diverse than just a decade ago (Statistics Canada 2010a, 2010b, 2011; Walters, 2003), the debate rages on about the most appropriate classroom setting for students with special needs, especially those with moderate to severe needs or low-incidence disabilities.

A number of scholars (Dore, Dion, Wagner, & Brunet, 2002; Dymond & Russell, 2004; Fuchs & Fuchs, 1994; Hallahan & Kauffman, 1994; Kauffman, 2002; Manset & Semmel, 1997; Marston, 1996; Paterson, 2007; Shankner, 1995; Zhang, 2001) espouse both the advantages of congregation and highlight the difficulties of inclusion. Shankner (1995) goes so far as to warn “full inclusion is replacing one injustice with another” (p. 19). However, a comparable body of research demonstrates positive effects of inclusive practices (Artiles, 2003; Boutot & Bryant, 2005; Cushing, Carter, Clark, Wallis, & Kennedy, 2009; Fitch, 2003; Hunt, Soto, Maiet, & Doering, 2003; Thomas & Gleeney, 2002).

Although much research on inclusion has been conducted over the past few decades, conflicting truths have been demonstrated. I posit that one factor contributing to this divergence is too much of the equity in education debate has focused on the most appropriate place for students with special needs and how students perform in that place, rather than on pedagogy. While there have been great strides in providing students with special needs physical access to classrooms in their community schools, for inclusion to be successful, students with special

needs cannot be merely afforded space. As Pivik, McComas, and Laflamme (2002) so eloquently expressed, “facilitating inclusive school environments requires ensuring physical access, the opportunity for optimal learning and social experiences, and providing a nurturing climate” (p. 103). This requires educators to be welcoming of diversity and innovative.

Context of the Study

While the inclusion debate continues, Alberta Education has led a new vision for inclusive school cultures that they describe as one inclusive education system. This emerged from *Setting the Direction*, a consultation process that began in the fall of 2008 for Albertans to provide input into the creation of a new framework for special education. The proposed new framework was released in June 2009. Twelve programming recommendations were organized under three overarching priorities; curriculum, capacity, and collaboration. Under capacity, the seventh programming recommendation was “[i]ncrease access to technologies to support the learning of all students” (Alberta Education, 2009, p. 9). The following June, the Government of Alberta provided its official response to the *Setting the Direction* framework, accepting all 12 of the recommendations.

The Government response to Strategic Direction Seven was to affirm “Government will maximize the power of technology to personalize learning and present material in multiple ways to support the learning of children and youth in an inclusive environment” (Alberta Education, 2010, p. 4). *Setting the Direction* was renamed *Action on Inclusion* in the fall of 2010. Implementation, that is, moving towards an inclusive education system, began September 2011 “in a limited number of school communities and…focus[ed] on helping people, and particularly educators, understand what they can do to support students’ success in inclusive environments” (Alberta Education, nd, para 13). The Government acknowledges that a wide variation among teacher beliefs regarding inclusion remains in today’s educational landscape and, under the new initiative, “for many, the shift in thinking and practice [will be] significant” (Alberta Education, nd, para 12).

Alberta Education's definition of inclusion continues to evolve and is "not just about learners with disabilities or exceptionalities. It is an attitude and approach that embraces diversity and learner differences, and promotes genuine equality of opportunities for all learners in Alberta" (Alberta Education 2017, p. 35). The current Inclusive Education Policy states:

> ... school authorities must ensure that all children and students (Kindergarten to Grade 12), regardless of race, religious belief, colour, gender, gender identity, gender expression, physical disability, mental disability, family status or sexual orientation, or any other factor(s), have access to meaningful and relevant learning experiences that include appropriate instructional supports. (Alberta Education 2017, p. 29)

Alberta Education (2017) identified six principles considered key for achieving an inclusive education system: (1) anticipate, value, and support diversity and learner differences, (2) have high expectations for all learners, (3) understand learners' strengths and needs, (4) reduce barriers within learning environments, (5) ensure capacity building, and (6) promote shared responsibility.

Problem

Over the past 16 years (2001–2017), several large-scale, provincially-funded projects have supported technology in education and equity in Alberta's education system. In 2001, Alberta launched SuperNet, a fibre-optics network initiative to connect every school, school, library, and provincial government facility in the province to the Internet while also allowing Internet Service Providers access to the network so communities across the province would have residential and commercial high-speed Internet available at competitive rates. From 2008 to 2010, Alberta Education offered the Innovative Classrooms Technology Funding program. This was a three-year, 56 million-dollar program designed to ensure instructional spaces were equipped with an instructional computer as well as a digital projector and / or an electronic whiteboard. Other provincial initiatives to address technology infrastructure, curriculum and resources, and professional learning are provincial videoconferencing and LearnAlberta.ca,

which is a password-protected website of digital teaching and learning resources that also houses digital versions of textbooks available for students with perceptual disabilities. iPads entered Alberta classrooms among these previous educational technology initiatives. Initial reflections on iPad integration into Alberta classrooms revealed:

> iPads are designed to create an intensely personal experience. This orientation can be out of step with the current realities of the classroom. Thus, while school jurisdictions have traditionally planned and supported technology within an enterprise environment, iPads present as a square peg. iPads not only run in contrast to our more systemic ways of planning for technology integration, but they also offer a new way of interacting with content. (Alberta Education, 2011, p.4)

Shortly after iPads entered Alberta classrooms, Alberta Education took a step towards realizing one of the four policy shifts identified by the Inspiring Education vision for education to 2030; Technology to Support the Creation and Sharing of Knowledge, with the publication of the *Learning and Technology Policy Framework* (LTPF; 2013). The LTPF is also grounded in the *Ministerial Order on Student Learning* (2013) that established goals and standards applicable to the provision of an inclusive Kindergarten to Grade 12 education in Alberta. The LTPF comprises five Policy Directions: 1: Student-Centred Learning, 2: Research and Innovation, 3: Professional Learning, 4: Leadership, and 5: Access, Infrastructure, and Digital Learning Environments.

To help guide the implementation of the LTPF, Alberta Education contracted IBM Canada Ltd. to co-design and conduct a Baseline Technology Assessment (BTA) for all public, separate, Francophone, and charter school authorities in the province. Of the 5,412 teachers surveyed through purposeful sampling, 68 percent indicated they believe their students have equitable access to digital devices at school and 81 percent reported they use technology to allow their students to demonstrate what they know through a range of media; yet very few reported using inclusive technologies to support the diverse learners in their classrooms. For

example, only 32 percent of Alberta teachers surveyed reported that they use text-to-speech to support students' learning, 23 percent reported they use word prediction to support students' learning, and 19 percent reported they use speech-to-text to support students' learning (Alberta Education, 2015). Clearly, research is needed to better understand why teachers and students are not leveraging the supports technology can provide diverse learners.

For the past quarter of a century, the use of computer technology in schools has been touted as part of the solution for creating optimal learning experiences and improving both K–12 and higher education. The current Association for Educational Communications and Technology definition of educational technology highlights the purpose of educational technology as "facilitating learning and improving performance" (Januszewski & Molenda, 2008, p. 1). In 1993, Seymour Papert asserted "we are at a point in the history of education when radical change is possible, and the possibility for that change is directly tied to the impact of the computer" (p. 36-37). In more recent years, educators have claimed new technologies are transforming education (Rose, Hasselbring, Stahl, & Zabala, 2005). Strudler (2010) goes so far as to state "nearly all work involved in enhancing learning and teaching with technology is about change in some way" (p. 229).

Some scholars claim the results of technology-facilitated learning on student achievement have been disappointing (e.g., Cuban, 2001; Penuel, 2006), yet for many students, "technology can be the difference between students with special needs sitting in a classroom watching others participate and all students participating fully" (Bausch & Hasselbring, 2005, p.9). Nonetheless, according to Sawyer (2006), by the end of the 20th century "no studies had shown that computer use was correlated with improved student performance" (p. 8). Cuban, Kirkpatrick, and Peck (2001) found that for teachers ranging from occasional to serious users, access to computer hardware and software "had marginal to no impact on teaching practices" (p. 825). Access to technology for students and their teachers is not enough to improve teaching and learning.

The types of digital technologies available have undergone exponential change over the past 25 years and are becoming ubiquitous; however, pedagogy and curriculum content have not experienced as widespread a change. Mishra and Koehler (2008) suggest "[o]ne way of thinking about teaching with technology is to view it as a "wicked problem" (Rittel & Webber, 1973), in which the goal is to find the right combination of technologies, teaching approach, and instructional goals" (p. 2). It is important to note the emergence of a body of research that pushes beyond access and amount of use. This new research examines how technologies, and the social and environmental factors in which they are immersed, are impacting the capabilities and functionings of students (eg. Edyburn, 2006; Friesen, Clifford, Francis-Poscente, & Martin, 2008, Rose & Meyer, 2000, 2002). This new research has begun to identify what works, under what conditions, for what purpose, and for which learners.

Technological initiatives in education have evolved from computer labs, to classroom computer stations, to school-based access to the Internet, to mobile laptop and netbook carts, to one-to-one laptop initiatives (Bonifaz & Zucker, 2004), to interactive whiteboards, and, most recently, to mobile technologies such as cell phones, iPods, and tablets. In recent years, emergent technologies have infiltrated all aspects of how our world works, with digital media playing an increasingly integral role in everyday life (Grisham & DeVere Wolsey, 2008; Toboso, 2011; Snyder, 2002), especially the lives of youth (Lenhart, Madden & Hitlin, 2005). In fact, we are in a unique time and place in history where many of today's adolescents have grown up immersed since birth in digital technologies.

Today's youth, including those with special education needs, inhabit an ever-changing media ecosystem comprised of pervasive digital media and social interaction often through online communication (Horst, Herr-Stephenson, & Robinson, 2010). Many scholars (e.g., Ito et al., 2010; Jukes, & Dosaj, 2006; & Prensky, 2001a, 2001b) posit this time and place as a digital milieu where "our values and norms surrounding education, literacy, and public participation are being challenged by a shifting landscape of media and communications where youth are central

actors" (Ito et al., 2010, p. 1), that is, a time and place that has transformed how students learn: "The advent of digital technology has dramatically changed routines and practices in most arenas of human work" (Mishra & Koehler, 2006).

The ever-increasing net of WIFI both in public and academic spaces, as well as the recent rapid proliferation of emergent mobile technologies, has had a significant impact on the digital milieu that most 21st century learners are immersed in. Growing up in this digital milieu with convenient access to digital technologies, which also has unprecedented media saturation, has impacted youths' ways of thinking, communicating, and learning (Barnes, Marateo, & Ferris, 2007; Oblinger & Oblinger, 2005; Prensky, 2007). However, there is a new digital divide emerging; a growing crevasse between the ways students use technology outside of school and the ways they are permitted to use it in class (Jacobsen, Clifford, & Friesen, 2002).

Rationale for the Study

Apple's release of the iPad in May of 2010, which was touted by many to have completely transformed the mobile tablet landscape (e.g., Levy, 2010; McCrea, 2010), quickly caught the attention of educators. Within months of the iPad's release, pilot projects exploring this mobile device were occurring in K–12 and post-secondary settings around the world; from North America, to Australia, to England. This mainstream technology also became the appropriated technology of choice at an unprecedented rate by many individuals with special needs (Rosenberg, 2012; Buchanan, 2010; Hager, 2010; Whent, 2012; Wilson, 2012).

The iPad is an exemple of a recent trend for emergent mainstream technologies to be more universally designed and has been embraced by many parents of students with special needs. Like their other products, Apple has done an exceptional job of integrating accessibility into the iPad. For example, the iPad is designed to be completely accessible to users with visual impairments right out of the box. Voiceover technology is integrated into the device. When an iPad is first turned on, if the device is not interacted with within a certain amount of time, it will begin to guide the user through the process with verbal instructions. Apple's quick launch of a

second-generation iPad in 2011 and a third-generation iPad in March 2012, both with user-requested improvements, is leaving its tablet competitors in the dust (Keith & White, 2012). The fourth- and fifth-generation iPads have continued to incorporate user-requested improvements while iOS updates regularly include improved accessibility features.

To effectively participate in academic and social settings, individuals with special needs often require technology supports. Traditionally in education, these supports, called assistive technology, were rooted in the medical model. Assistive technology for learning (ATL) includes "devices, media and services used in learning environments to overcome barriers for students with physical, sensory, cognitive, speech, learning or behavioural special needs to actively engage in learning and to achieve their individual learning goals" (Alberta Education, n.d, para 1.). Some examples of ATL are text-to-speech software, word-prediction software, speech-to-text software, speech-generating devices, and sight-enhancement systems.

Up until recently, specialized ATL devices were expensive, difficult to learn, complex to repair, and quite different than other types of technology people use on a daily basis, so they may serve to identify students as 'special' and isolate them from their peers. Common barriers to the effective integration of ATL into classroom settings are difficulties in obtaining, managing and maintaining equipment, the time and funds required for appropriate training and support, negative staff attitudes, and student resistance to the device. Therefore, device abandonment is a common occurrence.

Although the iPad is just in its first decade, more and more individuals with special needs are appropriating this mainstream device, and the apps available for it, to overcome barriers to becoming actively engaged in academic and social settings. Soon after the iPad's release, it was my experience as an Assistive Technology Learning consultant that many parents of students with special needs began purchasing iPads with the expectation their children will be able to use them in school. However, it is a device coveted by those with and without special needs: children, youth, and adults alike in the current digital media ecosystem. It is possible that

the iPad will transform the assistive technology landscape as well the mobile tablet landscape. While current emergent technology does not have robust enough supports to meet all the needs of diverse learners and make ATL obsolete, there is a shift underfoot in the ATL landscape.

The universal design of the iPad, the exponentially growing assortment of apps available through iTunes and the rampant, widespread acceptance of the device, warrants further investigation of its use in educational settings for all learners, particularly the potential of iPads to help facilitate technology-enhanced inclusive learning environments:

> iPads are part of a broad social and economic shift towards personalization.... Education exists within this larger frame and is experiencing pressure both from the public and from the research community to become more responsive to individual student learning interests and needs. iPads, as an extension of Apple's line of highly personalized products, enter the education space as a seemingly natural answer to these calls for a shift from one-size-fits-all to a custom fit. (Alberta Education, 2012, p. 17).

To be responsive to individual student learning interests and needs requires more than the purchase of mobile technology; it requires redesigning the learning experience and creating technology-enhanced inclusive learning environments. The purpose of this research study is to engage students and their teacher in an exploration of the iPad as a one-to-one device. More specifically, the purpose of this study was to build knowledge around the use of iPads to foster technology-enhanced inclusive learning environments and facilitate change in a cooperative way.

Research Questions

Central Question.

The inquiry was guided by the following research question:

In what ways does the design of technology-enabled, inclusive learning environments impact teacher and student learning and agency in middle school?

Sub Questions.

1. Do technology-enhanced learning activities change over time? If so, how?
2. Does learning with the iPad as a one-to-one device impact teacher self-efficacy to support students with diverse learning needs in an inclusive setting? If so, how?
3. Does learning with the iPad as a one-to-one device impact teachers' perception of students as learners and student perceptions of themselves as learners over time? If so, how?

Theoretical Framework

The educational landscape is complex with many conflicting theoretical perspectives and the field of educational technology is just as diverse. That said, my research with fifth-grade students and their teacher on iPads as one-to-one devices in an inclusive classroom was done through the lens of the Capability Approach.

The Capability Approach.

Amartya Sen, a Professor of Economics and Philosophy at Harvard University, first introduced the concept of the Capability Approach in 1979 during what is now considered a landmark lecture delivered at Stanford University entitled *Equality of What?* In this lecture, he offered *basic capabilities* as "a natural extension of Rawls's concern with primary goods, shifting attention from goods to what goods do to human beings" (Sen, 1979, pp. 218-219). Since this seminal talk, the Capability Approach has been further developed by Sen (see Sen, 1984, 1987, 1990, 1993, 1995, 1997, 2002, 2005) and other scholars, most notably Martha Nussbaum (see Nussbaum 1992, 2003, 2006).

The Capability Approach has emerged as a theoretical framework about well-being, development, and justice. According to Sen (1995) "'capability perspective' involves concentration on freedoms to achieve in general and the capabilities to function in particular (especially when assessing freedoms to pursue well-being)" (p. 266). It is inherently

interdisciplinary and influenced by a range of thinkers such as Aristotle, Adam Smith, and Karl Marx (Robeyns, 2005).

The fundamental assertion made by the Capability Approach is that well-being, development, and justice should be thought about in terms of what individuals are capable of doing and being (Robeyns, 2005). Therefore, "capability development relates to both the creation of opportunities and the ability to make the best of those opportunities" (Hinchliffe, 2009, p. 406). In contrast to resource-based approaches, the Capability Approach acknowledges that our abilities to convert resources into valuable activities are influenced not only by differences in our own abilities, but in social and environmental factors as well.

The Capability Approach comprises two main concepts: *functioning* and *capability* and focuses what a person can do or be rather than on resources (Robeyns, 2005). It is these two concepts that separate the Capability Approach from other ways of understanding well-being, development, and equity. Functioning is a valued activity or state of being that is is in the process of or has been achieved. Lozano, Boni, Peris, and Hueso (2012) have pointed out "'functionings' can be (1) activities like reading or writing; (2) physical states, such as being able to be well-nourished and healthy; (3) mental situations, like being happy, or (4) social functionings, such as being integrated into society" (p.134).

There is a difference between a functioning and a capability. "A functioning is an achievement, whereas a capability is the ability to achieve" (Sen, 1987, p.36). It is important to note that "[u]nder Sen's approach, capability does not constitute the presence of a physical or mental ability; rather, it is understood as a practical opportunity" (Mitra, 2006, p. 236-237). As Lozano et al. noted: "In terms of education, capabilities could be understood as the set of real opportunities students have to do and to be what they have reason to value" (2012, p. 135).

Two other key concepts of the Capability Approach are *agency* and *freedom*. Sen argues that capabilities are substantive freedoms; capabilities are what make freedom effective (Hinchliffe, 2007). Agency, on the other hand, is "characterized by one's ability to pursue goals

that one values and that are important for the life an individual wishes to lead. Agency means being an active participant in planning and conducting one's life" (Lozano, Boni, Peris, & Hueso, 2012, p. 134). Zheng and Stahl (2011) assert "the central role of 'agency' in Sen's Capability Approach allows us to challenge the perception of potential users of Information and Communication Technology (ICT) as passive receivers of innovations" (p. 70).

Sen (1993) stresses further the important distinctions between well-being and agency and between achievement and freedom. According to Lozano, et. al. (2012), "for the capability approach the goal of education is to expand people's agency (empowerment) to enable them to be the authors of their own lives" (p. 134). Hinchliffe (2007) points out that capabilities permit agents to take risks:

> Capabilities are not the same as competences, as generally understood, because whereas the latter can be identified in terms of identifiable outcomes, the development of capabilities permits a range of possibilities. Consequently, capabilities permit the exploration of agency in a way that competencies do not. They do this because of the link to possibility, that is, the link to the unexpected and the unforeseen. (p. 224).

As such, taking a Capability Approach can encourage innovation: new ways of thinking and doing.

Although the Capability Approach's roots are in poverty and welfare economics, interest is growing in this approach and its significance for education (see Hinchliffe, 2007, 2009; Saito 2003; Terzi 2005a, 2005b; Unterhalter 2007; Walker 2005, 2006). Interestingly, education—both in terms of formal schooling and informal learning—has always been central to the Capability Approach, which specifically emphasizes the contribution that the capability to be educated makes to other capabilities (Terzi, 2007). Saito (2003) presented the first critical examination of the educational significance of Sen's Capability Approach to human well-being; she demonstrated a strong relationship between Sen's Capability Approach and education. Walker (2005, 2006), delving into capabilities and education, attempted to operationalize the Capability

Approach by producing a provisional, situated list of education capabilities and discussed the relevance of the Capability Approach to participatory action research. Meanwhile, Hinchliffe (2007, 2009) examined learning as a capability, highlighting the relation between learning and truth, and explored the role of deliberation while developing a concept of the agent of capability. As a further example of interest in this subject, Unterhalter (2009) posed the question "How can we operationalise equity and equality of capabilities in ways that are useful to education planners?" (p. 422).

In a section that follows, the work of scholars interested in disability as well as ICT and who have embraced Capability Approach Theory, will be reviewed.

The Capability Approach and disability.

In 2005, Lorella Terzi presented the argument that the Capability Approach, as a normative framework for assessing inequality, "provides an innovative and important perspective for re-examining the dilemma of difference in significant ways" (2005a, p. 443) and "provides a new and important framework for reconceptualising impairment, disability and special needs" (2005a, p. 457). Terzi posits the Capability Approach provided two important contributions to the understanding of disability: one "relates to how we can think of impairment and disability as aspects of human diversity" (2005a, p. 207) and the second "pertains to democratic participation in determining relevant capabilities" (p. 209). According to Lozano, Boni, Peris, and Hueso (2012), Terzi also elaborated Martha Nussbaum's work and proposed seven basic capabilities for educational functioning: (1) literacy, (2) numeracy, (3) sociality and participation, (4) learning dispositions, (5) physical activities, (6) science and technology, and (7) practical reason.

Florian et al. (2006) echoed Terzi's argument that the Capability Approach "provides an innovative and important perspective" (p. 42), but suggested the two main insights provided are that "how people differ is not what is important; rather, it is the capability to choose and achieve that matters" (p. 43) and "considerations of the relational aspect of disability with respect to both

impairment and social institutions" (p. 43). Reindal (2009) investigated the claim that the Capability Approach fares better with an understanding of disability as presented by the World Health Organization's *International Classification of Functioning, Disability, and Health* (ICF) than by the social model and proposed the social-relational model, a refined version of the social model, as a better framework for understanding disability. Walker (2005) asserted that for researchers "committed to improving educational practice towards greater social justice through a fair distribution of knowledge, skills, attitudes, and educational success and qualifications, the capability approach offers a framework for judging well-being in and through education" (p. 108).

The Capability Approach and digital technology.

According to Oosterlaken and van den Hoven (2011), in 1997 Garnham was one of the first to apply the Capability Approach to ICT. "'Thinking of entitlements in terms of functionings and capabilities', he argued convincingly, "allows us to get behind the superficial indices of access and usage that we so often use for ICT policy purposes" (Oosterlaken & van den Hoven, 2011, p. 65). Since then, an increasing number of scholars have considered the potential for the Capability Approach to inform and reframe ICT deliberations and vice versa (eg. Birdsall, 2011; Coeckelbergh, 2010; and Zheng & Stahl, 2011). However, this awareness within the ICT and Capability Approach communities of the potential relevance of each to the other continues to be in its infancy. Birdsall (2011) cautions that while both researchers in the Capability Approach and ICT communities acknowledge the potential contributions ICT can make on advancing human capabilities, there is a lack of genuine engagement between the two communities. To facilitate collaborative dialogue, Birdsall proposed a set of normative values and objectives within the context of capabilities and communication rights.

Coeckelbergh (2010) focused on how using the language of capabilities may help shape human-technological practices. He expanded on the conceptualization of technology as one of the means to reach ends by exploring the nature of the relation between capabilities and information technologies in the context of emerging possibilities for human enhancement.

According to Coeckelbergh (2010), using the Capability Approach as a normative-ethical framework allows researchers to consider how technologies impact “our actual and potential functionings or capabilities we have as humans and as the particular persons we are living in a particular societal, cultural, and technological context” (p. 82). Zheng and Stahl (2011) outlined key characteristics of the Capability Approach and critical theory from the perspective of the role of technology and explored insights that can be drawn from critical theory to enrich and strengthen the Capability Approach in relation to technology and human development. They proposed a critical theory of ICT and argued it is a good supplement to the Capability Approach, while acknowledging that empirical research needs to occur that uses their conceptual argument.

Oosterlaken (2015) argued the importance of iteratively *zooming in* and *zooming out*. She described *zooming in* as focusing on the design details of technology and *zooming out* as an examination of the socio-technical networks in which technologies are embedded. Royle & Nikolic (2016) also noted the importance of the socio-technical networks and systems. They championed the development of student capability and functioning through changes in learning design and the purposeful integration of digital tools into practice where practices and policies are assessed to ensure that capabilities are realized. In a similar vein, Haenssgen and Ariana (2017) created the technology-augmented Capability Approach as a tool for framing and developing research on the social implications of technology. In addition to technology as inputs, the technology-augmented Capability Approach includes two additional categories: technical objects and technological conversion factors.

Scholars such as Morris (2009) and Toboso (2011) have begun to consider the Capability Approach, disability, and ICT. Morris (2009), for example, discussed how the Capability Approach can improve our understanding of the participation of children with disabilities in contrast with measurements of capacity and performance. To maximize the authentic participation of students with disabilities, it is important to consider how resources

such as technology can remove or reduce barriers to participation. Morris (2009) asserted we must aim to "equalize children's capability sets by removing restrictions to enable participation, thereby giving children a degree of choice and autonomy" (p. 94).

Toboso (2011) presented an analysis of disability, the Capability Approach, and ICT that incorporated the concept of functional diversity and advocated its integration into ICT design through universal design. Toboso warned:

> [A] lack of access to technologies makes it impossible for users to appropriate them... and this has a dramatic impact on their opportunities for participation in society because it forces their capability set to be severely reduced. (2011, p. 116).

Summary and Organization of the Study

This dissertation is organized into six chapters. Chapter One introduced the current study and its context. It explained the problem and rationale for the study. Chapter one also presented the research questions that will be examined and shared the theoretical framework that supports the research. It concludes with definitions of key terms.

Chapter Two is a critical review of the literature focused on educational technology, one-to-one programs, and theoretical frameworks. Chapter Three outlines the research design. It begins with a review of the research design and research questions. This is followed by a description of how the site was established and the participants as well as the data collection methods, known issues of validity and reliability, the specific data analysis measures, and ethical considerations. Chapter Four presents an analysis of data from several sources. It reports the Participatory Action Research (PAR) cycles, the process findings, and the impact findings. Chapter Five is a discussion of the knowledge gained from the study. Chapter Six explores implications of this research. It concludes with recommendations and a reflection.

Definitions

- Agency: The capacity and motivation to take purposeful action. It involves the activity and the initiative of the actor.
- Assistive Technology: Products, equipment, and systems that enhance learning by increasing, improving, or maintaining the functional capabilities of students with disabilities. It is considered a subset of educational technology.
- Dialogic Activity: Focused discussions among participants, the researcher and students, are positioned on equal footing in jointly exploring an idea and co-constructing knowledge. It is a mutual quest for understanding and insight.
- Ecological Agency: The belief that the achievement of agency results from the interplay of: (1) individual efforts, (2) available resources, and (3) contextual and structural factors.
- Individualized Program Plan (IPP): An IPP is a required document for all students with special education needs in Alberta. “It is a working document and a record of student prgress that contributes to a common undersatnding and coordination of efforts.” (Alberta Education 2006, p. 3). “...a concise plan of action designed to address students' special education needs, and is based on diagnostic information which provides the basis for intervention strategies...” (Alberta Education, 2004, p. 4).
- iPad: A tablet; touchscreen mobile personal computer, made by Apple.
- Motivational affordance: a concept proposed by Zang (2008) where features or functions of an IT artifact that support internal motivational needs can influence whether, how, and how much the IT artifact will be used. Deterding (2011) argued that “motivation is afforded when the relation between the features of an object and the abilities of a subject allow the subject to experience the satisfaction of such needs when interacting with the object” (p. 2).

- Multimedia: The use of more than one medium of expression or communication through a combination of different content forms such as text, images, audio, animations, video, and interactive content.
- One-to-one: Also referred to as ubiquitous access, this is a learning environment where students are provided a school-owned device for their sole use.
- Pedagogical Tool: Anything that a person uses to learn or teach. No limits exist on what might be a pedagogical tool; it is up to the educator or student to make connections between the tool and concepts or facts to be learned.
- Tablet: A handheld, mobile computer with a touchscreen display and a rechargeable battery.
- Technology-Enhanced Learning Environment: “Complex learning environments that enable appropriate use of technological resources in order to continually enhance the conditions conducive to learning” (Brown, 2013, p. 304).
- Technology Integration: The use of technology, such as mobile devices, in general content area classrooms where technology is an integral part of how the class functions and is as accessible as other learning tools.

CHAPTER TWO: REVIEW OF THE LITERATURE

The purpose of this action research was to study—with students and their teacher—iPads as one-to-one devices in an inclusive classroom. Specifically, my intent was to understand the use of iPads to facilitate technology-enhanced inclusive learning environments and, more specifically, to facilitate change in a cooperative way. To inform this study, it was necessary to conduct a critical review of current and relevant literature on the topic. While the review is captured most succinctly in this chapter, it was an ongoing process throughout the data collection phase of this study, as well as during the data analysis and interpretation phases. A rhythm of returning to the literature ensured the literature informed the research need as well as the action cycles and data analysis.

This critical review of the literature focused on (i) the historical perspective of emergent computer technologies in schools, (ii) distinct affordance of mobile devices for education, (iii) handheld-mobile devices as assistive technology, (iv) iPads in education, (v) critiques of computer technology in education, (vi) the impact of one-to-one programs on teaching and learning, (vii) key factors affecting technology integration in educational settings, and (viii) four conceptual frameworks: (i) Technological, Pedagogical and Content Knowledge; (ii) Universal Design for Learning; (iii) Teaching Effectiveness Framework; and (iv) Learning Ecologies Framework. Each of these topics are discussed in the following sections of this chapter.

Historical Perspective of One-to-One Computer Technology Initiatives in Schools

In the 1980s, when networking capabilities were just emerging, Apple initiated the one-to-one computer access movement in the K–12 setting with the Apple Classrooms for Tomorrow (ACOT) project by equipping several classrooms with desktop computers for instructional uses (Dwyer, 1994). The study of this first large-scale one-to-one initiative led to Sandholtz, Ringstaff, and Dwyer's (1997) proposal that innovation adoption is a process that encourage teachers to predictably progress in using technology over time through five specific stages: entry, adoption,

adaptation, appropriation, and invention. Although the ACOT project was a one-to-one desktop computer initiative, it is important to note that as desktop computers were first introduced into K–12 schools they most commonly were deployed via the creation of computer labs. This required teachers to schedule computer lab blocks that supported a learning-about-computers approach and created challenges to integrating the use of computers across various subjects.

As technologies evolved, so too did one-to-one initiatives (Donovan, Hartley, & Strudler, 2007). According to Johnstone (2003), Methodist Ladies College in Melbourne, Australia, was the first school in the world to experiment with laptop computers as one-to-one devices. During the 1989–1990 school year, all students in grades five to 12 had a Toshiba laptop on their school-supply list (Russell, Bebell, & Higgins, 2004). Similarly, in the mid-1990s, the Anytime Anywhere Learning initiative (a collaboration between Microsoft Corporation and Toshiba America Information Systems) provided both students and teachers in North America one-to-one access to laptop computers (Donovan, Hartley, & Strudler, 2007; Rockman et al., 1997). And around this same time, a small Canadian university began the Acadia Advantage initiative that pioneered the use of mobile computing technology by including leased laptops to students as part of their university tuition, and provided training and technical support for students and professors. By the new millennium, this initiative resulted in a complete rewiring of the campus and put laptop computers into the hands of over 7000 students and faculty (Aylward & MacKinnon, 1999).

The Maine Learning and Technology Initiative (MLTI), launched in 2001, was the first statewide one-to-one laptop initiative in the United States and remains one of the highest profile one-to-one mobile learning effort (Weston & Bain, 2010). The initial aim of MLTI was to provide every seventh and eighth grade student in the state with a laptop computer. More specifically, students and teachers were provided an Apple iBook, Airport wireless networking, Internet access, a variety of educational software, technical support, and targeted professional

development (Silvernail, & Gritter, 2007; Silvernail, & Lane, 2004). In 2009, MLTI expanded to high schools.

Alberta Education established a one-to-one laptop learning project, Emerge, in 2006 “to investigate the efficacy of laptops for teaching and learning in the 21st Century” (Alberta Education, 2010, p. i). Three-year grants were provided to 20 Alberta school jurisdictions and an Emerge Community of Practice was created to support professional development of the participating educators. This project was evaluated with a mixed methods design. Students participating in the Emerge project demonstrated significant gains in 21st century skills. Student engagement was consistently higher than overall Canadian engagement trends predicted across all three years of the program. However, there were slight declines in engagement for students participating for the second and/or third year. Capacity building through multiple means over the three years of the project was identified as a strong factor on the progress accomplished.

Daniels, Jacobsen, Varnhagen, and Friesen’s (2013) mixed methods case study on laptops in Alberta classrooms indicated minimal change in system capacity occurred as a result of the Technology and High School Success (THSS) initiative. The 294 teacher participants had a fairly even distribution with respect to their years of teaching experience. Although there were pockets of innovation in several classrooms, it was not connected to years of teaching experience and the impact of the THSS initiative was not widespread. It did not result in sustainable changes to learning opportunities for Alberta students. Three barriers were identified: “1) schools and school districts did not leverage the opportunity to revisit their existing vision(s), 2) schools and school districts did not use data to make changes, and 3) limited access to technology” (p. 10).

The advancement of mobile technologies evolved quickly beyond laptops and netbooks: “The advent in recent years of an array of mobile technologies such as multimedia capable cellular phones, iPods and iPhones, PDAs, and portable netbook computers, has stimulated

considerable interest amongst the education fraternity" (Melhuish & Falloon, 2010, p.2). Once again, as technologies evolved, so too did one-to-one initiatives. Educators began to experiment with PDAs, cell phones, and iPods. Then the iPad entered the mobile landscape; a new category of mobiles, tablets arose. Interestingly, how educators view tablets differs from how they view cell phones: "While the idea of cell phones in the classroom too often conjures up images of disruption, tablets are a game-changer; they encompass many of the tools smartphones offer while presenting an ever-expanding collection of tools for learning" (Johnson, Adams, & Haywood, 2011, p. 15).

In the fall of 2010, the Victorian Department of Education and Early Child Development in Australia was among the first to implement a large-scale trial of iPads as a one-to-one device. More than 500 iPads were provided to the students and teachers in eight Victorian Government schools. In its second year, more than 700 iPads were distributed to students at nine schools, ranging from Kindergarten to Year 12, and included the Royal Children's Hospital Education Institute. The aim of this initiative was "to investigate progressive and effective use of learning technologies in learning and teaching, to develop independent and self-initiated learning in students, and extend their learning beyond the classroom" (State of Victoria, 2011, p. 4). Additionally, they aimed to explore the value of the iPad and the applications it can access in educational settings.

In 2011, Maine's Auburn School District launched Advantage 2014: Learning in the Hands of Children; an initiative to provide a strong learning advantage to all students in grades K–3. Year One of this initiative was targeted to kindergarten (Auburn School Department, n.d.). Every kindergarten student in Auburn School District and their teachers were provided a second-generation iPad. Year Two, the 2012–2013 school year, included all students in kindergarten and first grade. All students in kindergarten as well as first, second, and third grade were included in Years Three and Four of this initiative.

In the first two years since the release of the first-generation iPad, one-to-one iPad initiatives ranging from very small (i.e., one classroom in a school) to quite large (i.e., targeted grades across entire districts) have been launched around the world. For example, a Texas School district announced what is believed to be the largest iPad initiative to date (Lambrecht, 2012). McAllen Independent School District began distributing 6,800 devices in February 2012 with the intention for the entire student population of more than 25,000 students to have an iPad or an iPod Touch: “School board president Sam Saldivar Jr. said the $20.5 million investment in the technology aims at ‘equity’” (Sherman, 2012 np). This historical perspective illustrates Mishra and Koehler’s (2003) assertion that educational technology is here to stay, and new technologies are becoming a significant presence in schools.

Distinct Affordances of Mobile Devices for Education

Mobile devices are “small machines that can be carried easily in one's palm and provide computing, as well as information storage and retrieval capabilities” (Cheung & Hew, 2009, p. 153). Since entering the 21st century, mobile devices have become prolific and are increasingly being used in educational settings as a tool for both teachers and students. In 2006, Chan et al. posited “ubiquitous access to mobile, connected, personal, handhelds [would create] the potential for a new phase in the evolution of technology-enhanced learning, marked by a continuity of the learning experience across different environments” (p. 6).

A review of empirically-based articles by Cheung and Hew (2009) was conducted before the release of the iPad. This review investigated 44 publications on mobile devices and revealed four main research topics: usage profile, viability as an assessment tool, learning outcomes, and attitudes. Through an analysis of these articles, Cheung and Hew (2009) identified seven major categories of student and teacher use of mobile devices: 1) multimedia access tool, 2) communication tool, 3) capture tool, 4) representational tool, 5) analytical tool, 6) assessment tool, and 7) task management tool. Of these major categories of uses, the three most frequent

uses centre on using mobile devices for communication (21.8 percent), multimedia access (20 percent), and task management (17 percent).

Although the most frequent uses of mobile devices as they began to enter the educational landscape were all things that can be done on a laptop or desktop computer, Mark van't Hooft (2008) argued that what makes current technologies so unique is a combination of characteristics that: make the digital tools increasingly mobile and connected, place the user in control with ample opportunities for personalization, and enable users to have rich experiences. Melhuish and Falloon (2010) argued that mobile devices offer distinct affordances for education, with five distinct affordances of mobile devices for education: 1) portability, 2) affordable and ubiquitous access, 3) situated, 'just-in-time,' learning opportunities, 4) connection and convergence, and 5) individualized and personalized experiences. Mobile devices "offer a unique opportunity for teachers and students...to capitalize on the flexibility and freedom afforded by these devices. However, these benefits demand new pedagogies and new approaches to delivering and facilitating instruction" (Corbeil & Valdes-Corbeil, 2007, p.54).

Handheld Mobile Devices as Assistive Technology

While handheld technologies are being appropriated as education technology, they are also being explored as assistive technology. It is important to acknowledge that research on the use of mobile devices such as the iPod as an assistive technology is also adding to the body of research on the use of mobile handheld devices to support student learning. For example, iPods have been investigated as supports for students with Autism Spectrum Disorders and students with intellectual disabilities.

Marks and Milne (2008) conducted a qualitative study in a segregated educational setting to explore the pedagogical and societal potential for the iPod for students with severe intellectual and social disabilities. The participants included ten students with an IQ measured as less than 50, many of them located on the autistic spectrum, and their teachers. Students were motivated to use the iPods and the behaviour of many students improved. However,

throughout the course of the study it became evident that teachers needed additional support with the process of integrating these emergent technologies into their students' educational programming.

A study by Cihak, Fahrenkrog, Ayres, and Smith (2010) evaluated the efficacy of video modeling delivered via an iPod and the use of the system of least prompts to assist students with transitioning between locations and activities within the school. Four students with autism, each attending their local neighbourhood school and fully included in all general education classes, were taught to manipulate a handheld device to watch video models. An ABAB withdrawal design (Barlow & Hersen, 1984), where A is the baseline phase and B is the intervention phase, was used to evaluate a functional relation between video modeling and the percentage of independent transitions by the student. Prior to the study, students required consistent teacher assistance to transition successfully from place to place. Overall, students demonstrated limited ability to transition independently from place to place during baseline with a mean number of independent transitions made by students of seven percent. When students used the iPod videos during intervention, ascending trends were observed with the mean percentage of independent transitions increasing to 77 percent. Descending trends were observed after the withdrawal of the video-modeling intervention with the mean percentage of independent transitions decreasing to 36 percent.

Interestingly, the mean percentage of independent transitions increased to 88 percent when the intervention was reimplemented; nine weeks later, students maintained a mean level of 98 percent independent transitions. In all instances, video modeling and the use of the video iPod resulted in independent transitions, although additional prompts were required at times. Moreover, students' inappropriate behaviours decreased to zero levels during transitional situations. This study demonstrated the potential of mobile technology as an effective assistive technology support that also facilitates student independence and agency.

iPads in Education

While there are a variety of mobile tablets on the market, iPads have been appropriated by the educational community at an unprecedented rate: “School jurisdictions were not immune to the iPad buzz and while there is still little scholarship on the effectiveness of iPads for learning and teaching, iPads are becoming more prevalent in classrooms and at a much faster rate than previous technology” (Alberta Education, 2012, p. 5). Published research on the use of iPads for teaching and learning is sparse.

Professor Rhonda McEwen at the University of Toronto is a pioneer in this area with her research on the mediating potential of iPads for students with autism. Her Touch Technologies in the Classroom research—in Kindergarten to Grade eight classrooms at a downtown Toronto school from February 2010 to December 2011—explored the efficacy of commercially-available handheld mobile devices that use touch technology for information input and output with the goal of analyzing the effects of using these devices in the classroom instruction of children diagnosed with Autism Spectrum Disorder. Similarly, Campigotto, McEwen, and Demmans Epp (2013) conducted an exploratory study in two special education classes to analyze teacher and student experiences related to the use of iOS devices and the MyVoice application. Participants were students with special education needs, including autism, attending two schools with grades seven through 12. Findings revealed increased student motivation and indicated that there is potential to give more ownership to students over their learning.

Pamplin (2011) presented on a research project on the iPad in a science teacher community of practice conducted by herself, Lloyd Goldsmith, Donnie Snider, and Jerilyn Pfeifer at the Society for Information Technology and Teacher Education (SITE) Conference. Thirty-eight secondary science teachers were provided an iPad to explore whether and how it could be educationally effective. Three key findings emerged: 1) teachers perceived easy, unfiltered access to the Internet as the iPad’s most significant educational benefit, 2) portability and

connectivity outside the classroom was another cited benefit, and 3) the lack of Flash capability and difficulty projecting were seen as significant limitations of the iPad in the educational setting.

Alberta Education gathered educators across the province for a knowledge gathering event in the fall of 2011 to add to the neophyte body of knowledge of iPads as a tool to support teaching and learning. The top three reasons noted by Albertan educators for bringing iPads into their classrooms were: 1) to support students with unique learning needs, 2) to meet the needs of every students through the operationalizing of the three Universal Design for Learning (UDL) principles, and 3) to increase student engagement.: “These three reasons share a common thread of personalization and reflect a need to shift from industrial/mass models of education to a more customized, relevant orientation to learning” (Alberta Education, 2012, p. 5). The data gathered during the day-long event from panelists, roundtable discussions, and Twitter feed indicated that while many teachers, schools and school authorities were struggling with implementation challenges, there also was strong recognition that iPads excelled in three areas: improving engagement, supporting multiple ways to access the curriculum, and enhancing assessment practices (Alberta Education, 2012, p. 5). One of the key implementation challenges was that unlike many other technologies appropriated by educational settings, the iPad was not designed to work within a managed network paradigm. Therefore, it does not easily adapt to a managed network environment and “at times, some of the functionality relative to personalization is likely sacrificed when the fit is forced” (Alberta Education, 2012, p. 13).

Bebell, Dorrie, and Muir (February 2012) released emerging results from the United States’ first implementation of iPads as a one-to-one device in kindergarten classrooms. One component of Auburn School District’s investigation into providing 1:1 iPads to their youngest learners was a nine-week randomized control trial examined the impact of the iPads on kindergarten students’ emerging literacy skills during the first trimester of the school year. A total of 266 kindergarten students (129 iPad students; 137 comparison students) participated in this pre/post quasi-experimental study across the district’s six public elementary schools. Students

in both the experimental and control groups demonstrated modest literacy gains. Gain scores were consistently greater for the students with iPads. While these differences in performance were not large enough to be considered statistically significant in nine of the ten areas measured, the findings are still promising because they demonstrate positive trends on academic achievement in the first year of implementation within the context of the thoughtful deployment of iPads as a tool to support learning in a systematic way that addresses pedagogy and teaching.

The exploratory case study of a pilot project of one-to-one learning with iPads in four American ninth-grade geography classrooms by Chou, Block, and Jesness (2012) revealed benefits and challenges for both students and their teachers. The three student benefits identified were active engagement, increased time for projects, and improved information literacy and digital skills. However, the student challenge was distraction. Two teacher benefits were identified: student-centred activities and enhanced teaching with updated information. Lack of teacher-selected apps and the need for more time and training were identified as teacher challenges.

Karsenti and Fievez's (2013) study of iPad in 18 schools across Quebec, Canada, included of 6,057 junior and senior high students and 302 teachers. Interestingly, 53.6 percent of students never or very rarely had used an iPad before they were implemented at their school, while 70.2 percent of teachers never or very rarely had used an iPad before. Fifteen benefits of the iPad in education were identified:

1. increased student motivation,
2. greater access to information,
3. portability of the device,
4. ease of making notes on PDF documents,
5. ease of organizing work,
6. quality of students' presentations,

7. quality of teachers' presentations,

8. greater collaboration among students, and between students and teachers,

9. more creativity,

10. variety of resources used (images, videos, applications, etc.),

11. students can work at their own pace,

12. development of students' IT skills,

13. development of teachers' IT skills,

14. improved reading experience, and

15. teachers can cut down on paper.

Similar to Chou, Block & Jesness' (2012) study, distraction was the greatest challenge identified by Karsenti and Fievez. Additional challenges were revealed: writing lengthy texts, learning to handwrite, unsuitable digital textbooks for the touchscreen format, teacher planning of courses, underuse of digital textbooks, organizing students' work, teachers' lack of information about resources available for the iPad, and a decline in academic performance.

Friesen, Jacobsen, and Brown's (2014) case study of iPads in early elementary classrooms included kindergarten to fourth grade teachers in four school jurisdictions across Alberta, Canada, who were participants in a research community of practice. Research findings included: 1. using technology appropriately and strategically is an authentic tool for student expression and technology-enabled tasks support the full range of student voice to come through, 2. Technology-enabled tasks often made student learning, both the process and the product, more visible, which promoted formative assessment, 3. students became more metacognitive, that is, thoughtful about their learning processes, 4. strong levels of students ownership, advocacy, perseverance, personalization and emotional ties to the learning were evident, 5. Students were self-focused, self-regulated, and highly engaged with the learning tasks, and 6. professional learning that is grounded in research, sustained over time, and socially enriched within a community of practice enhanced teacher practice.

Ciampa‘s (2014) single case study explored the lived experiences of a grade six teacher and students to investigate their perceptions of the motivational affordances of using mobile devices for learning. Six categories emerged as the elements of mobile environments that stimulate intrinsic and extrinsic motivation: 1) challenge, 2) control, 3) sensory and cognitive curiosity, 4) competition, 5) cooperation, and 6) recognition.

Smith and Santori’s (2015) descriptive study explored the integration of iPads into classroom practice through observations of iPad-based teaching and learning in six middle-grades classrooms across two public school districts during one academic school year. Five key findings about iPad-based teaching and learning were identified: 1) facilitates differentiation, 2) facilitates visualization of content and concepts, 3) fosters independence and agency among teachers and students alike, 4) is dynamic, and 5) is fun, engaging, collaborative, and interactive.

Vu’s (2015) qualitative study investigated what types of teacher training resulted in teachers’ successful use of iPads and what factors affect their decisions to use iPads in their classrooms. Findings indicated teachers had limited formal training opportunities so self-learning and support from colleagues was common. Two key factors related to teachers’ iPad use in their classrooms were identified: 1) lack of access to an iPad at home and 2) school leaders’ expectations.

An emerging body of research shows promise for iPads as educational technology and assistive technology. Many positive impacts on learning have been identified, such as motivation, connectivity outside the classroom, engagement, and student ownership. However, for this promise to become a reality, the conditions required for teachers to leverage emergent technology must be fostered. For example, professional learning that is grounded in research, sustained over time, and socially enriched within a community of practice was found to enhance teacher practice.

Critiques of Computer Technology in Education

While a considerable body of literature celebrates the integration of computer technologies in schools, espousing the benefits of one-to-one computing environments, there is a growing call for concern (e.g., Bianchi, 2004; Brahrampour, 2006; Fried, 2008; Jaillet, 2004; Hu, 2007; Stoll, 1999; Vascellaro, 2006). Among the celebratory and cautionary voices, critics have also emerged. For example, Laurillard (2007) points to the history of technology in education as the repeated process of a "technology solution devised for other requirements, in search of a problem it can solve in education" (pg. 153), which all too often have produced "less than optimal effects" (p. 154). While a body of research supports Laurillard's claims, it is important to note when reading such studies and weighing the results to consider what is deemed important to measure and how it is measured. As Lei and Zhao (2008) note: "Student technology use and learning is experience-related and at times hidden or subtle; consequently, it may not be assessed through traditional outcome evaluation" (p. 117).

Cordes and Miller (2000) warned that the educational system's infatuation with computers is supported by low quality research and "is diverting scarce resources from children's real unmet needs" (p. 77), which they highlight as eliminating lead poisoning, as well as nutrition programs, health care, high-quality child care, and early-childhood education for low-income families. Cordes and Miller also note six critical needs of American public schools: 1) reducing classroom sizes, 2) raising teachers' salaries, 3) funding aids and counselors, 4) repairing and renovating school buildings, 5) building new schools, and 6) reviving school programs such as music, art, and physical education. Known hazards of computers in childhood are also noted in this report, including physical, social emotional, intellectual, and moral hazards. While Cordes and Miller dispute the quality of research demonstrating the benefits of computers in schools, no research related to their claims about the negative effects of computers are cited in their publication. Therefore, it is impossible to evaluate the quality of the research their conclusions are based on.

Larry Cuban first raised his concerns regarding the trend of computers being both oversold by policy makers and promoters and underused by those in education following his research on how computers are being used for instruction. Cuban (2001) presented case studies of several American classrooms ranging from elementary to high school. He found that most teachers used computers to maintain current instructional practices and noted no concrete evidence showing using computers led to academic achievement gains. Cuban, Kirkpatrick, and Peck (2001), in a research article on computer use in two high-tech schools, highlight that access to equipment and software seldom leads to widespread teacher and student use. Only four of the 14 teachers in this qualitative study changed their teaching practices and used computers to assist them in making their classrooms more students-centred. Interestingly, teachers' age, experience, and gender were noted as not being factors. Overall, only "incremental changes in teaching style occurred as a consequence of enhanced access to new technologies.... Most teachers in the two high schools adapt technology to fit the familiar practices of teacher-centered instruction" (p. 825). This result needs to be interpreted within context; both schools utilized a computer lab approach. Even so, there were students, coined by Cuban, Kirkpatrick and Peck (2001) as *open-door students*,"whose lives changed with increased access to technology" (p. 823). Interestingly, open-door students were primarily males from varied ethnic backgrounds.

Although Cuban, Kirkpatrick, and Peck (2001) conducted their research over a seven-month period during the 1998–1999 school year, it is important to note that they shadowed their key informants, 12 students (including 35 of their teachers) and 11 teachers, for just one school day. It is unclear if an observation protocol was used during this shadowing and if it was conducted by one, two, or all three of the researchers. They also interviewed teachers and students. In one section of the article, they note 26 student volunteers were interviewed, but later they indicate it was 33. A large source of data was derived from teacher and student surveys administered to more than 880 students and 100 teachers. The researchers do not note

if they created this survey or if it was one used in previous studies. Neither are reliability and validity measures for the survey reported. Additionally, while a teacher survey was administered at one high school in October 1998, it was administered at the other high school in April 1999.

Oppenheimer first warned of 'the computer delusion' in 1997. Later he described what he calls education's history with technotopia starting with its enthusiastic adoption of motion pictures. Oppenheimer (2003) also presented scenes of computer use across the United States. A common theme through these scenes is "education's opportunities lie primarily in the teachers' hands, not in technology" (p. 399). His perception is that while in some cases computers can be useful in schools, overall "high technology is steering youngsters away from the messy, fundamental challenges of the real world—and toward the hurried buzz and neat convenience of an unreal virtual world" (p. 411). He goes so far as to warn that "this leads all of us to sideline activities that have long helped youngsters develop fundamental capacities, particularly the imagination, that can sustain society over the long haul" (p. 411). While Oppenheimer quotes key scholars in the computers in schools debate, he does not cite research to back any of his opinions. Nor does he provide evidence for his claim that many of the studies demonstrating that computers improved students' performance were more anecdotal than conclusive.

Neil Postman (1993) warned about the deification of technology in describing "when, how and why technology became a particularly dangerous enemy" (p. xii). He argued that in our rush to embrace technology we have not taken time to consider what is being lost. According to Postman, the "computer is the quintessential, incomparable, near-perfect technology for Technopoly" (p. 111) and one of the most ominous consequences of Technopoly is 'information glut,' that is, the explosion of context-free information. He asserts we must free children from the dominance of technology. Calling for *technical modesty*, Postman emphasizes "it is important to remember what can be done without computers, and it is also important to remind ourselves of what may be lost when we do use them' (1993, p. 120). My rebuttal to Postman, which echoes

that of UDL and ATL scholars such as Rose and Eyburn, is we must remind ourselves about which students may be lost on the journey to completing high school if educators do not allow them to use the ever-evolving tools of their culture to authentically engage in learning.

In addition to these critics, a growing number of researchers and educators are raising "serious concerns about the conceptualization, implementation, and unresolved expectations associated with computers in school, particularly 1:1 computer programs" (Bain & Weston, 2009, p. 50). Murray and Olcese (2011) echo this concern in their research on the first version of the iPad, acknowledging "the iPad is pushing the edge of both hardware and software innovations...[but] these advances are underused in applications applicable for teaching and learning" (p. 48). Their study on the potential effect the iPad and its apps might have on teaching and learning, with an intentional focus on things that could not be done with an analogue equivalent, revealed "there is a paucity of applications that truly extend capability, much of what these applications allow can be done with other devices, and this leads us to conclude that the current trajectory will not revolutionize teaching and learning" (p. 48). Although Murray and Olcese (20110) were exploring what iPad apps can allow users to do that they could not otherwise do, from a teaching and/or learning perspective, their study was limited to 315 apps. Also, they did not observe the use of these apps by students and teachers in classrooms. The evaluations of the apps targeted for the study are based on the researcher's own interactions with them where they "sought to understand the extent to which applications provided opportunities to collaborate or extend what users might otherwise be able to accomplish" (p. 45).

Critics of educational technology express concern at the lack of impact on student achievement and teacher pedagogy. To gain a deeper understanding of the potential of emergent technologies to enhance student engagement and achievement, particularly of those students who have traditionally not done well in school, it is essential to spend time with them and their teachers to explore *what they can do* and *who they can be* with an iPad as a learning

and teaching tool. For iPads to be a positive disruptive innovation in the educational setting, it is imperative for researchers, educators, and students to build knowledge around their use to design technology-enhanced inclusive learning environments and facilitate change in a cooperative way.

Impact of One-to-One Programs

One-to-one mobile computing programs are occurring all over the world. These programs are diverse in their approaches, devices, and goals. Although current one-to-one mobile computing initiatives differ in many ways, they all provide students with individual access to mobile devices and wireless school networks to access the Internet with via their mobile devices. While research has not been able to keep up with the rapid expansion of one-to-one initiatives, use of the laptop computer as a one-to-one mobile device is a growing area of research.

Although some critics question the quality and breadth of the body of research on one-to-one initiatives, numerous positive impacts of one-to-one laptop programs have been demonstrated for both teaching and learning. Bebell and O'Dwyer (2010) remind educators "empirical research studies in bona fide 1:1 settings is still quite limited" (p. 13), yet they optimistically espouse that a collective understanding is beginning to develop. Table 2.1 below summarizes the benefits of one-to-one laptop programs.

Table 2.1 Benefits of One-to-One Laptop Programs

Benefits	Research Evidence
increased student engagement	Bebell, 2005; Bebell & Kay, 2010; Downes & Bishop 2015; Garcia & Lock, 2011; Keengwe et al., 2012; Mouza, 2008; Penuel, 2006; Rockman, 1997; Rutledge, Duran, & Carroll-Miranda, 2007; Shapley et al., 2009;

Benefits	Research Evidence
	Trimmel & Bachmann, 2004
improved attendance	Warschauer & Grimes, 2005; Zucker & Hug, 2007; Zucker & McGhee, 2005
reduction in disciplinary problems	Baldwin, 1999; Greaves, Hayes, Gielniak, & Peterson, 2010; Warschauer & Grimes, 2005
improved technology skills	Bebell & Kay, 2010; Léger & Freiman, 2016; Shapley, Sheehan, Maloney, & Caranika-Walker, 2009
increased use of computers for writing, analysis, and research with online resources and productivity tools	Baldwin, 1999; Dunleavy, Dexter, & Heinecke, 2007; Grimes & Warschauer, 2008; Penuel, 2006; Russell, Bebell, & Higgins, 2004
enhanced student research skills and collaboration	Bebell & Kay, 2010
enhanced student achievement	Bebell & Kay, 2010; Crook, Sharma, & Wilson, 2015; Gulek & Demirtas, 2005; Lowther & Ross, 2003; Mouza, 2008; Muir, Knezek, & Christensen, 2004; Rutledge, Duran, & Carroll-Miranda, 2007; Swan, Van ‘t Hooft, Kratcoski, & Unger, 2005 Trimmel & Bachmann, 2004; Zheng, Warschauer, Lin, & Chang, 2016
change in the student / teacher relationship	Mouza, 2008; Zucker & McGhee, 2005

Benefits	Research Evidence
shift in teachers' attitudes and teaching practices (i.e., movement towards student-centred classrooms)	Bebell & Kay, 2010; Dawson, Cavanaugh, & Ritzhaupt, 2006; Mouza, 2008; Norris & Soloway, 2004; Rockman, 1997; Swan, Van 't Hooft, Kratcoski, & Unger, 2005; Warschauer, 2008

It is important to note some aspects of instructional practices remained resistant to change. In their 2007 study, Dunleavy, Dexter, and Heinecke found that the second most frequent use of laptops were for drill-and-practice type exercises. Dawson, Cavanaugh, and Ritzhaupt (2006) reported very little evidence of differentiated instruction or alternative assessment practices throughout their study. Also, a study by Donovan, Hartley, and Strudler in 2007 indicated teachers "…were uncomfortable as they attempted to blend their traditional pedagogies with the requirements for teaching in the one-to-one environment...[and] were observed primarily using laptops for word processing and other teacher-centered curriculum activities" (p. 277). In a case study of two seventh grade teachers, Garthwait and Weller (2005) demonstrated that "the effects of ubiquitous computing were strongly shaped by their beliefs about teaching and learning" (p. 373). These researchers demonstrated that teachers are an integral factor in the effective or ineffective use of mobile devices.

As Papert reminded educators and researchers in the early eighties, computer technologies are tools and it is not about the tool, it is about what is done with the tool. "Everyone realizes that it is carpenters who use wood, hammers and saws to produce houses and furniture, and the quality of the product depends on the quality of their work" (Papert, 1987, p. 24). However, educational researchers would be remiss to focus too intently on teachers without also recognizing the impact of context. A teachers' technology integration in the classroom is impacted by the kinds of social and institutional contexts they work within (Mishra

& Koehler, 2007): “The need to study the teacher in the context of the social organisation of the school, rather than as an isolated agent, has been emphasised” (Grunenberg & Summers, 1992). This requires both *zooming in* and *zooming out*.

An emerging body of evidence supports the one-to-one use of mobile handheld devices to support student learning and achievement in the K–12 educational setting (Banister, 2010). For example, Royer and Royer (2004) investigated the use of a Palm handheld device with PiCoMap, a free application, to provide a cheaper more accessible alternative than a laptop or desktop computer for creating concept maps. Two ninth-grade biology classes comprising 41 students with previous experience in creating concept maps by hand and with the computer software Inspiration were participants. Student reactions to using the handheld devices to create concept maps were very positive. The teacher reported students were motivated to complete their concept maps with PiCoMap. He noted a limitation of the free application was that it would not generate more than 35 subconcepts for any one map. Interestingly, the students found a way to work around this limitation by creating individual files, each focusing on a different branch of the concept map. However, when one class completed an assignment on PiCoMap and the other completed it on Inspiration, the mean score for the maps created on a desktop computer was higher. One possible explanation for this is it may have been easier for students to see relationships behind ideas when the entire map was visible on the screen.

Garcia and Friedman (2011) investigated the effect of iPads on the achievement of eleventh grade U.S. history students. More specifically, the study sought to explore the impact of the app Explore 9/11 on student achievement. They utilized a quasi-experimental design. The study occurred over a series of two 50-minute class periods. The participants were 74 students: 49 students in two standard sections and one honours section used iPads and 25 students in one honours and one standard section received the content with traditional methods. No mention is made if students with special needs were included in any of the sections. Results indicated the Explore 9/11 app had a positive impact on overall student achievement. However,

the impact was small in quantitative terms. Interestingly, students in the iPad sections demonstrated collaboration and cooperation, which was not evident in the sections that used traditional paper resources. Garcia and Friedman (2011) suggest it may have been this group collaboration, facilitated by the iPads, that positively impacted students' achievement.

Numerous positive impacts of one-to-one laptop programs have been demonstrated for both teaching and learning. However, some aspects of instructional practices have remained resistant to change, perhaps because instructional practices are strongly shaped by teachers' beliefs about teaching and learning. Teachers' beliefs and actions are influenced by the context within which they teach, that is, the social organization of the school. The evidence also supports the one-to-one use of mobile handheld devices to support student learning and achievement in K–12 classrooms.

Key Factors Impacting Technology Integration

Effective integration of technologies such as laptops in educational settings is complex and requires attention to several key factors. Inan and Lowther (2010) created an estimated path model to "examine the direct and indirect effects of teacher beliefs, teacher readiness, professional development, overall support for school technology, and technical support on laptops integration in K–12 classrooms" (p. 5). The results of their study showed five variables, of which teacher readiness and teachers' beliefs had the greatest direct effect on laptop integration.

Teachers' readiness.

Technology is used more frequently by teachers who feel ready (Inan & Lowther, 2010). Pedagogical and technological professional development, technical support, and overall support each contribute to teachers' readiness. Murphy, King, and Brown (2007) noted the importance of support systems in improving teachers' feelings of readiness, while Inan and Lawther (2010) identified ongoing professional development as integral.

Teachers' beliefs.

The belief system of the teacher, that is, their beliefs about student learning, good teaching, and the potential for technology to support learning, help construct their teaching pedagogy, which is established before emerging technologies are introduced to a teacher's classroom. Therefore, they impact technology use in the classroom (Sclater, Sicoly, Abrami, & Wade, 2006; Windschitl & Sahl, 2002). Fortunately, belief systems, as with teachers' readiness, can change in the right environment.

Conceptual Frameworks

Three conceptual frameworks may help mitigate teachers' readiness and teachers' beliefs. Two key variables of technology integration are TPACK; UDL; and the Teaching Effectiveness Framework. A fourth conceptual framework, the Learning Ecologies Framework, acknowledges that teachers practice their craft in a complex system. It ensures teaching and learning is considered through a systems lens.

Technological, Pedagogical, and Content Knowledge (TPACK).

In the last five years, the TPACK model by Mishra and Koehler has emerged as a useful conceptual framework for understanding the teacher knowledge needed for effectively teaching with technology. The TPACK Framework builds on Shulman's construct of Pedagogical Content Knowledge (PCK) to include educational technology (Angeli & Valanides, 2009; Koehler & Mishra, 2005, 2008, 2009). It "emphasizes the connections among technologies, curriculum content, and specific pedagogical approaches, demonstrating how teachers' understandings of technology, pedagogy, and content can interact with one another to produce effective... teaching with educational technologies" (Harris, Mishra, Koehler, 2009, p. 396). It shifts the focus from the affordances of the technology, taking "a step towards understanding what makes a technology an *educational* technology by emphasizing that educational technologies exist in the interplay between pedagogical knowledge, content knowledge, and technology knowledge" (Mishra, Koehler, & Kereluik, 2009, p.?). Figure 2.1 below illustrates the individual components

of TPACK: Technological Knowledge (TK), Content Knowledge (CK) and Pedagogical Knowledge (PK), and relationships among them, that is, Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Knowledge (TPK).

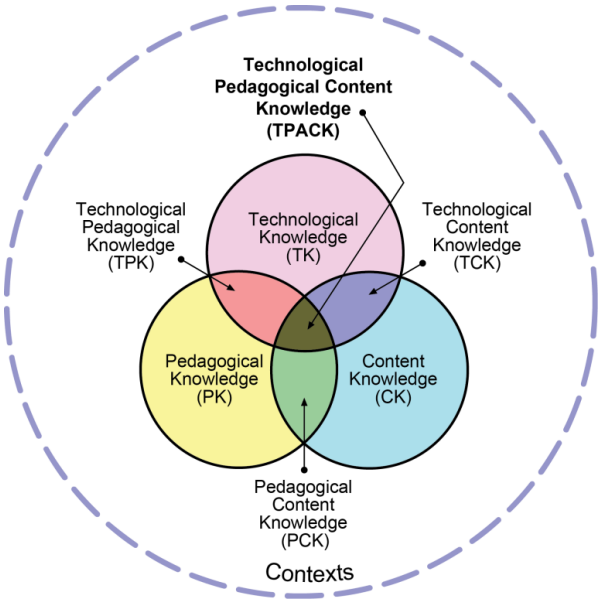


Figure 2.1: Technological Pedagogical and Content Knowledge. (Image used with permission from http://tpack.org/.)

When a new technology, such as the iPad, is introduced into a learning environment, teachers must reconstruct the dynamic equilibrium among the individual components of TPACK to leverage the unique affordances of the new technology (Spires, Wibe, Young, Hollebrands, & Lee, 2009): “Ultimately, the pedagogies and technologies should complement one another and intensify students’ opportunities to construct content knowledge” (Spires, Wibe, Young, Hollebrands, & Lee, 2009, p. 13). However, TPACK is more than the sum of its parts that are illustrated in the framework above: “TPACK is different from knowledge of its individual component concepts and their intersections. It arises instead from multiple interactions among

content, pedagogical, technological, and contextual knowledge" (Harris, Mishra & Koehler, 2009, p. 401). The TPACK Framework "allows teachers, researchers, and teacher educators to move beyond oversimplified approaches that treat technology as an 'add-on' instead to focus again, and in a more ecological way, upon the connections among technology, content, and pedagogy as they play out in classroom contexts" (Koehler & Mishra, 2009, p. 67).

Despite the widespread use of TPACK in research studies and with educators, criticisms have been raised. A key criticism of TPACK is its compartmentalization of seven mutually exclusive domains commonly represented simplistically through a Venn diagram of three overlapping circles (see Figure 2.1). Some scholars have questioned the distinct boundaries of these domains. For example, Angeli & Valanides (2009) noted "the boundaries between some components of TPCK....are fuzzy indicating a weakness in accurate knowledge categorization or discrimination, and, consequently, a lack of precision in the framework" (p.157). More specifically, Parr et al. (2013) expressed concerns with "the notion of apparently discrete bodies of content knowledge and pedagogical knowledge, with the presumption that expertise for subject content and pedagogy lies in different communities" (p. 14). Graham (2011) asserts the TPACK Framework has the potential to provide a strong foundation for future technology integration research if there is clarity regarding "the boundary conditions that enable one element in the framework to be distinguished from adjacent elements" (p. 1973).

Universal Design for Learning (UDL).

UDL was developed by the U.S.-based Center for Applied Special Technology (CAST). CAST focuses on the leveraging of current digital technologies to remove barriers to learning inherent in traditional print-based curriculum faced by many of the diverse learners in today's classrooms (Hitchcock, Meyer, Rose, & Jackson, 2002). It has its roots in the universal design movement in architecture initiated by Ron Mace that resulted in the curb-cuts so common on today's sidewalks (McGuire, Scott, & Shaw, 2006; Rose & Meyer, 2002). As the universal design movement took root within the design and urban planning disciplines, public spaces

have become more accessible. Interestingly, this improved access has benefited a wide range of people beyond the target users. For example, curb-cuts, which were originally designed for people with visual impairments, also support new moms with strollers, teenagers on rollerblades or skateboards, and the elderly.

As public spaces such as schools became increasingly accessible, educational researchers began to note the irony of access to the building but not the learning events occurring in those spaces, which was an all too common experience faced by many students with special education needs. Although the framework and guidelines of UDL are not derived from the principles for architecture (Rose & Gravel, 2010), they are an extension of universal design from the school building to classroom learning events. UDL in particular "reflects the view that a singular option to access curricular materials (usually text) and methods may produce barriers to diverse learners just as the single entrance mode of a staircase presents a physical barrier for some" (Bremer, Clapper, Hitchcock, Hall, & Kachgal, 2002, p. 2).

UDL stems from cognitive neurosciences as a theory and framework to guide the design of inclusive learning environments for diverse learners. As such, it is a framework for designing educational environments that enable all learners to gain knowledge, skills, and enthusiasm for learning based on three principles: multiple means of representation, multiple means of expression and action, and multiple means of engagement (CAST, 2012). Rose and Meyer (2002) assert that flexibility in the media used to share information in the classroom and support for knowledge building is integral to affording all students space in our classrooms and the dignity to learn in the ways they are most successful so all learners are provided appropriate instructional support and challenge to reach their full potential: "Applying the increasing power of emerging technologies...UDL can help us move past the early-stage, old-use applications of new learning technologies" (Rose, Meyer, & Hitchcock, 2005, p. 21).

Although UDL is not as possible without current digital technologies, it is about much more than integrating technology into classrooms: "UDL is not defined by or confined to

technology. The technology must be combined with effective pedagogy, which can either stand alone as UDL, or stand with the technology" (King-Sears, 2009, p. 201). It's about restructuring the learning environment to effectively leveraging technology and its extensive pedagogical affordances. "The issue is no longer whether teachers should integrate technology in their existing practices, but how to use technology to transform their teaching with technology and create new opportunities for learning" (Angeli & Valanides, 2009, p. 154).

Teaching Effectiveness Framework.

The Teaching Effectiveness Framework includes five core principles of effective teaching practice: 1) teachers are designers of learning, 2) work students are asked to undertake is worth their time and attention, 3) assessment practices improve student learning and guide teaching, 4) teachers foster a variety of interdependent relationships, and 5) teachers improve their practice in the company of their peers: "Surrounding these five core principles, and infused into each of them, is the effective use of the technologies of our time for both teaching and learning" (Friesen, 2009, p. 4). A strength of this framework is its holistic approach with a focus on teaching, learning, assessment, and collaboration.

Learning Ecology Framework.

Spires, Wibe, Young, Hollebrands, and Lee (2009) argued that "the teacher is the single, most important factor in determining student success" (p. 4), focusing on one aspect of the microsystem. However, it is important not to discount the agency of students and to also acknowledge that teachers practice their craft in a complex system. The Learning Ecology Framework supports a systems view when considering teaching and learning. According to Januszewski and Molenda (2007), "the essence of the systems view [in education] is to step back and note the factors that surround and influence events in the classroom" (p. 71). Further, it is crucial to consider the entire ecological system of the learning environment: "Only through a systemic lens can educators fully understand the forces that actually impact the quality of [teaching and] learning" (Januszewski & Molenda, 2008, p. 75). Januszewski and Molenda

(2007) remind educators that it is only through “seeing the classroom in its larger context can one restructure the environment to be more supportive of more powerful instructional strategies” (p. 71).

Barron offered that “[t]he learning ecology framework draws on ecological perspectives as well as constructs developed from sociocultural and activity theory” (2006, p. 196). An example of an ecological perspective, the ecological systems framework, maintains “how a child interacts with his/her environment is based on a series of systems…and how these systems interact” (Killoran, 2003). The ecological systems framework emerged from Urie Bronfenbrenner’s (1979) conceptualization of the ecological model of development. Bronfenbrenner argues that “in order to understand human development, [and therefore learning], one must consider the entire ecological system in which growth occurs” (Bronfenbrenner, 1994, p. 37). Bronfenbrenner identifies four ecological systems that are nested structures: the microsystem, the mesosystem, the exosystem, and the macrosystem, which exert reciprocal influences on one another over time, that is, the chronosystem.

Over time, this ecological model of human development has evolved and there is “a marked shift in the center of gravity of the model...the transition from a focus on the environment to a focus on processes” (Bronfenbrenner & Morris, 2006, p. 794). This evolving model is now called the bioecological model. According to Bronfenbrenner and Morris (2006), the bioecological model consists of four major properties: process, person, context, and time. The foundation of the model is process, also referred to as proximal processes, that is, the interaction that occurs between an individual and their environment over time and, therefore, has significant influence on an individual’s development.

Person comprises the individual’s characteristics as well as characteristics of people that compose the microsystem. Within the bioecological model, context is defined as the environment within which proximal processes unfold. Context includes features that facilitate or inhibit proximal processes. An integral aspect of this model is the bi-directionality of influence:

students are viewed as active participants of their own development, capable of impacting their environment.

The ecological model has great relevance in the field of inclusive education due its emphasis on the importance of the interaction between the development of an individual and the systems within that individual's social context: "The ecology metaphor of learning views allows the environments to be seen from a systemic perspective, and to understand learning at a rich diversity of levels, in which the participants interact within and between each level" (Looi, 2001, p. 13). It also acknowledges the tight intertwining of person and context (Barron, 2006). This aligns with the World Health Organization's definition of disability as "a complex phenomenon, reflecting an interaction between features of a person's body and features of the society in which he or she lives" (World Health Organization, 2012, para. 2). Therefore, it is a useful framework through which to view the impact of introducing iPads as a one-to-one device in inclusive learning environments.

Spires, Wibe, Young, Hollebrands and Lee (2009) posit we are moving towards a new learning ecology due to "constant access to tools and rich information" (pg. 5) in one-to-one settings, that is, "a learning-forward environment that takes on organic attributes with evolving interdependence among participants" (pg. 5). Mobile and ubiquitous learning environments are changing teacher and student practices. For example, Spires, Wibe, Young, Hollebrands, and Lee (2009) identified four unique conditions prompted by the new learning ecology in one-to-one learning environments: (1) immediate and constant access to information, (2) teacher as content expert, facilitator, consultant, mentor, and improvisationalist, (3) self-directed, self-regulated, curious and creative learners, and (4) intensity, relevance, and personalization of learning.

It is unlikely a single conceptual framework will provide a sufficient basis for exploring the impact of a complex innovation such as a one-to-one iPad initiative within schools. Therefore, I chose a strategic blend of the aforementioned conceptual frameworks: TPACK, UDL, Teaching Effectiveness, and Learning Ecology.

Positioning the Study

Although numerous positive impacts of one-to-one laptop programs have been demonstrated for both teaching and learning, critics of educational technology express concern for the lack of impact on student achievement and teacher pedagogy. Effective integration of technologies in educational settings is complex and requires attention to several key factors. Also, students are important allies in the work of leveraging technology for teaching and learning. However, their perspective is not well represented in the current body of knowledge.

Summary

This critical review of the literature focused on educational technology and conceptual frameworks. Areas of educational technology included: 1. the historical perspective of emergent computer technologies in schools, 2. distinct affordance of mobile devices for education, 3. handheld mobile devices as assistive technology, 4. iPads in education, 5. critics of computer technology in education, 6. the impact of one-to-one programs on teaching and learning, and 7. key factors affecting technology integration in educational settings. Four conceptual frameworks were discussed: 1) Technological, Pedagogical and Content Knowledge, 2) UDL, 3) Teaching Effectiveness Framework, and 4) Learning Ecologies Framework.

CHAPTER 3: RESEARCH DESIGN

The purpose of this qualitative study was to research, with students and their teacher, the use of iPads as one-to-one devices in an inclusive classroom. The study's purpose was based in the researcher's concurrence with Mishra and Koehler's (2003) belief that:

> Effective technology users often find innovative and conceptually sophisticated (though not necessarily technologically sophisticated) solutions to authentic pedagogical problems through the creative reinterpretation and re-purposing of existing technologies. Doing so requires a willingness and ability to critically examine new tools in terms of their implications for standards-based teaching and learning in the classroom. (Mishra & Koehler, 2003, p. 5)

More specifically, the purpose of this study was to build knowledge around the use of iPads to facilitate technology-enhanced inclusive learning environments and facilitate change in a cooperative way. My orientation as a researcher is towards emancipatory interests, that is, the release of human potential (Herr & Anderson, 2005):

"The notion of emancipatory knowledge interests leads to potential for critical reflection and the problematization of current practices as well as one's own unexamined assumptions" (p. 27–28). As researcher, I heeded Watson's (2001) warning not to position the "technology as the catalyst for change, but rather its tool" (p. 264). In my study, I position inequity as the catalyst for change and mobile tablet technology as a disruptor.

Chapter Three outlines the research methodology that was used for this study. The chapter begins with a review of the research design and research questions. This is followed by a description of establishing a site and the participants. I then provide a description of the data collection methods, known issues of validity and reliability, and the specific data analysis measures. Finally, I describe ethical considerations and end with a summary of the methodology.

Participatory Action Research Methodology

My theoretical perspective guided my research design. Although, I "start from the premise that man [*sic*] lives in a world which constrains rather than develops his full range of possibilities" (Burrell & Morgan, 1979, p. 307), I agree with bell hooks (1994) that the classroom is a radical space of possibility. Also, I recognize there are many possible perspectives on any issue.

To align my research with my theoretical stance, which includes postmodernism as well as a commitment to "transcending the limitations of existing social arrangements" (Burrell & Morgan, 19, p. 32), I utilized PAR theory and methodology. PAR draws from two different research approaches: participatory research and action research combining both the goals of achieving practical objectives and changing social reality through group participation as well as improved capacity and practice of researchers. PAR is "doing research *with* and *for* people rather than *on* people" (Lofman, Pelkonen & Pietila, 2004; Reason, 1981) and brings to the forefront "questions relating to power, knowledge and participation" (Clark, 2010, p. 115). PAR is a research approach that can develop the agency of participants and help them realize they each have the ability to initiate and enact change, and unites such agency in terms of community and social justice (Kemmis & McTaggart, 2008; Kindon, Pain, & Kesby, 2007). Brydon-Miller, Maguire, and McIntyre (2004) assert PAR is "transforming society by empowering individuals to take control of change within their own environment" (p. 139).

PAR seeks to reduce the power of discourse and expert status through the partnership of insiders and researchers to generate insider knowledges. Also, I believe PAR can empower students, especially marginalized students, to speak, to be heard, and to create change. "Through involvement in the PAR process, students can find ways of contributing their voices to the educational issues affecting their own lives and opportunities and those of their peers" (Bland & Atweh, 2007, p. 346). According to Freire (2000), "every human being, no matter how

‘ignorant’ or submerged in the ‘culture of silence’ he or she may be, is capable of looking critically at the world in a dialogical encounter with others” (p. 32).

PAR “seeks to help people within a particular time frame and location become more familiar with and aware of the constraints that prevent them from participating fully in their communities... [and] enable them to take action to eliminate or minimize those constraints” (Savin-Baden & Wimpenny, 2007, p. 333). Therefore, as an approach to educational research, PAR has an intentional focus on collaborative research, action for social change, and participant education. This orientation shifts inquiry from an individual to a collective endeavour that is an evolving approach to inquiry, openly aimed at transformative personal, organizational, and structural change (Brydon-Miller & Maguire, 2009). According to MacIntyre (2008), the defining characteristics of PAR are: 1) the active participation of researchers and participants in the co-construction of knowledge, 2) the promotion of self and critical awareness that leads to individual, collective, and/or social change; and 3) the building of alliances between researchers and participants in the planning, implementation, and dissemination of the research process.

Brydon-Miller and Maguire (2009) asserted that PAR is more than a set of technique; PAR “is a systematic approach to personal, organizational, and structural transformation” (p. 80) with “a commitment to collaboration and partnership throughout the problem-posing, knowledge creation, and action-taking cycles of a project” (p. 88). Rather than an explicit format, PAR research has seven principal features that inform the research process itself. PAR is a social process, is participatory, is practical and collaborative, is emancipatory, is critical, is reflexive, and aims to transform both theory and practice (Kemmis & McTaggart, 2008). These guiding principles lend to a PAR approach that “generally starts small and develops through the self-reflective spiral” (McTaggart, 1991, p. 175). This action research spiral comprises

- *Planning* a change;
- *Acting* and *observing* the process and consequences of the change;
- *Reflecting* on these processes and consequences;

- *Re-planning*;
- *Acting and observing again*;
- *Reflecting again*, and so on…" (Kemmis & McTaggart, 2008, p. 563)

The core steps in enacting PAR cycles have been articulated at varying levels of complexity by different authors. I followed Coghlan & Brannick's (2010) suggestion of a cycle comprising "a pre-step (context and purpose) and four basic steps: constructing, planning action, taking action, and evaluating action" (p. 8).

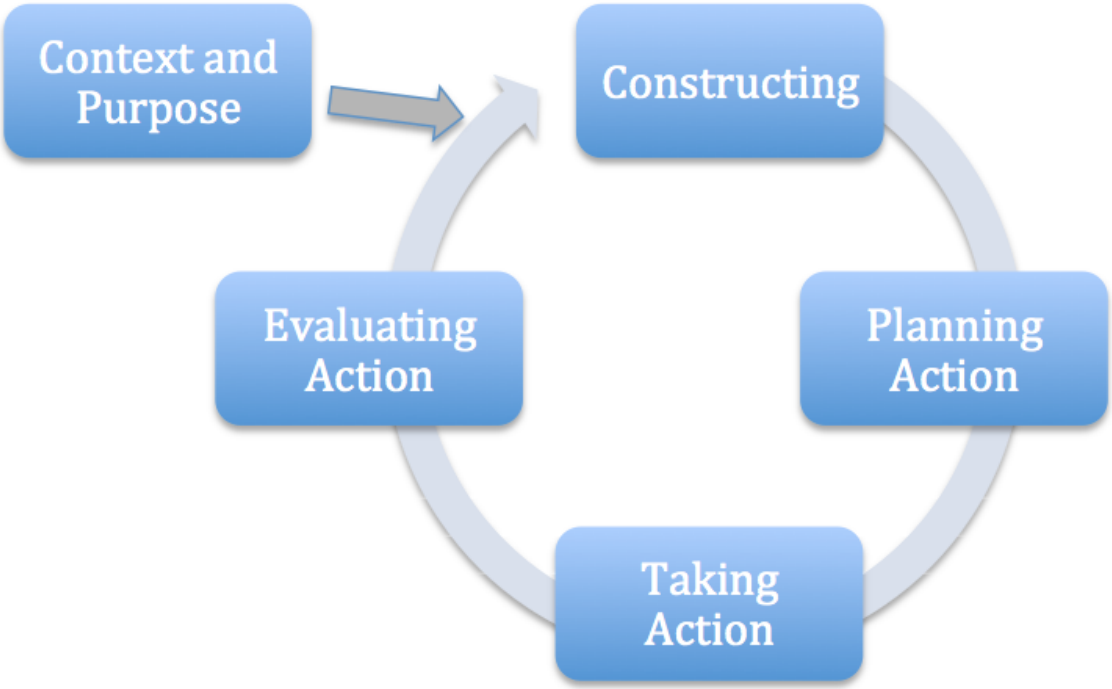


Figure 3.1: PAR Cycle Core Steps

Research that is critical, participatory, and action-oriented fundamentally questions *who* has the right to engage in research by positioning students, community members, and K–12 teachers as legitimate and integral participants in the research process:

> It also fundamentally challenges the hierarchy of knowledge production and changes the relationship of knowledge producers to knowledge consumers; critical participatory

> action research opens up spaces for populations who were formally only regarded as the objects of research to act as the subjects and empowered participants in research that matters a great deal to them. (Morrell, 2006, p.3)

PAR encourages equitable involvement of researchers and participants in the research process. This empowerment in and through the research typically involves participants in the entire research process: “In PAR, involvement is centered to those most affected by a problem. It engages them in planning, carrying out, and applying the results of the research” (Morales, 2016, p. 159). This study is a limited version of PAR, however, constrained by my position as a doctoral researcher and commitments to the University of Calgary that prohibited me from involving the research participants in the data analysis. It also was constrained by the school year.

Collins (2009) suggested “a perspective that seems suitable for classroom research is one of participatory, collaborative action research. It is ecological in the sense that it includes significant actors in a classroom research setting, including children” (p. 216). Through PAR, researchers can “tap into children’s direct experiences and…give these perspectives value and status” (Clark, 2010, p. 116). Youth participatory action research (YPAR) is based on the same principles as PAR and elevates the importance of youth voice, including their involvement in the research process. Ozer, Ritterman and Wanis (2010) identified capacity building as an essential element of YPAR, involving training of young people to “identify major concerns in their schools and communities, conduct research to understand the nature of the problems, and take leadership in influencing policies and decisions to enhance the conditions in which they live” (p. 153).

Critiques of PAR include concerns about the under-theorization of power, more specifically, the possibilities for marginalization that occur within group participatory processes. Hickey and Mohan (2004) suggest attention needs to be paid to internal group dynamics in

addition to external social structures. They assert that those with power speak for others, which can suppress individual agency. Heeding this warning, I strove to avoid consensus during group work through the design of the focus group meetings including the questions and facilitation protocol.

Research Questions

In what ways does the design of technology-enabled, inclusive learning environments impact teacher and student learning and agency in middle school?

1. Do technology-enhanced learning activities change over time? If so, how?
2. Does learning with the iPad as a one-to-one device impact teacher self-efficacy to support students with diverse learning needs in an inclusive setting? If so, how?
3. Does learning with the iPad as a one-to-one device impact teachers' perception of students as learners and student perceptions of themselves as learners over time? If so, how?

Establishing a Site

Given the nature of PAR and the demands placed on teachers who engage in classroom research, the ethics approval processes at the university and school authorities, the movement of staff, and the focus on an emergent technology, participant recruitment can be a challenge. Purposeful sampling procedures were used to locate the research site. Initially, I used convenience sampling and jurisdictions participating in the One-to-One Mobile Tablet Project funded by Alberta Education, which was an exploration of iPads in inclusive, rural middle-school classrooms, to identify potential research sites. Multiple approvals after provision of an ethics certificate by the University of Calgary were necessary, including the following: School Board Approval, Principal Approval, Educator Consent, Parental Consent, and Student Assent. I requested permission to conduct research from all four of these school jurisdictions. Two of these four school jurisdictions approved my request. All six teachers participating in the One-to-One Mobile Project within these two school jurisdictions were sent a research recruitment

package and I followed-up via email. Unfortunately, none of these teachers chose to participate in the study.

When no teacher participants were confirmed, I then used snowball sampling to find other potential participants who met the eligibility criteria for the study. Based on this snowball sampling, I requested permission to conduct research at one urban and one rural school jurisdiction. The urban school jurisdiction approved my research application with the stipulation I must first inform the principal and confirm his approval before contacting the potential teacher participants indicated in the research application. It is important to note that during the 10-week research approval process with the urban school jurisdiction's central office, the original principal of the target school who launched the iPad initiative accepted and began a new position outside of the school jurisdiction.

Participant Recruitment

The research participants were drawn from one urban elementary school in Alberta, Canada, with iPads implemented as a one-to-one device. In the fall of 2012 this school launched an iPad initiative with both the English and French Immersion classes of grades four, five, and six. Accordingly, all six of the fourth, fifth, and sixth grade teachers at the school were invited to participate. Two fifth-grade teachers, one male and one female, expressed interest in participating in this study. One fifth-grade teacher consented. Once the teacher consent form was signed, students and parents were informed of the research. All 26 students, 20 males and six females, in her homeroom class were given the opportunity to participate. The teacher participant provided me access to her students and their parents to introduce the research opportunity.

A research information package described the research, informed parents of the implications of the research, any associated risks, and asked for informed consent with the acknowledgement that students could opt out of the research at any time. Teachers, students, and parents received separate consent forms. Parents needed to consent for the students to

participate and then the students had to give their assent to participate on a separate form as instructed by the ethics board overseeing the research.

In addition to a research information package, I was allowed 30 minutes to provide a verbal overview and answer students' questions when handing out the materials. During this information session I ensured potential student participants understood this PAR would only be until the end of the school year. Leeson (2007) stressed the importance "participants are aware that the relationship would be time limited and that there would be no contact following its termination" (p. 140). Although I offered to hold a parent information session at the school, the teacher participant declined.

I was keenly aware that seeking parental permission can reduce agency. After parental consent was obtained, I emphasized the students' active consent, encouraging them to decide if they wished to join in and assuring them they had the right to choose not to sign the assent form. All ten students, eight male and two female, who returned parental consent forms also signed an assent form.

All participants, including parents who gave consent for the student participants, were invited to call or email me or my graduate supervisor if there were any questions or concerns about the research carried out in the school. No such calls or inquiries were received. The teacher participant and all student participants were treated in accordance with the ethical guidelines of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (CIHR, 2010).

Description of Participants

The participants included one fifth-grade teacher with four years teaching experience and ten of 26 students. It was the teacher's first time teaching the fifth grade. In fact, for the past three years, Ms. H followed a cohort of students, first teaching them grade three, then grade four, and currently grade five. Of the ten student participants, eight were male and two female

student participants. One of the male student participants had an IPP. The student participants ranged between the ages of ten and twelve.

Pseudonyms, fictional names, have been used for the participants. During the individual interviews, participants were reminded their real names would not be used when results of our research was shared. Acknowledging the power in participant naming, participants were provided the opportunity to decide what their pseudonym would be. Only one student had a preference for their pseudonym. The remaining pseudonyms were assigned by me, primarily to convey gender. Lahman et. al. (2015) warn “people will assign characteristics to other people according to their name” (p. 449).

Table 3.1 - Distribution of Student Ages

Student participants lived in a unique neighbourhood where the majority of housing units are in multi-family dwellings. Due to the affordable, high-density housing surrounding the school, students in the English stream tend to be new to the city. Some are also new Canadians. According to the 2011 Census of Canada, 73 percent live in rental housing and 75 percent moved to the neighbourhood within five years, with 37 percent moving from elsewhere in the city, 11 percent from elsewhere in Alberta, 16 percent from elsewhere in Canada, and 11 percent from outside Canada. Students in this class reflect their neighbourhood. For example,

Alicia (a pseudonym) mentioned “I was born in the Philippines and I moved to Canada when I was like three or four years old.” In addition to English, languages spoken in the student participants’ homes included Filipino, Tagalog, Ilocano, Russian, Romanian, Shona, Vietnamese, French, and German.

The student participants who lived in affordable, high-density housing all had access to various technologies in their homes. Student participants reported technologies including gaming devices (e.g., X-Box, PlayStation and Wii), mobile devices (e.g., iPod, iPhone, iPad, and laptop) and desktop computers. While some of these devices were personally owned by the students, often they were shared among their family members. For example, when discussing the technologies in his home Alex, mentioned, “iPad, iPhone, iPod, and a computer. They are not mine though, but we share with the whole family.” Interestingly, this goes against a common stereotype that only students in more affluent neighbourhoods have access to technology at home.

Data Collection

In order to provide thick and rich description of the ways a fifth-grade teacher and her students in an inclusive learning environment demonstrate agency with the iPad as a one-to-one device, multiple forms of data were collected over an extended period of time. The types of qualitative methods used were naturalistic, as naturalistic inquiry emphasizes the importance of the context (Lincoln & Guba, 1985). Data collection methods included focus groups, interviews, observations, journaling, a survey, documents. and artifacts.

Focus Groups.

“In Participatory Action Research (PAR), group processes are central in facilitating change and focus groups are widely used by action researchers” (Chiu, 2003, p. 165). Stringer and Dwyer (2005) advised that focus groups are an effective data collection tool as they can be primary entry points into action research process and help support PAR’s focus on the inclusion of those most impacted by an issue. In the spirit of PAR, focus groups were group discussions

with student participants. They occurred during lunch at regularly scheduled intervals throughout May and June to form the basis of the research study. The first session centred on capturing the participants' initial reactions to having a class set of iPads and their hopes and dreams for the iPad as a one-to-one device. The focus for subsequent sessions emerged from the project itself as it evolved. For example, the teacher participant requested the research focus on their final science unit of the year on wetlands. For an example Focus Group Agenda, see Appendix A. I digitally recorded each focus group discussion and wrote notes on a whiteboard. Digital photos were taken of the whiteboard at the end of each focus group before it was erased. After each focus group meeting, I transcribed the digital recording, removing any student names, and inserted the digital whiteboard picture(s) if appropriate. Each transcription was brought to the next focus group meeting for member checking. Participants were assured their comments would be kept confidential.

Interviews.

Semi-structured individual interviews were conducted with each student participant and then their teacher. According to Gillam (2000), semi-structured interviews—when done well—yield the "richest single source of data" (p. 65). Noor (2008) recommended this approach because "it offers sufficient flexibility to approach different respondents differently while still covering the same areas of data collection" (p. 1603). I used an information protocol during the interviews that included a header to record key demographic data such as date, time, place, and interviewee name, and five to seven questions with probes "for asking questions and recording answers" (Creswell, 2009, p. 183). Interviewees were assured their comments would be kept anonymous. For a full list of the student interview questions, see Appendix B. For a full list of the teacher interview questions, see Appendix C. In addition to these formal interviews, informal conversations occurred with students and their teacher during classroom observations. Informal conversations with the teacher also occurred before and after school, both face-to-face and via email.

Observations.

Another useful tool for gathering data is direct observation. Site visits occurred on a regular basis to observe and gather information in the natural setting. The emphasis during these classroom observations was on "understanding the natural environments of the participants, without altering or manipulating it" (Gay, Mills, & Airasan, 2009, p. 366). Classroom observations are important because

> …it is not unusual for persons to say they are doing one thing but in reality, they are doing something else... Also, persons may not be consciously aware of, or be able to articulate, the subtleties of what goes on between themselves and others. (Corbin & Straus, 2008, p. 30)

I was a privileged, active observer; moving in and out of the roles of mentor, teacher's aide and observer.

The roles of mentor and teacher's aide allowed me to develop deeper relationships with the participants. In the role of mentor, I listened attentively to Ms. H when she shared details about the lessons she was planning for courses other than science and challenges she was facing. I took time to reflect on this collegial dialogue and would respectfully offer instructional support. For example, during my first week in her classroom, Ms. H mentioned they would be wrapping up the math unit on fractions and that she was struggling with how to use the iPads in Math class. Ms. H's frustration was evident when she shared "I do have an operations app, but it doesn't do decimals." To shift the conversation from apps focused specifically on fractions and decimals, I asked her about what student misconceptions about fractions and decimals she was noticing. In the role of teacher's aide, I spent time working with students individually or in small groups. During my first day in the classroom, students were working on completing an autobiography using the Explain Everything app. This was their first time using this app so some students struggled with the tool. For example, a few students were having difficulty with clearly recording themselves. I showed these students that their Apple earbuds were also a

microphone and demonstrated how to use them to reduce the background noise when recording their voice. Other students had difficulties with the content for their autobiography. I worked with individually with these students to help them brainstorm key items they wanted to include.

Notes were taken during and just after classroom observations to support the collection of rich descriptions. As advised by Creswell (2009), both descriptive notes and reflective notes were recorded. An observation protocol "is an important tool that provides structure for recording information from observation sessions (Gay, Mills, & Airasan, 2009, p. 367). After spending some time with the participants in their classrooms, I chose the Technology Integration Matrix (TIM) rubrics (instructional setting indicators, teacher indicators, student indicators) as one observation tool. TIM provides a framework for evaluating technology integration in the classroom: "The TIM is grounded in the social constructivist theoretical framework which places learner interactions as key constructs of learning" (Allsopp, Hohlfeld, & Kemker, 2007). As such, the TIM associates five levels of technology integration: entry, adoption, adaptation, infusion, and transformation (Apple Inc., 1995; Dwyer et al., 1990), with each of the five characteristics of meaningful learning environments: active, constructive, goal directed, authentic, and collaborative (Jonassen, Howland, Moore, & Marra, 2003). The three principals of the UDL Framework (Rose & Meyer, 2002) and three dimensions of student engagement (Willms, Friesen, & Milton, 2009) were also used as lenses during classroom observations.

UDL is a framework for designing educational environments that enable all learners to gain knowledge, skills, and enthusiasm for learning based on three principles: multiple means of representation, multiple means of expression and action, and multiple means of engagement (CAST, 2012). The principle to provide multiple means of representation includes: 1) perception, 2) language, mathematical expressions, and symbols, and 3) comprehension. The principle to provide multiple means of action and expression includes: 1) physical action, 2) expression and

communication, and 3) executive functions. The principle to provide multiple means of engagement includes: 1) recruiting interest, 2) sustaining effort and persistence, and 3) self-regulation.

Willms et. al. (2009, p. 7) identified three dimensions of student engagement: 1) social engagement, 2) academic engagement, and 3) intellectual engagement. Social engagement is defined as students' sense of belonging and participation in school life. This includes participation in school clubs such as sport teams, music clubs, students' council, and the yearbook committee. Academic engagement is defined as students' participation in the formal requirements of schooling. This includes attending class on a regular basis and completing coursework in a timely manner. Intellectual engagement is defined as students' serious emotional and cognitive investment in learning, using higher order thinking skills (such as analysis and evaluation) to increase understanding, solve complex problems, or construct new knowledge. Willms et.al. acknowledge that "the complex relational and organizational aspects of school have a powerful and important impact on all forms of engagement" (p. 32).

Journal.

A self-reflective research journal was kept during the life of the research project as a space for me to write about my tensions and learnings, as well as my critical reflections on the effect of the project and how it was progressing. "For qualitative researchers, the act of journal writing may be incorporated into the research process to provide a data set of the researcher's reflection on the research act" (Janesick, 2011, p. 156); therefore, it is a strategy that can facilitate reflexivity (Ortlipp, 2008). As I am the main instrument of data collection, keeping a self-reflective journal assisted me in deepening and examining my understanding of my role and experiences in the field while maintaining an ongoing reflexive account of my experiences as a researcher: "The research journal, particularly at critical junctures in our work, may allow us to analyze how we have come to be the researchers we are at that particular time" (Borg, 2001, p.167). Also, journal entries chronicle research decisions made throughout the study.

Documents.

Naturally occurring public and private documents in the classroom deemed relevant to the study were reviewed. Parental permission, via the research consent form, was obtained before reviewing private student documents such as report cards. As advised by Creswell (2009), notes regarding the documents were compiled including "information about the document...and key ideas in the documents" (p. 183). Relevant artifacts to be reviewed were negotiated with the classroom teacher. They included report cards, individualized program plans, and unit plans.

Artifacts.

Classrooms are rich sources of visual and written data that can contribute to our understanding of classroom events: "Such artifacts are a valuable data source that qualitative researchers may use as a starting point for conversations with research participants (Gay, Mills, & Airasan, 2009, p. 374). They are a rich source of information not available from data collected through discussions, interviews, and observations (Norum, 2008). They can reveal potential tensions between what participants say and what they do (Creswell, 2007). Artifacts can also provide clues to teachers' beliefs about what promotes learning and illustrate any scaffolding designed to support diverse learners. Relevant artifacts to be reviewed were negotiated with the participants. They included classroom displays, student work samples, teacher feedback on graded assignments, and lesson materials.

Data Analysis

Creswell (2007) identified three key elements of data analysis in qualitative research: 1) preparing and organizing the data, 2) reducing the data into themes through a coding process, and 3) representing the data. As the data were collected, I transcribed all discussions and interviews to become acquainted with the data. Digital files that were created for the

discussions, interviews, observations, documentation notes, and journal entries were stored on an external hard drive. All files were protected by setting a password on the external hard drive.

The first time I read all data I wrote write memos. “It is important that you write notes in the margins or underline sections or issues that seem important to you so that you will have a record of your initial thoughts and sense of the data” (Gay, Mills, & Airsasian, 2009, p. 450). “For participatory action researchers, *how things changed,* because of the relationships between participants and their shared work, is the focus of the research and its reporting” (McTaggart, 1998. p. 222). This focus on how things changed influenced my data analysis as well.

Data analysis is discussed in a linear fashion below. However, I engaged “in the process of moving in analytic circles” (Creswell, 2007, p. 150). With action research, “there are multiple layers to the data analysis process: the initial meaning making, including some decisions regarding directions for interventions or actions; and then a revisiting of the data for a more thorough, holistic understanding” (Herr & Anderson, 2005, p.81). Following PAR’s iterative cycle of inquiry, the various forms of data were collected, managed, and analyzed simultaneously.

Focus Groups, Interviews, Observations and Journal Entries.

Detailed analysis of data gathered through discussions, interviews, observations, and journal entries began with a coding process, following Creswell’s dictum that codes will be developed “only on the basis of the emerging information collected from participants” (2009, p. 187). I used the meaning of analysis context as the unit of analysis for coding. These codes include anticipated codes, unanticipated codes, unusual codes, and theoretical perspective codes. As advised by Creswell (2009), I used this coding process “to generate a detailed description of the setting or people as well as categories or themes for analysis” (p. 189). Important data were then identified and compiled in categories by clustering similarly coded units. Inductive data analysis was used to identify themes. This inductive process involved

working back and forth between the themes and the database until a comprehensive set of themes was established (Creswell, 2009).

Table 3.2 - An example of code and theme development

Text	Code	Theme
“The video bar thing wouldn’t buffer quick enough ‘cuz you would have to wait ‘cuz too many people were on at the same time.”	WIFI	challenges
“Update the apps cuz most of them keep crashing.”	iPad management	
“I felt really proud of them that they took much more ownership and responsibility for their learning.”	self-directed learning	student empowerment
“We can just do the Speak Select and like listen or have it highlight the words for us.”	iPad personalization	

Classroom Artifacts.

Coffey (2014) argued that “qualitative research can be enriched by a careful and critical attention to the gathering and analysis of documents, of various kinds, in various modes and through various media” (p. 368). Goetz and LeCompte (1984) identified four key activities: "locating artifacts, identifying the material, analyzing it, and evaluating it" (p. 155). Classroom artifacts “become data through the questions posed about them and the meanings assigned to them by the researcher” (Norum, 2008, p. 23). Norum (2008), Hodder (1998), and Schreier (2014) informed my approach to analyzing classroom artifacts. Qualitative content analysis was applied to these data. The documents and artifacts were analyzed within the context they were created while also being considered within the context of the research to identify evidence that corroborated or contradicted what emerged from the discussions, interviews, and observations. “Artifacts can be used to support or challenge other data sources and literature, to generate or

confirm hunches, and to help provide thick description of people and/or settings" (Norum, 2008, p. 24).

Rigour

The strategic assortment of data I chose to collect necessitated that I spend a prolonged amount of time in the field: "The more experience that a researcher has with participants in their actual setting, the more accurate or valid will be the findings" (Creswell, 2009, p. 192). The multiple data sources also allowed me to use rich, "thick description" (Geertz 1973) when I conveyed the findings in Chapter IV. Before beginning the coding process, I checked all transcripts "to make sure that they d[id] not contain any obvious mistakes made during transcription" (Creswell 2009, p. 190). I triangulated different data sources, such as the discussions, interviews, and observations to identify and justify themes because "If themes are established based on converging several sources of data...then this process can be claimed as adding to the validity of the study" (Creswell, 2009, p. 191). During the coding process, I developed and maintained a qualitative codebook to ensure "there [wa]s not a drift in the definition of codes, a shift in meaning of the codes" (Creswell, 2009, p. 190).

In addition to the reliability and validity strategies for qualitative research identified above, I also conducted my research to demonstrate validity in ways specific to action research. Herr and Anderson (2005) suggested five validity criteria to demonstrate and evaluate rigour in action research: outcome validity, process validity, democratic validity, catalytic validity, and dialogic validity. Outcome validity considers "the extent to which actions occur, which lead to a resolution of the problem that led to the study" (p. 55). Process validity entails evidence the research findings are "a result of a series of reflective cycles that include the ongoing problematization of the practices under study" (p. 55). The research findings of this study are a result of eight reflective cycles. (See Table 4.1 - Timeline of multiple action research cycles.) Process includes, but is not limited to, the research methods. It entails triangulation to ensure

multiple views on the issue being researched. One example of how multiple views deepened what was learned through this study is with regards to the identification of barriers to the effective and efficient use of iPads for learning. Students clearly articulated their frustrating experiences with the iPad. However, they had misunderstandings about the cause of some of these frustrations. Exploring the teachers' perceptions about the issues raised by student participants encouraged more open dialogue between the teacher and I. This led to uncovering the true cause of these student frustrations which informed the actions required to remove or reduce these barriers before 'the change' could be implemented. In this study I used multiple stakeholder triangulation as well as used multiple methods to collect data, conducted member checking when possible, and used multiple theoretial frameworks when analyzing the findings.

The extent to which the research is done in collaboration with the participants and that multiple perspectives are included demonstrates democratic validity. I collaborated with the teacher participant through weekly planning meetings and the student participants through five focus group meetings. The qualitative data sources provided a rich resource for particpant quotes and the inclusion of teacher and student voices throughout this dissertation. Catalytic validity "highlights the transformative potential of action research" (p. 57). It is the degree to which the research process causes participants and the researcher to deepen their understanding of a reality and move to action in order to transform it. Evidence of catalyic validity is the barriers to the effective use of iPads that were uncovered and the Science Wetlands Unit that was co designed by the researcher and classroom teacher with input from the student participants. Dialogic validity considers a researcher's participation "in critical and reflective dialogue" (p. 57). A researcher's journal faciliated my participation in critical and reflective dialogue while conducting the research as well as examination of my own biases while writing this dissertation. Additional evidence of dialogic validity is the dialogue at my presentations of this study and its preliminary findings at conferences such as the Hawaii International Conference on Education.

Ethical Considerations

This study was reviewed by a supervisory committee and approved by submitted to the University of Calgary. I gained consent from the University of Calgary's Conjoint Faculties Research Ethics Board to conduct the research and followed the guidelines set out by the board. This study was also reviewed by the school board, which required to me to submit a research application as well as a school volunteer application and criminal record check.

Stringer and Dwyer (2005) noted that when conducting research, ethical considerations must be given strong consideration to protect the well-being and interest of participants. A number of ethical, social and moral issues with regards to voluntary consent may arise when using PAR in in K–12 environments. Four positions of authority need to be carefully considered: the university researcher, the principal, the teachers, and the parents as they are entangled with issues of power differentials. This study sought to work with fifth-grade school students and their teacher and, as such, the primary potential ethical considerations for the study were informed consent, coercion, and confidentiality.

Informed Consent.

People were informed about the research prior to their participation including the purpose of the study, what they were being asked to do, the types of information would be collected, and what would happen to that information. Potential adult participants (teachers) were provided with a research information package, including a consent form, and asked to provide written consent for their involvement. It included my contact information in case they had any questions before making their decision to participate. For more details on the teacher participant recruitment materials, please see Appendix D: Teacher Consent.

Because this study involved minor participants, a group most certainly considered a vulnerable population both in and outside of academia, students' parents were required to give their written consent. Students attended an in-class information session during school hours and were provided a research information package to take home and discuss with their parents (or

legal guardian) that included a letter detailing the study, a consent form, and a student assent form. Additionally, students, their parents, and the teacher were informed of possible risks and their right to withdraw at any time during the study without penalty. Participants were informed that although they could withdraw from the study at any time, the data collected up to that point would be used in the study. For more details on the student participant recruitment materials, please see Appendix E: Parent Consent and Appendix F: Student Assent.

Coercion.

While I did not anticipate issues of coercion for participants as there was no pre-existing affiliation with the school, it was important to acknowledge the power imbalances that exist within our society between children and adults. Diligent efforts were made to ensure that students were aware of their rights to participate or opt out of the study through the classroom presentation and student assent form, as well as reiterated verbally several times throughout the study. It was clearly communicated that even if a student's parents (or guardian) gave consent, they had the right to choose not to participate in the study and if they chose to withdraw their parents would not be informed. Additionally, the classroom teacher was informed that students should not be pressured to participate. Due to the potential for student reimbersements to serve as a way to coerce participants and make those who are not participating feel excluded, I did not offer any reimbursements. However, I did attend a visit to a local spray park with the class during the last week of school and brought popsicles for all the fifth-grade students attending.

Coercion was also of concern with regards to the teacher participant as she may have felt obligated to participate based on her principal's approval of the research. I explained in writing and verbally that participation was voluntary with no penalty for withdrawing at any time.

Confidentiality.

I had no pre-existing affiliation with the school and, as such, was an outsider keenly aware of issues of confidentiality, privacy, and protection of information. Measures were taken

to protect the information. All collected data were safely stored in filing cabinet and in a password-protected desktop computer, which is kept in my home office. It is inaccessible to anyone other than the researcher. Anonymity was not possible for the student participants, as the focus group meetings were face-to-face. However, confidentiality expectations were discussed, and group rules were established. Although focus group participants reviewed transcripts after the audio was transcribed, names were not included in the transcript to protect individuals' identities. I worked with the school to book a quiet, private room for the lunchtime focus group meetings; heeding Groundwater-Smith's (2007) caution that "It is important every care is taken to ensure they are not overheard and their responses commented upon by third parties" (p. 122).

Limitations and Delimitations

Six limitations and two delimitations of the research design described above should be acknowledged. First, the findings reflect limited aspects of teacher and student experiences with iPads. Second, this study focused on iPads, which makes transferring the findings to other mobile devices difficult. Third, the participatory manner to approaching potential collaborators often is multifaceted, time consuming, and demanding (White, Suchowierska, & Campbell, 2004). Fourth, developing participatory relationships blurs the boundaries between researchers and subjects and may be perceived as resulting in biased and unscientific research. Fifth, empowerment raises expectations that cannot always be met (Boyden & Ennew, 1997). Sixth, my position as a doctoral researcher and commitments to the University of Calgary prohibited me from involving the research participants in the data analysis. Nor could they be co-owners of the raw data. Therefore, due to the nature of doctoral studies, I was only able to conduct a limited form of PAR.

A delimitation was the timing of the study. Due to challenges with participant recruitment, this study started in the spring. This late start resulted in a compressed research timeline during the end of the school year. Time constraints related to conducting research at the end of the

school year posed challenges with regards to the PAR spiral. A second delimitation of the study is that it only included fifth-grade students and may not be representative of school-age students in elementary school. Within the context of a one-to-one mobile device project, the scope of this study was limited to one urban, inclusive, middle-school classroom in Northern Alberta, with an intentional focus on the classroom practices of a fifth-grade teacher and her students.

Role of the Researcher

I am a certificated teacher who has worked on the education field for the past 20 years. According to Greenwood and Levin (2007), action research practitioners play the role of the "friendly outsider" (p. 124). On the continuum of positionality, I locate myself in *outsider in collaboration with insiders* (Herr & Anderson, 2005). However, I must acknowledge multiple positionalities as I am not only a researcher, but an educator, and an ATL consultant. This affords me an insider status as well. It is important to note that I am not a staff member of the participating school nor an employee of the school jurisdiction in this study. Prior to the study, I had no professional or academic connection to the school. Even so, I addressed the unique dilemma of insider research by embedding self-reflection throughout the research process to see taken-for-granted aspects of teaching and learning with technology from an outsider's perspective. Because of the unique positionality of action researchers, "bias and subjectivity are natural and acceptable in action research as long as they are critically examined rather than ignored" (Herr & Anderson, 2005, p. 60) and mechanisms, such as a researcher's reflective journal, were put in place to mitigate against any distorting effect they may have on the research outcomes.

Assumptions

The underlying philosophical beliefs that guided this study were that of advocacy and a participatory worldview. Assumptions related to this research were:

- The purpose of academic research is not just to describe, understand, and explain the world but also to change it.
- Organizations are socially co-constructed and comprise multiple meanings, so there is no single truth to be discovered.
- Children are entitled to have their voices heard regarding situations and contexts that affect them.
- Children are a group for whom having voice; greater power, and knowledge in educational research is vitally important.
- Students' voices are not singular.
- Students are key stakeholders in the education enterprise.
- The teacher and student participants answered the individual interview questions openly and honestly.

Summary

This qualitative PAR study used purposeful sampling procedures to locate the research site, an urban elementary school in Alberta, Canada, with iPads implemented as a one-to-one device. There were 11 participants: a fifth-grade teacher and ten students. The research study used multiple methods of gathering data to answer the research questions. Qualitative techniques included student focus groups, individual interviews with students and their teacher, researcher observations, and classroom artifacts. Focus group and interview transcripts as well as observations and journal entries were analyzed thematically. Content analysis was conducted on the classroom artifacts data. The next chapter presents the findings of the research.

CHAPTER FOUR: RESEARCH FINDINGS

Chapter Four reports the PAR cycles, the process findings, and the impact findings. Two main types of PAR cycles occurred: 1) technology and 2) teaching and learning. Problem-posing, knowledge creation, and action-taking cycles were embedded within these two types of PAR cycles. Multiple action research cycles were operating concurrently. These cycles included Student iPad Personalization, iPad Maintenance, iPad Management, Class iPad Customization via App Selection, Science Wetlands Unit-Content Representation, Science Wetlands Unit-Knowledge Building, Science Wetlands Unit-Action & Expression, and Science Wetlands Unit-Assessment.

The process of engaging students in an authentic exploration of their science learning with iPads and informing the design of the wetlands unit was a rich experience that contributed to the findings of this research study. The process findings are three dominant themes that emerged during the focus groups: challenges, customization, and choice. Impact findings refer to what was learned through implementation of the change that was co-designed: the Science Wetlands unit. Seven dominant themes emerged from the classroom observations and individual interviews: increased collaboration, improved student engagement, student empowerment, teacher empowerment, technology-enhanced learning environment, shifts in teacher perceptions of learners, and shifts in students' perceptions.

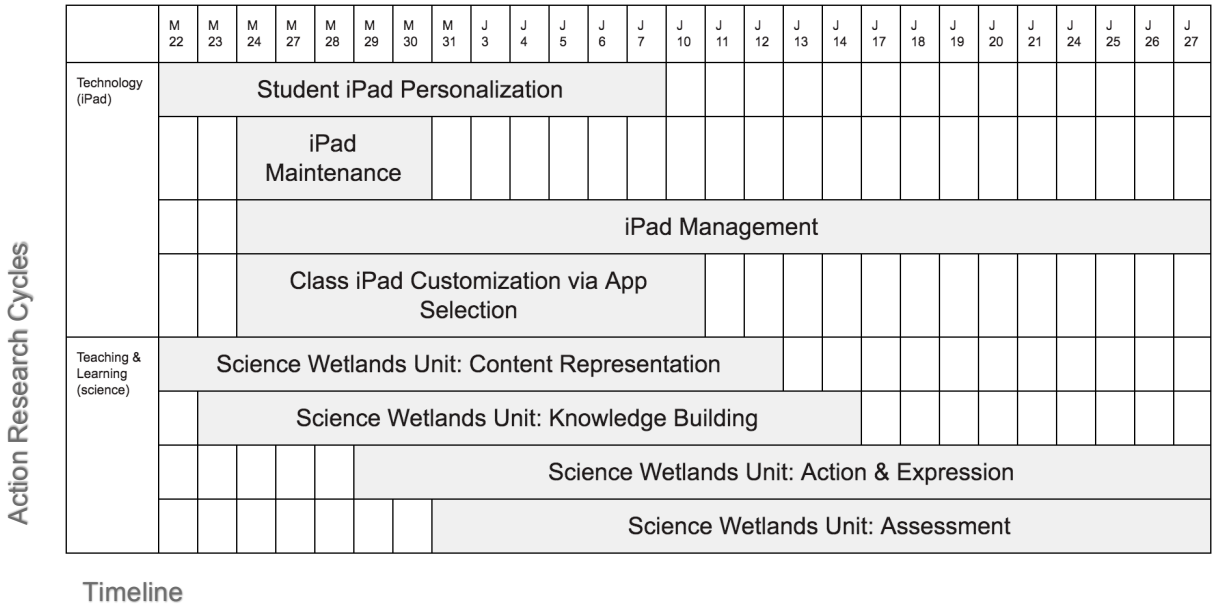
PAR Cycles

I followed Coghlan and Brannick's (2010) suggested cycle comprising a pre-step of establishing context and purpose "and four basic steps: constructing, planning action, taking action, and evaluating action" (p. 8). The pre-step involved three half-day site visits where I strove to establish a collaborative relationship while gaining an understanding of the context and identifying the gap between the current and desired state. The PAR cycles of constructing, planning action, taking action, and evaluating action occurred over six weeks, which included

ten half-day and two full-day site visits. The focus was to capitalize on new, emerging opportunities while managing persistent dilemmas.

To initiate the PAR cycles, the teacher participant and I engaged in dialogic activity; identifying the gap between merely having one-to-one access to a mobile device and leveraging the mobile device in an educational setting then constructing what the issues were. Through this process, two types of issues were identified: 1) student and teacher technology knowledge and 2) the teacher's science content knowledge and pedagogy. Due to this, two main types of cycles occurred: 1) technology and 2) teaching and learning. Multiple action research cycles were operating concurrently. See Table 4.1 for the timeline of research cycles.

Table 4.1 - Timeline of multiple action research cycles



Technology cycles.

Students, as the primary users of iPads in educational settings, have important perspectives regarding the challenges of truly leveraging mobile tablet devices to support their learning. The ten student participants and their homeroom teacher identified technology barriers to effective and efficient use of iPads for learning.

Student iPad personalization. One key challenge in supporting the learning needs of this diverse fifth-grade class identified by the teacher was that English was not the first language, or the language primarily spoken in the home, for most of her students. Also, student participants mentioned not being good readers while others felt they were not good writers.

The iPad's intuitive interface and students' previous experience with iOS through iPhones supported its quick integration into their school day. However, while students were confident users of the iPad, they did not know how to best use it as an educational tool personalized to meet their individual needs. For example, Alicia shared, "I didn't know we could do that [text-to-speech] since it would be a lot easier since we don't have to, like, to read ourselves. We could just listen to it." Classroom observations revealed both the teacher and her students lacked technical knowledge about the iPad's built-in features and native apps: In my journal I noted "I demonstrated Speech Selection to the class and everyone, including the teacher, was surprised the iPad could read to them." During her interview Ms. H acknowledged, "I had no idea [about the built-in accessibility features]." Ms. H also noted this is something other teachers in her school may not be aware of: "You know I have to make sure to remember to tell the other teachers that. We have a lot of ELL learners."

It is important to note there was a fear among the students of going into certain areas of their iPad such as the settings. For example, Alicia mentioned "Um, well I was kinda nervous 'cuz I might accidentally break some of the rules 'cuz there is this contract on the iPad and I might break the rules and I'm not, I don't break the rules a lot." Before being given access to the school-owned iPads, students were required to sign an acceptable use policy It is important to note that elements of the school's iPad acceptable use policy and contract may have contributed to this. For example, the iPad acceptable use document and contract includes the following statements:

- “Pupils should not modify the iPad in any way other than instructed by the administrator or other school personel [*sic*].”
- “[P]upil iPads will be subject to random spot-checks…Any inappropriate material or unauthorized configuration changes will be dealt with under the digital citizenship discipline process.”

In particular, although the teacher and her students had access to the class set of iPads for almost two full school years, they were unaware of the accessibility features built into iOS. Ms. H shared she had no idea about the built-in accessibility features. “I really only saw it as touch the app, now learn how to use the app. Not in terms of like how you showed us it reading, which would be so helpful for so many [students]” Therefore, the first problem identified to be worked on was a lack of student iPad personalization. As the teacher and I planned action to address the lack of student iPad personalization through a student coaching session on the accessibility features built into iOS, such as text-to-speech, word predictions, and speech-to-text, a new problem emerged; iPad maintenance.

iPad maintenance. Although the most recent version of iOS had been released seven months earlier, and iOS updates are free, the class set of iPads was still using the previous version of iOS that did not include some of the accessibility features of the current version. This update had not occurred because the iPad deployment protocol at the school was that the principal updated the iPads and loaded on apps at the beginning of the school year, two months before Apple usually releases the new iOS. At the same time the student participants and I engaged in dialogic activity; identifying the gap between merely having one-to-one access to a mobile device and leveraging the mobile device in an educational setting, then constructing what the issues were. During lively discussions focused around iPad celebrations and challenges student participants clearly articulated their frustration with what Justin referred to as *glitchy apps*. For example, Shawn shared, “When an app isn’t working right it will just send us out of it.” Susan indicated, "Sometimes they crashed, sometimes they would just freeze and you

can't even, even if you pressed the home button you couldn't get out of it." Looking more closely into the glitchy apps issue revealed most of the apps on the students' iPads had updates available for download. Therefore, the second problem identified to be worked on was a lack of regular iPad maintenance. As the teacher and I planned action to address the lack of regular iPad maintenance through a teacher coaching session on how to install updates on a class set of iPads, a new problem emerged. Classroom teachers did not have the capability; permission and access to passwards, to download updates or install new applications during the school year.

iPad management. While I was co-planning the science unit with Ms. H, she mentioned her cart and class set of iPads had been set up by her former principal in September. The iPads had been deployed in this school using a top-down management model. Only one person in the school had the Apple ID and Apple Configurator information. At first, this was the principal. When the principal moved to a new position mid-way through the school year, he provided the Apple ID and Configurator login information to the assistant principal. Therefore, the third problem identified to be worked on was a lack of teacher ownership over the technology in her classroom. I acted as role of advocate for the teacher and her students with school leadership, stressing the importance of downloading the free iOS and application updates before the end of the school year, and offering the leadership team support in developing an iPad management system that would better meet the needs of the teachers and students. In my journal I noted "When the assistant principal and I logged into the iTunes account there were more than 3800 updates and 70 downloads pending!"

The action planned was to design a new school protocol for managing the Apple Account and the six charging carts with class sets of iPads. This new protocol was a distributed leadership approach where one staff member was identified to manage the Volume Purchase Program (VPP) and the six classroom teachers with iPad carts would be provided the account

information required to do their own updates. It was beyond the scope of this research, but I noted that the teachers would require coaching.

iPad customization via application selection. A barrier to truly leveraging the class set of iPads, identified by both the teacher and the student participants, was their lack of input into the applications available on their iPads. Shared during a focus group conversation, Justin's wish was "if we could download our own apps." The school did not have a formal process for requesting applications or explicit funds allocated to classroom teachers for purchasing applications. Ms. H revealed during an interview:

> …we were asked to give a list of apps, but for the most part I believe it came from the admin saying 'Oh, these ones. We'll put these ones on.' A lot of them were not really applicable to, um, my grade specifically but everything was just put on to see how we could use it I guess.

Nor was a process for removing applications established in the school. This gap is reflected in the student comment "They are just there [on our ipads] for no reason some of them." Similar to teachers' lack of authority to install new applications, a discussion with Ms. H also revealed classroom teachers did not have the capability to remove unused applications during the school year. The problem identified to be worked on was a lack of classroom iPad customization via application selection.

I gained permission from the principal to have access to the school's iTunes account in order to purchase two applications for the Science Wetlands unit using VPP. The purchasing process went very smoothly and I reimbursed the school for the cost of the applications required for the research. I provided coaching to both the teacher participant and assistant principal on how to push these applications to specific iPads in the class set. Due to the time constraints of this study, no action was taken to address the school-wide lack of classroom iPad customization via application selection. However, it was recommended that before the next school year the

school leadership team develop a process for teachers to request specific applications and guidelines for the VPP manager to use when deciding if the school would purchase the requested application or not.

Action evaluation. Technical challenges at the classroom level were contributed to by school-wide processes and policies related to technology. Student perspectives in addition to the teacher's perspective were integral to identifying these challenges. For example, the students' user experiences with applications freezing and crashing provided evidence of the negative impact the top-down approach of iPad deployment was having on their learning. The teacher perspective provided clarity about the iPad maintenance routine, or lack thereof. The teacher, still in the process of receiving her permanent certification, did not believe she had the power to challenge the iPad deployment approach and address these challenges. Therefore, advocating on behalf of Ms. H was required to reduce and remove barriers to effectively and efficiently using iPads for learning. The removal of these barriers created the conditions necessary to launch the redesigned science unit.

Teaching and learning cycles.

While uncovering, and planning to resolve, technical barriers to effectively and efficiently using iPads for learning, the teacher participant and student participants also identified challenges to leveraging one-to-one access to iPads in science class. These challenges were in four main areas: (1) content representation, (2) content knowledge building, (3) demonstration of learning, and (4) assessment.

Science content representation. A challenge noted by the teacher participant was the lack of a digital repository or Learning Management System (LMS) for educators and students within her school district. According to Ms. H, "we don't have a sharing platform, that's a huge thing." In previous science units, Ms. H struggled with how to best share digital content with her students and fell into the comfortable routine of creating a unit package that she would print and

provide to students. Ms. H explained, “Like usually, how I’ve done it in the past is they get a hand-out that says the requirements or expectations of the project but that’s it.” Conversations with Ms. H before and after school revealed she did strive to incorporate multimedia into her units so often would supplement the science unit package material with videos that she would play via the SmartBoard at the front of her classroom. The problem identified to be worked on was a lack of a digital tool to share content with students

The action planned to address this lack of a digital tool to share content with students was the development of a class website for the Science Wetlands Unit. I recommended the website creation tool Weebly due to its easy drag and drop website editor with a wide variety of design templates and powerful multimedia features that allow the addition of pictures, videos, audio players, documents, maps, and photo galleries.

Science content knowledge building. A challenge identified by both the teacher and student participants was the design of how students were supported in building their science content knowledge. Ms. H shared, “Normally, [I use] very, very traditional methods [in science class] like direct teaching, notes, and things like that. [I also use] pictures and stuff, like I would show pictures on the SmartBoard.” Typically, the teacher controlled access to and the pace of the content. Students all did the same thing at the same time. According to one student, Michael, “She showed videos. I think she went to Discovery on her computer to the SmartBoard. She talk about [it]... teaching us by talking about it.” Paul mentioned “She [our teacher] used, sometimes created a presentation and she just like read it to us and she...ask questions while reading.” Although the teacher incorporated multimedia into her science lessons, she struggled to engage students in the content. Ms. H noted “While I was blah-blahing...I could visibly see they are not paying attention to me, you know, and sometimes I would be like ‘Oh god, let’s just please get through this lesson.’” The problem identified to be worked on was the lack of student choice and appropriate control of their science content knowledge building.

The actions planned to address this lack of student choice were: (1) shifting to a more student-directed knowledge building approach where teacher-curated video and print resources, housed on the class's Science Weebly, are explored independently by students and (2) shifting from students copying teacher-created notes and completing short-answer comprehension questions to students creating graphic organizer jot notes while reading and viewing the curated science content. Three specific graphic organizers were chosen to provide students scaffolding with their science knowledge building: wetlands RAN, wetlands web, and wetlands plants and animals Venn diagram. Ms. H stated, "I have used them before, but sorta just 'oh, this is a best teaching practice, graphic organizers', but never for a meaningful reason like this; organizing the key information that they are going to use to showcase their knowledge."

Demonstration of science learning. A challenge noted by the student participants was the lack of choice in demonstrating their learning. During a focus group conversation, students brainstormed many ways they could show what they know about wetlands and wondered if they should pick just one to recommend to their teacher. One student expressed frustration with the idea of their being one perfect assignment and application to suggest. The rest of the students agreed I should bring forward all their ideas. It is important to note that typically students would individually complete the same culminating project using the same application. John mentioned "We go to Wikipedia and search [the topic] and put it in Keynote or Pages." Ms. H acknowledged "I used the same apps all the time. Like I didn't sorta venture out...It was mainly used for the apps Keynote and Pages." The problem identified to be worked on was the lack of multiple means of expression and student choice.

The actions planned to provide multiple means of expression and student choice were: (1) shifting from one culminating project with everyone using the same application to culminating project options, often requiring app-smashing, with suggested applications and (2) shifting from individual project work to small-group collaborative projects. During a focus group discussion,

student participants suggested three different learning activities that would allow them to show what they know about wetlands and the teacher agreed to all three options: educational poster, educational video, and a wetlands model. The students also suggested multiple applications and low-tech options for completing each learning activity. Although the teacher hesitated at first, she agreed. Ms. H later stated "I'm gonna put that on the record right now, when you said the Minecraft, my mind was like 'ok, that's going to be a royal pain' and I really, really second guessed that. But I'm so grateful that they came up with that because they really, really used it…[as] a learning tool." Students were also provided the option to work with a partner or in a small group of three and were allowed to choose their own groupmates.

Science assessment. A challenge noted by the teacher was the impact of multiple means of expression on assessment. Specifically, Ms. H worried about the time it would take to create criteria for the three different assignments and then mark them all. She expressed concern about the students knowing what to do without a checklist for each assignment. Ms. H also worried if all three of the assignments would allow her to accurately assess her students' knowledge about wetland ecosystems. The action planned was to co-construct rubrics with the student participants. There was a shift from a teacher-created project checklist to teacher and student created rubrics. See Table 4.2 for a summary of the changes designed and implemented.

Table 4.2 - Summary of Changes Designed and Implemented

	Technology (1:1 iPads)		Teaching & Learning (Science)
May 22 – June 7	**iPad Accessibility Features** From students and their teacher not being aware of the free built-in accessibility features of the iPad to students having the choice to access and personalize their use of these features.	**May 22 – June 12**	**Science Wetlands Unit- Content Representation** From teacher-created work booklet to teacher-(and student-) curated digital resources housed on website (Weebly).
May 24 – May 30	**iPad Maintenance** 1. iOS update (to access most recent accessibility features that had been released in October) 2. app updates	**May 23 – June 14**	**Science Wetlands Unit- Knowledge Building** 1. From teacher control over the order and pace of the content to independent student exploration of curated resources. 2. From short-answer comprehension questions after reading and viewing to graphic organizer jot notes while reading and viewing.
May 24 – June 27	**iPad Management** From top down to shared management model regarding the school protocol for purchasing, deploying, and maintaining apps.	**May 29 - June 27**	**Science Wetlands Unit- Action & Expression** 1. From 1 culminating project (1 app, usually keynote, if iPads used) to culminating project options requiring app-smashing 2. From individual project to small-group collaborative projects.
May 24 – June 10	**Apps** From only apps selected by former principal available on iPads to student recommended apps for the Science Wetlands Unit culminating project options.	**May 31 - June 1 4** **June 5 – June 27**	**Science Wetlands Unit- Assessment** - From summative assessment of short-answer comprehension questions to formative self-assessment via RAN - From teacher-created project checklist to teacher and student created rubrics.

Action evaluation. The teaching and learning PAR cycles successfully addressed challenges to leveraging one-to-one access to iPads in science class and supported the teacher in moving her practice to be more student-centred versus teacher-directed.

Weebly As an Online Digital Repository. Overall, the Weebly as an online digital repository was well accepted by the teacher and the students. The teacher appreciated finally having an online digital repository. Ms. H said,

> I was so impressed by [Weebly]. I was like 'Oh, there is a way, rather than using Google Docs or paper, there is a way to get the information to the students', because that really shocked me …We were being pushed [by administration] to do everything digital, but there was that discrepancy.

She also noted that Weebly was "very user friendly...just drag and drop." Students also appreciated the Weebly. All ten students viewed the Weebly as an improvement over their science work booklets. For example, Susan mentioned, "It was really cool because there was a website just for our class and it had lots of great information and videos you could watch." Two students mentioned it was better than paper while five other students specifically mentioned multimedia. Three students mentioned the Weebly was easier. One of them mentioned this was because they could use the text-to-speech support to read. The teacher's commitment to expand her use of Weebly attests to its success in meeting her online digital repository needs. Ms. H shared "I am definitely using this next year. I've already chosen a unit to start with."

Two unexpected results of using Weebly as an online digital repository were: (1) 24-7 access to the science content for students and (2) student input into the curated resources. Ms. H mentioned "one of the challenges with the iPad...is that they can't take it home. With the Weebly, I know they can access that at home as well. They don't need their iPads." Student participants interacted with the Wetlands Science Weebly, and the content it contains, after school hours. Some shared it with family members. For example, Susan who said "At home...I

sometimes go on it. I showed my mom, like the field trip photos because she volunteered at the wetlands and she took some photos." Some shared it with friends in other classrooms. For example. Alicia said "I went to my friend's house and asked her if we could go on the Weebly. She said ok and we just watched one video."

During one of the student focus groups it was mentioned they wanted more information on a specific topic. For example, Alex noted "There's not like a lot of information about the animals that live in the wetlands and plants. Maybe we need more links." I took 15 minutes to do a quick Google search and then add a couple of new hyperlinks to the Weebly. It is so easy for the online digital repository to evolve. Throughout the unit, the curated resources grew based on student feedback. Students were thinking about the learning activity they wanted to do and making sure they were building knowledge deep enough to complete it successfully.

Knowledge building. The classroom teacher required some coaching in order to feel confident in moving away from teacher-directed lessons. With support, Ms. H successfully shifted towards a more student-centred approach and perceived this shift has having a positive impact on her students'' engagement. Ms. H acknowledged,

> At first it was uncomfortable because I, in my head...the control thing, 'Can I be sure they are actually on task?' but the more and more that I watched like a fly on the wall I was like 'Oh, they are all doing it. They're all looking through it, they're all listening intently.'

This shift also impacted the teacher's beliefs about the capabilities of her students. Ms. H realized,

> They were actually doing the jot notes at the same time and getting the appropriate information and it wasn't me stopping the video 'ok, write that down'. You know what I mean?... they don't need me to stop the video and say write that down.

She went on to remark that "I would have to say [what surprised me] the most would be how well they interacted with the information. Like, I really underestimated them." She noted "I

felt really proud of them [during the wetlands unit] that they took much more ownership and responsibility for their learning." The teacher also perceived a positive impact on student learning. Ms. H mentioned "I thought about this the entire unit, and I could see this happening, they know this information more, I guess the word is rigorously." "I am so confident that they would know this unit better than any other unit I taught this year."

Students appreciated and respected having more control over their learning. According to Justin, "Chemistry was one of the boringest units, wetlands was one of the funnest." Paul mentioned,

> Every time you watched a video and read some fact, like a fact of something, it gives you information about stuffs so when it comes to the final project you will be like, kinda a bit prepared because like [you have] some information about it.

Initially Ms. H was most comfortable with teacher-directed lessons where she imparted knowledge to her students. Through coaching focused on scaffolds that support student knowledge building, Ms. H shifted towards a more student-centred approach that had students become more active in their learning.

Expression. Providing options for students to demonstrate their learning was another difficult shift in thinking for the teacher. Ms. H's major concern about students working on different things was classroom management, such as students' going off-task on their devices when they were supposed to be working on their projects. This turned out to be an unfounded concern. Ms. H shared, "You know, it was difficult to, like cross my fingers that they would be doing what they are supposed to be doing, and they all did!" Perhaps student choice impacted on-task behaviour through students' level of commitment to their projects. Paul mentioned,

> I think [my classmates] felt happy because they can have their choices, what they would like to do, and they have the right to choose whatever, like what activity they want to do instead of forcing them to do like this project you are not even good at.

When launched, the learning activity options on the Weebly also impacted on-task behaviour during their Wetlands knowledge building. Ms. H noticed, “They knew, and there was a clear expectation that by the end of this unit you will need the information to do X, Y, or Z, you know, and I felt that kinda gave them that drive.” Collaborative work and commitment to group mates may have also contributed to the level of on-task behaviour. Zander felt “it’s a lot funner to do it that way [collaboratively] than just like doing a little project. That we got to do a pretty big project.”

Assessment. The teacher was pleasantly surprised by the quality of the student participants’ input into the rubrics. Shifting from a checklist to a rubric helped make the key elements a quality project more explicit to students and clarified teacher expectations, while still allowing flexibility in how students approached their projects.

Process Findings (Designing a Change: Science Wetlands Unit)

Process findings refer to what was learned by engaging students in an authentic exploration of their science learning with iPads and informing the design of the wetlands unit. The process of engaging students in an authentic exploration of their science learning with iPads; identifying the gap between merely having one-to-one access to a mobile device and leveraging the mobile device in an educational setting, then constructing what the issues were, was a rich experience that contributed to the findings of this research study. Five focus groups were held with the student participants. These focus groups were approximately 45 minutes long and usually occurred one week apart. The focus groups were used to explore predetermined topics. Three dominant themes emerged during the focus groups: challenges, customization, and choice.

Challenges.

Two main barriers to effectively and efficiently using iPads for learning were identified by the student participants, and therefore were main contributors to student iPad challenges: (1)

the school WIFI infrastructure and (2) the iPad management model, which impeded regular iPad maintenance.

Infrastructure. Frustration was created through the iPad implementation process. Bandwidth issues negatively impacted the students' ability to use the iPad to enhance their learning. Students expressed frustration when their ability to find information on the Internet and view educational videos were impeded. For example, Alex shared "I don't like it when your WIFI turns off and then you are searching up something you really need and then it just turns you off the WIFI and you can't get it." Shawn mentioned "I don't like when, um, like you are playing a video but when starting it off you have to wait till it gets to the grey line."

iPad Maintenance. Application instability, perhaps exacerbated by running older versions instead of downloading updates as they are released, also negatively impacted the students' ability to use the iPad to enhance their learning. "[It is frustrating] when your iPad glitches out and forces you out of the apps." One student implored, "update the apps cuz most of them keep crashing."

Customization.

Although students were assigned a specific iPad for the school year and their class had its own charging cart, the iPads seemed generic. Specifically, they lack customization in two ways: (1) the iPads had all the same applications as the other middle-school classrooms and (2) none of the built-in accessibility features had been turn on and personalized to best meet each students' needs.

Applications. Student participants expressed concern there were applications on their iPads that they had not used all school year, "...they are just there for no reason some of them", and wondered if their iPads would work better if unused applications were not taking up memory on their device. One student went so far as to request the teacher "remove apps not being used." Student participants also expressed interest in being allowed to add applications they

use outside of school on their own iOS devices to their school-owned device. “[An iPad wish,] if we could download our own apps.”

Accessibility Features. Although students had a class set of iPads for almost two years, none of the built-in accessibility features were being accessed. None of the student participants were even aware of these features and that they could be personalized to meet their learning needs. However, once I showed them a few of the key embedded supports, such as text-to-speech and word prediction, students were excited to have the opportunity to set up these supports to best meet their needs and use them when knowledge building and demonstrating their learning.

Choice.

Student desire for multiple ways to demonstrate what they have learned was highlighted during the focus group sessions. Specifically, they expressed a desire for choice in two key areas: (1) learning activities and (2) iPad applications.

Learning activities. During focus group discussions on how they could show what they know about wetlands, student participants identified multiple means of expression including a poster, slide show presentation, book, video, mini-movie, and explainer-type video. Instead of choosing one means of expression to suggest to their teacher as the wetlands unit’s culminating activity, they decided to request the class could choose from three means of expression: a movie, a poster, or a model. The opportunity to collaborate rather than work independently was also suggested.

iPad Applications. In addition to activity choice, student participants also recommended tool choice and brainstormed several potential applications—some already on their iPads and some they have used outside of school on their own iOS devices—for their teacher to consider. Their suggestions included iMovie, Explain Everything, Animoto, SimpleMind+, Teleprompter, Pages, Keynote, Scribblenauts, and Minecraft.

Impact Findings (Implementing the Change: Science Wetlands Unit)

Impact findings refer to what was learned by implementing the change that had been co-designed, that is, the impact of the Science Wetlands Unit on the students and their teacher. Seven dominant themes emerged from the classroom observations and individual interviews with the student participants and their teacher: increased collaboration, improved student engagement, student empowerment, teacher empowerment, technology-enhanced learning environment, shifts in teacher perceptions of learners, and shifts in students' perceptions.

Increased collaboration.

When given the choice to work independently or collaboratively during the wetlands unit, only one student chose to work independently. The physical design of the classroom, which was always conducive to collaborative work, was leveraged during the wetlands unit. Students used the desk pods and other collaborative spaces in the room to meet and work with their groupmates. For example, one pair of students choose to create a public service announcement about wetlands. They used one of their iPads as a teleprompter and the other as a video camera and film editor. Zander explained,

> Um, like I would write the script on my iPad and he would have the movie on there but then we would take turns filming each other and then when we were in the same scene as each other we would put the iPad down and record it.

Most of this collaborative work was completed face-to-face, as school-owned devices were not allowed to leave the school. Due to this constraint, there was no teacher expectation to use technology to collaborate in digital spaces outside of school hours. Students worked out their own ways to share the work equitably. For example, one pair of students chose to design a wetlands model using the Scribblenauts application. They ensured all elements of their model were researched-based and were observed devising a plan so both did the research as well as

the actual design of the model. Later in an interview one of these students, John, explained “We switched, like the search for informations and I did on the Scribblenauts and then we switch.”

Classroom observations, using the Technology Integration Matrix - Student (see Table 4.3), also revealed increased collaboration over time. Observations before the Wetlands Science Unit revealed students primarily worked alone when using their iPads. Often, they were all doing the same assignment. However, there was very little discussion about the learning among students or co-construction of knowledge and the learning tasks were very teacher-directed. The goal-directed criteria for the Student shifted from not quite entry level to adoption. During the Wetlands Science Unit students were observed planning and evaluating their culminating learning activity. The collaborative and constructive criterion shifted from entry level to adoption and adaptation. During the Wetlands Science Unit students were observed working together and using technology independently to build their science knowledge. The active and authentic criterion shifted from adoption level to adaptation. The locus of control shifted from the teacher to the students and students were observed using technology to enhance their collaboration.

Technology Integration Matrix (TIM) Key (Florida Center for Instructional Technology, n.d.):

Entry	Adoption	Adaptation	Infusion	Transformation

These five levels of technology integration: entry, adoption, adaptation, infusuion, and transformation were used to assess the five interdependent characteristics of the learning environment.

Table 4.3 - Technology Integration Matrix- Student

Student	May 2013	June 2013
Active	Students are using technology in conventional ways and the locus of control is on the Teacher. (Adoption)	Students work independently with technology tools in conventional ways. Students are developing a conceptual understanding of technology tools and begin to engage with these tools. (Adaptation)
Collaborative	Students primarily work alone when using technology. Students may collaborate without using technology tools. (Entry)	Students have opportunities to use collaborative tools, such as email, in conventional ways. These opportunities for collaboration with others through technology or in using technology are limited, and are not a regular part of their learning. (Adoption) Students have a beginning level of conceptual knowledge of using technology tools for working with others. (Adaptation)
Constructive	Students receive information from the teacher via technology. (Entry)	Students begin to utilize technology tools (such as graphic organizers) to build on prior knowledge and construct meaning. (Adoption) Students begin to use technology tools independently to facilitate construction of meaning. With their growing conceptual understanding of the technology tools, students can explore the use of these tools as they are building knowledge. (Adaptation)
Authentic	Students have opportunities to apply technology tools to some content-specific activities that are related to the students or issues beyond the instructional setting. (Adoption)	Students begin to use technology tools on their own in activities that have meaning beyond the instructional setting. (Adaptation)
Goal-Directed	None	Students follow procedural instructions to use technology to either plan, monitor, or evaluate an activity. For example, students may begin a K-W-L chart using concept mapping application. (Adoption)

As seen by the Technology Integration Matrix - Setting (see Table 4.4.), the technology-rich classroom always had the potential to facilitate student collaboration. The design of the wetlands unit supported a shift so the technology available in the classroom was better leveraged to enable collaboration. The authentic criteria for the setting shifted from entry level to infusion. The constructive and goal-directed criterion shifted from adaptation level to infusion. The active criteria shifted from adaptation level to partial transformation. The collaborative criteria remained at the infusion level.

Table 4.4: Technology Integration Matrix- Setting

Setting	**May 2013**	**June 2013**
Active	Technology tools are available on a regular basis. (Adaptation)	The arrangement of the setting is flexible and varied, allowing different kinds of self-directed learning activities supported by various technologies, including access to online resources. (Transformation) However, this access is not robust enough for all students to view online videos simultaneously.
Collaborative	Technology tools that allow for collaboration are permanently located in the setting and are available in sufficient quantities to meet the needs of all students. (Infusion)	Technology tools that allow for collaboration are permanently located in the setting and are available in sufficient quantities to meet the needs of all students. (Infusion)
Constructive	Technology tools that facilitate the construction of meaning are available to students for conventional uses. (Adaptation)	The setting includes a variety of technology tools and access to rich online resources that are available in sufficient quantities to meet the needs of all students. (Infusion)
Authentic	Resources available via technology in the instructional setting include primarily textbook supplementary material and reference books or websites, such as encyclopedias. (Entry)	The setting provides a variety of technology tools and access to rich online resources, including information outside of the school and primary source materials, that are available in sufficient quantities to meet the needs of all students. (Infusion)

Setting	May 2013	June 2013
Goal-Directed	The setting includes access to technology tools (such as graphic organizers, calendars, spreadsheet software, and timeline software) for planning, monitoring progress, and evaluating outcomes. (Adaptation)	The setting includes access to a variety of technology tools for planning in sufficient quantities to meet the needs of all students. (Infusion)

Improved student engagement

It was observed during this study that students attended school regularly, arrived on time, usually were on task during class time, and completed assignments. Classroom observations were analyzed and coded. My classroom observations, as the researcher, before the Science Wetlands Unit indicated that while students were sometimes observed to be ritualistically compliant, most often they were academically engaged. Students who were ritualistically compliant arrived on time and were not disruptive in class but were not always on task. Students who were academically engaged were productive during class time and completed assignments. However, during the wetlands unit students were also observed in flow, that is, deeply absorbed in their science learning. When there was downtime during the school day students often chose to work on their wetlands project. Shawn mentioned “We just work on our project on our free time.” Ms. H noticed,

> In order to create the model in Minecraft, they had to learn the material. It almost drove them to learn more about wetland ecosystems because they got to create the model and they were going back and referring to their jot notes all the time.

A few students were even observed requesting to stay in at recess to continue working on their wetlands projects. They had moved from academic engagement to intellectual engagement. Ms. H shared “I just feel like they learned it at a higher level; rigorous, engaged, excited, independent, um, much more inquisitive: ‘I want to learn more about this rather than I have to learn about this’.”

Student empowerment.

Overall, the design of the wetlands unit created enabling conditions for student choice and self-directed, purposeful use of tools. Zander expressed “[I like] that we getta, um, go freely on the website you created and, like, look up, um, ah like the Internet and that we got to watch some videos.” Ms. H acknowledged “I felt really proud of them [during the wetlands unit] that they took much more ownership and responsibility for their learning.”

Classroom observations, using the Technology Integration Matrix - Summary (see Table 4.5), also revealed increased student empowerment. This was primarily evident in increased student choice about tools and their use as well as choice regarding learning activities. The collaborative, constructive, and goal-directed criteria shifted from entry level to adaptation. The authentic criteria shifted from adoption to adaptation and the active criteria shifted from adaptation to infusion.

This choice and self-directed, purposeful use of tools made the knowledge building meaningful for students. Paul mentioned,

> Every time you watched a video and read some of fact, like a fact of something, it gives you information about stuffs so when it comes to the final project you will be like, kinda a bit prepared because like [you have] some information about it.

Students also explored the accessibility features and personalized their use of them to best meet their needs. Shawn noted “Now we can just do the Speak Select and like listen or have it highlight the words for us or like do the Speak Select and then like hear how it’s pronounced when we don’t understand a word.” Through the design of the wetlands unit opportunities for student choice and self-directed, purposeful use of tools were created. This contributed to student empowerment.

Table 4.5 : Technology Integration Matrix- Summary

Summary	May 2013	June 2013
Active	Conventional independent use of tools; some student choice and exploration (Adaption)	Choice of tools and regular, self-directed use (Infusion)
Collaborative	Individual student use of tools (Entry)	Collaborative use of tools; some student choice and exploration (Adaption)
Constructive	Information delivered to students (Entry)	Independent use for building knowledge; some student choice and exploration (Adaption)
Authentic	Guided use in activities with some meaningful context (Adoption)	Independent use in activities connected to students' lives; some student choice and exploration (Adaption)
Goal-Directed	Directions given, step-by-step task monitoring (Entry)	Purposeful use of tools to plan and monitor; some student choice and exploration (Adaption)

Teacher empowerment.

Two separate, yet related, supports contributed to teacher empowerment. Through the process of clarifying technology challenges, I was well positioned to advocate on behalf of the teacher and support a shift from school leadership control over the iPads towards teacher autonomy. Spending time in the school on a regular basis also provided the opportunity for me to provide just-in-time coaching. Although the teacher was grateful for her technology-rich classroom, she lacked self-efficacy. Self-efficacy is the belief in one's capabilities to carry out the necessary actions required to succeed in prospective situations (Bandura, 1977). When reflecting on receiving a class set of iPads Ms. H shared,

> The whole thing was daunting, because I only taught for a year and a half before that, I'm going to obviously use what I know or grew up knowing. And then when we were asked to use the iPads...It was scary.

The combination of autonomy and job-embedded capacity building provided through this PAR study was integral to the teacher feeling empowered. During her individual interview at the end of this study, Ms. H mentioned "I am less, ah, nervous. [I understand] that it doesn't have to be perfect, but you have to be reflective about it. Um, I would say I am more confident." Autonomy over iPad management in combination with coaching contributed to teacher empowerment.

Technology-enhanced learning environment.

There was a shift from merely being a technology-rich classroom to a technology-enhanced learning environment. Listening to student participant perspectives and being open to my coaching helped the teacher create a technology-enhanced learning environment primarily through improving her pedagogical practices. A focus on learning design rather than tools enabled the teacher to design learning activities that are pedagogically informed and make effective use of appropriate resources and technologies. Before this research, the teacher used technology to support a traditional, teacher-centred approach. For example, Susan shared "We just, Ms. M put a few videos on the board, the Smart Board, and then she would give us pieces of paper and we would have to answer them". During the wetlands unit, the teacher shifted from being the only one selecting and actively using technology to being open to student ideas and guiding student choices of tools. Instead of using technology to deliver information to students, she gave them access to tools and guided them to wetlands resources. She also provided the opportunity for students to work collaboratively and encouraged them to explore other capabilities of the tools. Through these curated digital resources and her support of students personalizing their interaction with these digital resources via the iPad's accessibility features, the teacher provided multiple means of representation. Instead of every student doing the same assignment in the same way, the teacher provided multiple means for action and expression. In particular, she implemented the following UDL guidelines: 4.1 Vary the methods for response

and navigation, 5.2 Use multiple tools for construction and composition, and 6.3 Facilitate managing information and resources.

Classroom observations, using the Technology Integration Matrix - Teacher (see Table 4.6), also revealed shifts in teacher practice that contribute to technology-enhanced learning environments. The design of the wetlands unit supported a shift, so the technology integration was more active, collaborative, constructive, authentic, and goal-directed. The collaborative and goal-directed criteria shifted from entry level to adaptation. The constructive and authentic criteria shifted from entry / adoption levels to adaptation. The active criterion shifted from entry / adaptation levels to infusion.

Table 4.6 - Technology Integration Matrix- Teacher

Teacher	**May 2013**	**June 2013**
Active	The teacher may be the only one actively using technology. This may include using presentation software to support delivery of a lecture. (Entry) The teacher controls the type of technology and how it is used. The teacher may be pacing the students through a project, making sure that they each complete each step in the same sequence with the same tool. Although the students are more active than students at the Entry level in their use of technology, the teacher still strongly regulates activities. (Adoption)	The teacher guides, informs, and contextualizes student choices of technology tools and is flexible and open to student ideas. Lessons are structured so that student use of technology is self-directed. (Infusion)
Collaborative	The teacher directs students to work alone on tasks involving technology. (Entry)	The teacher provides opportunities for students to use technology to work with others. The teacher selects and provides technology tools for students to use in collaborative ways, and encourages students to begin exploring the use of these tools. (Adaptation)

Teacher	May 2013	June 2013
Constructive	The teacher uses technology to deliver information to students. (Entry) The teacher provides some opportunities for students to use technology in conventional ways to build knowledge and experience. The students are constructing meaning about the relationships between prior knowledge and new learning, but the teacher is making the choices regarding technology use. (Adoption)	The teacher has designed a lesson in which students' use of technology tools is integral to building an understanding of a concept. The teacher gives the students access to technology tools and guides them to appropriate resources. (Adaptation)
Authentic	The teacher assigns work based on a predetermined curriculum unrelated to the students or issues beyond the instructional setting. (Entry) The teacher directs students in the conventional use of technology tools for learning activities that are sometimes related to the students or issues beyond the instructional setting. (Adoption)	The teacher creates instruction that purposefully integrates technology tools and provides access to information on community and world problems. The teacher directs the choice of technology tools, but students use the tools on their own, and may begin to explore other capabilities of the tools. (Adaptation)
Goal-Directed	The teacher uses technology to give students directions and monitors step-by-step completion of tasks. The teacher monitors the students' progress and sets goals for each student. (Entry)	The teacher selects the technology tools and clearly integrates them into the lesson. The teacher facilitates students' independent use of the technology tools to set goals, plan, monitor progress, and evaluate outcomes. The teacher may provide guidance in breaking down tasks. (Adaptation)

Technology Integration Matrix (TIM) Key (Florida Center for Instructional Technology, n.d.):

Entry	Adoption	Adaptation	Infusion	Transformation

Shifts in Teacher Perceptions of Learners.

During the Wetlands Science Unit two shifts occurred: (1) the teacher saw her students as more responsible learners and (2) the teacher saw students with learning difficulties as more capable of learning science.

Responsible. Through providing students choice and autonomy with appropriate supports, the teacher saw her students as taking more responsibility and then being more responsible. Ms. H mentioned, “I would have to say [what surprised me] the most would be how well they interacted with the information. Like, I really underestimated them.” More importantly, she saw students who typically struggled with science in a different light. Zander shared his thoughts on how Ms. H saw them a more responsible during group work. “I think she’s happy too because we used it [Minecraft] responsibly and we weren’t fooling around on it. We weren’t constantly playing on it. We were doing our work like we were supposed to.” Alicia, when reflecting on the Minecraft and Scribblenauts apps, shared that her classmates “actually do their work and finish what they have to do on it.” However, one student, Justin, felt his teacher may have noticed not all students were being responsible. He mentioned “they were just playing on it, adding stuff to their wetlands model when it didn’t need adding.”

Capable. One student, who often did the minimum to complete his science work, revealed a passion for science that the teacher did not know existed. Ms. H mentioned, “And his passion for it, that amazed me too. Like, that individual has never been so proud of his work and wanting to show me every little aspect.” The teacher also saw a number of students as more capable when they were not constrained to demonstrating their science learning primarily through writing and without assistive technology supports. Ms. H confessed, “I’m going to say, also on the record, that there were certain students where now I’m second guessing myself because they went from being perhaps a borderline proficient/ basic student to shocking me. Like absolutely, like WOW!”

Shifts in students' perceptions.

Two key shifts occurred: (1) how students perceived themselves as readers and (2) how students perceived themselves as writers and the activity of writing.

Readers. Students with decoding and fluency difficulties felt they were better readers when using the iPad. They appreciated the text-to-speech and zoom supports. For example, Paul who said "Oh, the Speaker one, and then that really helped a lot [when reading on the iPad]. Yeah, I would just listen to it and then just understand it." and Zander who said,

> Um, I can't read verbally that well out, um in a book or something. I have to like put my face up to it to see it 'cuz I can't read the words properly and on the iPad, I can just zoom in and I can just read the words easily.

Writers. Students with letter formation and spacing difficulties or difficulties with expressing themselves through writing felt they were better writers when using the iPad. Typing helped relieve the stress of struggling to print legibly. For example, Susan mentioned, "You can type, not just write. You can just press a button and it writes it, you don't have to trace and stuff." Some students found the text-to-speech accessibility feature an important writing support because it helped them independently edit their work. For example, Paul said,

> Sometimes when doing my project, I would just use it [text-to-speech] to check my work 'cuz you would listen to someone reading it [what you had wrote] and then it would help check your work because if you have punctuation wrong or stuff like you misspelled this and they would like read it and then you would know.

This independence helped them feel more confident in their ability to demonstrate what they know through writing. One student also shared about using the supports available on her iPad to write for an authentic purpose. Susan mentioned "For the movie you get to write a script and make an informational video for you to act in and stuff with sound effects and that's fun."

Summary

This chapter reported the PAR cycles as well as the findings. Two main types of cycles occurred: 1) technology and 2) teaching and learning. Multiple action research cycles were operating concurrently. The findings were clustered into process findings and impact findings. Process findings refer to what was learned by engaging students in an authentic exploration of their science learning with iPads and informing the design of the wetlands unit.

Three dominant themes emerged from the student focus groups: challenges, customization, and choice. Impact Findings refer to what was learned through implementation of the change that was co-designed; the Science Wetlands unit. Seven dominant themes emerged from the classroom observations and individual interviews: increased collaboration, improved student engagement, student empowerment, teacher empowerment, technology-enhanced learning environment, shifts in teacher perceptions of learners, and shifts in students' perceptions. The data collected from participants' interviews, focus groups, and observations provided insight into their perceptions about their experience of the iPad as a learning tool and showed a shift from a technology-rich classroom to a technology-enhanced learning environment.

In Chapter Five, I will answer the research questions and discuss the findings in relation to the existing literature.

CHAPTER FIVE: DISCUSSION

In this chapter, I address the research questions by drawing on key themes while presenting the overall findings for the study. The study was designed to explore the research question: In what ways does the design of technology-enabled, inclusive learning environments impact teacher and student learning and agency in middle school?

Discussion of Findings

This study revealed that a technology-rich classroom does not equal a technology-enhanced learning environment. Unintentional systemic barriers may mute the potential of one-to-one access. To truly leverage mobile devices for learning, multiple levels of the digital learning ecosystem--classroom, school and school authority--must be considered including the primary users' perspective. It is important to uncover and consider the ideas students have about how one-to-one access to iPads can be leveraged to support and enhance their learning.

There were ten key findings; three process findings, and seven impact findings. The process findings emerged through engaging students in an authentic exploration of their science learning with iPads. This exploration focused on identifying the gap between merely having one-to-one access to a mobile device and leveraging the mobile device in an educational setting, then constructing what the issues were. The impact findings emerged through the implementation of a science unit that was collaboratively designed considering students suggestions. The ten key themes of the two categories of findings were:

1. Designing to Leverage Student Use of iPads
    a. challenges
    b. customization
    c. choice
2. Impact of Moving from Technology-Rich to Technology-Enhanced Learning Environments

a. increased collaboration

b. improved student engagement

c. student empowerment

d. teacher empowerment

e. technology-enhanced learning environment

f. shifts in teacher perceptions of learners

g. shifts in students' perceptions.

Each of these will be discussed in the following sections**.**

Leveraging student use of iPads.

To leverage student use of iPads, analysis of the data from this study found three main areas of consideration related to the design of the digital learning ecosystem- challenges, customization, and choice.

Challenges. The educational leaders in control of the digital learning ecosystems design, which includes infrastructure as well as policies and procedures, unintentionally designed it in ways that created significant barriers to effective teacher use of mobile devices as pedagogical tools and students use of mobile devices as learning tools. Without a feedback loop, these educational leaders remained unaware of structural and contextual factors impeding effective mobile device use for teaching and learning. In particular, student participants expressed considerable frustration with the school's WIFI and application instability. This finding aligns with previous research on mobile devices as pedagogical tools. For example, Minshew and Anderson (2015) identified connectivity as a barrier stating "constant inaccessibility appeared to lead to frustration of both Isabell and her students" (p. 344). Daniels, Jacobsen, Varnhagen, and Friesen's (2013) study on laptops revealed

> …a frustrating disconnect between increased access to technology and networks in secondary classrooms and the actual ability of classroom teachers and students to benefit from and take advantage of this access...Content and Internet site filters, network

> firewalls and choked Internet speeds prevent students and teachers from accessing high-quality online resources during class time. Further, filters and firewalls disrupt and often disable attempts to foster online collaboration. (p. 8).

As occurred in previous iterations of mobile initiatives, such as laptops, there was a disconnect between the education leaders responsible for designing the digital learning ecosystem, including their view on what is required for teaching and learning in 21st century classrooms, and the needs of the teacher and her students. Although addressing the school's WIFI infrastructure and set up was out of the scope of this study, reducing difficulties caused by application instability due to uninstalled free application updates was negotiated with school-based leadership by the researcher. Acknowledging and addressing this challenge improved students' experiences using the iPad as a learning tool. It also improved the teacher's experiences with iPads in her classroom. This increased her confidence in the reliability of the iPads which, in turn, increased her willingness to integrate the iPad into her lessons.

Customization. The educational leaders in control of the digital learning ecosystems design, including app procedures as well as the acceptable use agreement, unintentionally designed it in ways that did not encourage teacher-selected apps or student personalization of the accessibility features. Until I advocated for a change in the app procedures at the school, the classroom teacher did not have access to the account to download and install apps. Also, she did not have a budget for purchasing apps and there was no official process to request app approval. These barriers discouraged the teacher from searching for new apps. It negatively impacted the teacher's sense of ownership over the class set of iPads, even though they had been assigned to her class for almost two years. These barriers may have contributed to her hesitation to remove apps from the class set of iPads that she had no intention of having the students use. This finding aligns with previous research on factors that affect teachers' use of iPads in their classrooms. Vu's (2015) qualitative research conducted with 21 K–12 teachers revealed not all the teachers could access the account to download apps, which "discouraged

teachers from searching from new apps and implementing them in their teaching" (p. 11). Although policies and procedures for acquiring apps existed within Cladwell Middle School, Minshew and Anderson (2015) found they "were another example of an external barrier that teachers had to overcome when using the technology in their classroom" (p. 346).

Customization in a timely manner through applications downloaded onto the iPad, as well as activating and personalizing appropriate accessibility features, impacted what students could do with their iPad to support their learning during the science unit their input helped design. It also changed the teacher's relationship with the class set of iPads. My disruption of the school's process for app selection and maintenance allowed the teacher to begin to envision future possibilities of what teaching and learning with a class set of iPads could look like.

Choice. Consideration of the first two areas, challenges and customization, through the researcher acting as a coach and advocate, helped create conditions where the science teacher could act on the students' request for choice. The teacher recruited interest in the wetlands unit by optimizing student choice and autonomy in two ways: learning activities and iPad applications. This optimization of student choice and autonomy was initiated by the student focus group meetings. The students who participated in these focus groups identified multiple ways they could show what they know about wetlands and requested each student in their class could choose for themselves rather than everyone in the class completing the same one. In addition to activity choice, student participants also recommended tool choice and suggested many potential applications for their teacher to consider. Ciampa (2014) asserts the success of technology-rich environments rests on the mobile user's ability to make his/her own choices.

The student participants were pleasantly surprised when their teacher used all their suggestions when finalizing the design of the wetlands unit. Although this was the first time students had such choices in science, they handled the responsibility of this very well. The teacher's initial concern that students would be off-task on their devices when they were supposed to be working on their projects, turned out to be an unfounded concern. In fact, some

students requested to stay in at recess to continue working on their projects. This finding is counter to previous research on iPads in the classroom, such as Karsenti-Fievez (2013) who found iPads as to be a source of distraction that contributed to off-task behaviour. One potential explanation for this conflicting result may be that learning task design, rather than the learning tool, is a major contributor to off-task behaviour of students.

Ecological view of agency.

Taken together, the three findings above suggest that it is not enough to consider the available resources and individual efforts when attempting to leverage iPads as a learning and teaching tool. The results from this study imply contextual and structural factors are key when moving from a technology-rich classroom to technology-enhanced learning environment. The ecological view of agency posits the achievement of agency results from the interplay of: (1) individual efforts, (2) available resources, and (3) contextual and structural factors.

Rather than seeing agency as residing in individuals as a property or capacity, the ecological view of agency sees it as an emergent phenomenon of the ecological conditions through which it is enacted:

> This concept of agency highlights that actors always act by means of their environment rather than simply in their environment [so that] the achievement of agency will always result from the interplay of individual efforts, available resources and contextual and structural factors as they come together...(Biesta & Tedder, 2007, p. 137)

Before this limited PAR study, the individual efforts of the teacher and the available resources in the classroom were muted by an invisible web of contextual and structural factors. Through PAR, a process to encourage and value student voice was created that deepened understanding of the impacts of the technology ecosystem on student learning and teaching.

TPACK Framework.

The TPACK Framework (see Figure 5.1) suggests that content, pedagogy, and technology, as well as teaching/learning contexts are integral to effective technology integration

in educational settings. The developers of TPACK assert it is heavily contextual and acknowledge that:

> [s]ocial and institutional contexts are often unsupportive of teachers' efforts to integrate technology use into their work. TPACK depends on a variety of factors including, but not limited to, the specific classroom culture, student characteristics, as well as school and district policy. (Koehler & Mishra 2009, pg. 61).

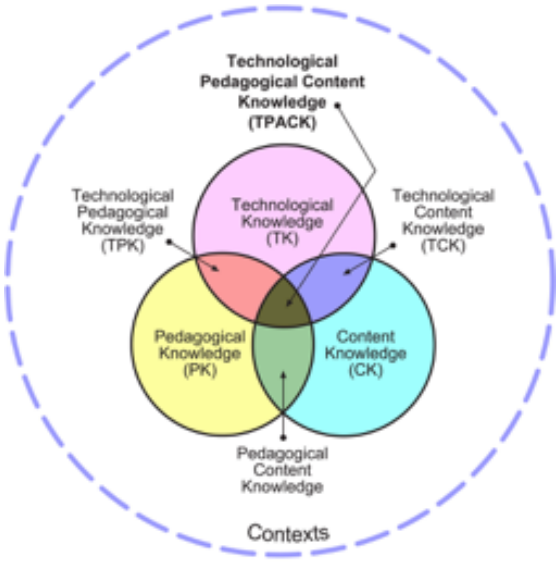


Figure 5.1: Technological Pedagogical and Content Knowledge. (Image used with permission from http://tpack.org/.)

However, a common tool used when operationalizing the TPACK Framework, the TPACK survey, does not include context questions as core items used to measure the components of TPACK. By design, this survey focuses conversations about technology integration on the classroom teacher. This myopic focus minimizes the fact that what teachers can do with the technology in their classrooms, and allow their students to do with technology, is shaped by the context in which they teach. The teacher in this study was constrained by the ecosystem her classroom was situated within. As Frye (1983) so eloquently explained,

> [people are often] confined and shaped by forces and barriers which are not accidental or occasional and hence avoidable, but are systematically related to each other in such a way as to catch one between and among them and restrict or penalize motion in any direction. (pg. 4)

Therefore, a teacher's TPACK must be interpreted in consideration of the context in which they teach. When this PAR study helped make visible some of the contextual and structural factors and influenced them, the teacher could move from merely a technology-rich classroom towards a technology-enhanced one through intentional design.

Bioecological Model.

According to Bronfenbrenner and Morris (2006), the bioecological model consists of four major properties: process, person, context, and time. The foundation of the model is process, that is, the interaction that occurs between an individual and their environment over time and, therefore, has significant influence on an individual's development. Person consists of the individual's characteristics as well as characteristics of people that compose the microsystem. Within the bioecological model, context is defined as the environment within which proximal processes unfold. Context includes features that facilitate or inhibit proximal processes. An integral aspect of this model is the bi-directionality of influence; people are viewed as active participants of their own development, capable of impacting their environment.

The context of the fifth-grade classroom in this study included features that inhibited proximal processes. Power structures embedded in the K–12 system, such as the permanent teaching license process, limited the bi-directionality of influence. When the teacher in this study first received the class set of iPads, she was new to the profession and still on a temporary contract with an interim professional teaching certificate.

Impact of Moving from Technology-Rich to Technology-Enhanced Learning.

Analysis of the data from this study found seven main areas of impact: increased collaboration, improved student engagement, student empowerment, teacher empowerment,

technology-enhanced learning environment, shifts in teacher's perceptions, and shifts in students' perceptions.

Increased collaboration. The design of the wetlands unit provided students the opportunity to work independently or collaboratively. All students except one chose to work with a partner or in a small group. Although students primarily worked independently during the previous science unit, in the wetlands unity the students collaborated effectively and shared the work equitably. This is similar to Ciampa's (2014) study where the students in cooperative-learning groups engaged in more positive, task-oriented interactions with each other. Karsenti and Fievez's (2013) study demonstrated greater collaboration among students as a benefit of iPads in K–12 classrooms. Interestingly, the students in Ciampa's (2014) case study identified opportunities to work with other students as an important motivational factor.

Improved Student Engagement. During the wetlands unit, students' engagement in their science learning moved from academic engagement to intellectual engagement. They were observed in *flow*, that is, deeply absorbed in their science learning. Similar to the Friesen, Jacobsen, and Brown's (2014) study, during this *flow* students were often working collaboratively using a variety of tools.

Other research demonstrates similar impacts. Ciampa's (2014) case study revealed that students, when given the opportunity to interact with information in a way that made sense to them, demonstrated a stronger desire to learn when using the tablet. Chou, Block and Jesness' (2012) case study indicated active engagement as one positive impact of the integration of iPads on student learning. Friesen, Jacobsen and Brown's (2014) case study revealed strong student emotional ties to technology-rich learning tasks as well as higher levels of intellectual investment by, and engagement of, students. Moving from a technology-rich classroom towards a technology-enhanced learning environment, as done through the wetlands unit, contributes to student engagement as an impact of iPads.

Student empowerment. The design of the wetlands unit supported a shift so that technology integration was more active, collaborative, constructive, authentic, and goal-directed. Students were given choice and the freedom to deepen their knowledge about wetlands. This student choice and self-directed, purposeful use of tools contributed to student empowerment. Students also explored the iPad's accessibility features and personalized their use of them to best meet their needs.

Similarly, Smith and Santori's (2015) descriptive study identified iPad-based teaching and learning fosters independence and agency among students. Strong levels of student ownership, advocacy, and perseverance were evident in Friesen, et al.'s (2014) case study of iPads in early elementary classrooms where student agency in the use of technology was promoted. This suggests the importance of moving beyond using technology to engage students to student empowerment in and through their learning.

Teacher Empowerment. A combination of autonomy with regards to iPad management and job-embedded capacity building was integral to the teacher feeling empowered. Addressing contextual and structural factors, as well as fostering an openness to student input, created enabling conditions for the teacher to leverage her class set of iPads. Friesen, Jacobsen and Brown's (2014) mixed methods case study revealed a research community of practice, through it's provision of opportunities for collaboration and sustained, quality professional learning, helped mitigate many of the barriers and challenges teachers encounter when using technology for teaching and learning. The middle-school teacher in Ciampa's (2014) case study felt empowered by being open to students' suggestions regarding apps. Chou, et al.'s (2012) case study revealed that regular professional development played an important role in boosting teacher confidence and providing innovative ideas for iPad integration. Teacher agency and coaching are required for teachers to move beyond using new technologies in old ways.

Technology-Enhanced Learning Environment. A focus on learning design rather than tools enabled the teacher to design learning activities that are pedagogically informed and make

effective use of appropriate resources and technologies. There was a shift from merely being a technology-rich classroom to a technology-enhanced learning environment. Once contextual and structural factors were addressed, listening to student participant perspectives and being open to my coaching helped the teacher create a technology-enhanced learning environment primarily through improving her pedagogical practices. Karsenti and Fievez's (2013) study found many teachers lacked the technological and pedagogical knowledge to leverage the iPads in their classroom, but those provided capacity-building opportunities and adequate implementation support faced fewer challenges. Teachers in the Friesen, Jacobsen and Brown's (2014) case study found teachers' design of learning activities and the effective integration of technology improved when provided ongoing mentorship on using an inquiry framework for task design.

Shifts in teacher's perceptions of learners. Two shifts occurred: (1) the teacher saw her students as more responsible learners and (2) the teacher saw students with learning difficulties as more capable of learning science. Friesen, et al.'s (2014) case study also found that students were responsible learners; self-focused, self-regulated, and highly engaged with the learning tasks. Also, when metacognitive aspects of students' work were intentionally incorporated in task design, technology-enabled tasks often made student learning more visible.

Shifts in students' perceptions. Two key shifts occurred: (1) how students perceived themselves as readers and (2) how students perceived themselves as writers and the activity of writing. Students felt they were better readers and writers when using the iPad. The students Karsenti and Fievez's (2013) study reported reading was more enjoyable on the iPad. However, they reported writing on the iPad was difficult. There is no indication of how many, if any, of the 6057 students included in this study used the iPad's built-in accessibility features that support written composition, such as word prediction.

Summary

The seven main areas of impact were due, in part, to this PAR study acting as job-embedded professional development for the classroom teacher and her willingness to grow as a science teacher. This research provided the teacher just-in-time learning opportunities that were subject specific and individualized to the teacher's needs, situated in the larger context of her school's digital ecosystem. It also provided her the opportunity to consider and act on students' perspectives when designing the wetlands unit.

This study revealed that a technology-rich classroom does not equate a technology-enhanced learning environment. Unintentional systemic barriers may mute the potential of one-to-one access. When the design of technology integration, at both the school and school authority level, creates significant barriers to effective student and teacher use of mobile devices as pedagogical tools, their ability to act in new and innovative ways is thwarted. This makes it difficult for teachers and students to develop and exert their agency.

In Chapter Six, the implications of this research are explored. This is followed by suggestions for future research and a reflection.

CHAPTER SIX: CONCLUSION

This final chapter includes nine implications for practice and recommendations for educational stakeholders. Next, five suggestions for future research are discussed. This chapter concludes with a reflection that includes challenges, what worked well, and what was gained through this study.

Implications for Practice

This study of fifth-grade students and their teacher in a technology-rich environment provided insight into some of the barriers to the development of technology-enhanced learning environments using iPads and how to overcome them. The findings imply that the potential of iPads is not being fully realized in the context of learning and teaching as well as provides insight on how they can be leveraged as pedagogical devices. It provides evidence that the learning environment, and the education system it is nested in, is creating disabling conditions. Nine recommendations for educational stakeholders, including the Department of Education, educational leaders, teachers and Faculties of Education are presented to support a shift from technology-rich classrooms to technology-enhanced learning environments.

Department of Education.

1. Ensure technology is appropriately embedded in new curriculum as it is developed.

As curriculum, such as the Alberta Programs of Study, is updated to meet the changing needs of the education system, it is essential that technology is intentionally embedded to ensure curriculum is relevant to and engaging for the diverse learners in today's classrooms. Provincial curriculum is a core element of equity in education; it is the basis of the learning experiences teachers design for their students. Technology should be a key element of any framework guiding the design and development of new curriculum.

Educational leaders.

2. Ensure infrastructure, policy, and procedures create conditions that support teachers and students to effectively use technology for teaching and learning.

Removing or reducing technical difficulties caused by infrastructure design and device management procedures will improve both teachers' and students' experiences using mobile devices, such as iPads, as a pedagogical tool. One-to-one initiatives, Bring Your Own Device (BYOD) policies, and the shift towards student-centred learning lead to increasing demands on school infrastructure. This necessitates regular technology audits to ensure the bandwidth and WIFI access meets learning and teaching needs. Schools need sufficient bandwidth for students to be using mobile devices simultaneously and reliable access to WIFI school-wide. Also, policy and procedures related to mobile devices, such as iPad management, need to be audited to ensure iPads to thrive as a pedagogical tool. The installation and updating of applications as well as updating the iOS need to occur on an as-needed basis so both students and teachers can utilize mobile devices in classrooms efficiently and with little effort.

3. Provide job-embedded professional development and teacher networking opportunities.

Supporting teachers' learning requires that educational leaders (the ministry, teachers' association, and school authorities) provide a continuum of learning opportunities. Too often when new technologies are appropriated by education the learning opportunities provided for teachers focus on training and are episodic. While teachers do need training on emergent technologies, such as the iPad, and episodic professional development focused on knowledge acquisition can support them with learning how iPads can be used for teaching and learning, teachers also need ongoing support to understand their school's digital ecosystem, integrate technology into the learning activities they design, where appropriate, and reflect on their

practice. Therefore, sustained professional learning and collaboration, combined with one-to-one coaching, is required to leverage emergent technology as pedagogical devices. Classroom teachers need access to job-embedded professional development in the form of learning opportunities that are sustained over time, embedded in teacher practice, subject specific, and responsive to individual teacher needs. They also need time to network and collaborate with other teachers, within their school and at other schools, for intentional and meaningful opportunities to be reflective practitioners.

Merely allocating resources to acquire technology for classrooms, without accompanying these investments with an investment in professional learning, is not enough to facilitate changes in the learning activities teachers design. The individual efforts of educators as well as contextual and structural factors can inhibit change. Intentionally designing enabling conditions through infrastructure, policy, procedure, and professional development can remove or reduce barriers to leveraging iPads as a pedagogical device.

Educational leaders and teachers.

4. Recognize students as key stakeholders.

With the rapid appropriation of mobile devices and the move towards student-centred learning there has been a shift away from teachers being the primary users, that is, the ones actively using technology, to students being primary users. For example, the ISTE Standards for Students have evolved from the focus in 1998 on learning to use technology, to the focus in 2007 on using technology to learn, to the focus in 2016 on transforming learning with technology. The ISTE Standards for Students have recently been redesigned to empower student voice and ensure that learning is a student-driven process. As such, students need to be recognized and valued as key stakeholders who can provide important insights into how the digital ecosystem of a school impacts their ability to leverage the mobile devices they have access to and how emergent technologies can support their learning. Recognizing students as

key stakeholders includes increasing and supporting their power within their school and the school jurisdiction.

5. Regularly collect, discuss, and act on student feedback regarding educational technology in their schools.

One way to foster student influence on a school authority's approach to educational technology and the digital ecosystems in school is to regularly collect, discuss, and act on student feedback. Educators can use surveys and focus groups to collect student perspectives about the technology in their schools, how they can use it, and how they think technology could better support their learning. This data collection should be the start to a cyclical process for an authentic purpose; deepening educators understanding of the complex digital ecosystems of schools, that leads to action then reflection, which often leads back to data collection.

6. Cultivate an authentic youth voice by including diverse student representation on educational technology leadership teams at both the school and jurisdiction level.

Educational leaders and teachers should partner with students as key stakeholders in their learning and use of mobile devices by including student representatives on leadership teams-related educational technology at both the school and jurisdiction level. Intentionally engaging students and providing this opportunity for agency also necessitates providing students the opportunity to build the skills to speak out respectfully in a diverse group that may have differing perspectives and opinions. Support students with taking on the responsibility of joining an educational technology leadership team. This includes coaching, so students can take appropriate and effective leadership roles. It is crucial that student members of educational technology leadership teams are full members, not token representatives, and that their perspectives are integrated into decision-making processes. Ensure the student voice is heard and students are empowered with purpose. But students should not be forced to participate. To

ensure diverse student representation, some students may need to be encouraged to consider participating, especially students who have not felt successful or supported in school.

Teachers.

7. Create a classroom culture that enables student agency.

Agency is not something students are born with, or without, or something that is given to them by their teachers. Agency is as an emergent phenomenon of the ecological conditions through which it is enacted. It results from the interplay of: (1) individual efforts, (2) available resources, and (3) contextual and structural factors (Biesta & Tedder, 2007). Create the conditions in your classroom where students can develop their agency as learners through the intentional design of contextual and structural factors, and supporting individual student efforts towards mastery over themselves and their learning.

8. Provide technology training for students on how to customize their interactions with the iPad to best support their learning.

To best leverage iPads for the diverse learners in today's classrooms, it is important that we do not assume that teachers and students are aware of the iPad's built-in accessibility features and know how they can be personalized to meet their teaching and learning needs. Even if students are confident. iPad users, it is important to provide opportunities for all students to explore built-in accessibility features. In addition to training, students need the authority to customize these accessibility features. Ensure students know they can adjust their iPad's settings and encourage them to do so.

9. Provide students with options on how and why to use a variety of technology tools in the learning activities you design.

Intentionally design student choice and appropriate student control of science content knowledge building into learning experiences. Encourage students to personalize how they

interact with their iPad. Provide them choices on how they build their science knowledge and how they demonstrate what they know. Providing options through a variety of learning activities should also include the opportunity to choose the application best suited for how they will demonstrate what they know. Students should have the opportunity to make meaningful choices about their learning; how they learn, the pace, with whom, and where.

Faculties of Education.

10. Design Bachelor of Education programs that model technology-enhanced learning environments in both face-to-face and online settings.

Intentionally create the conditions where all courses offered to pre-service teachers during their Bachelor of Education degree are exemplars of technology-enhanced learning environments. It is important that pre-service educators have the opportunity to experience technology-enhanced learning and have critical conversations about technology and inequity.

Fostering a shift from technology-rich classrooms to technology-enhanced learning environments has implications for practice at all four levels within the K-12 education system: classroom, school, school jurisdiction, and Department of Education as well as at universities with a Faculty of Education. Teachers, educational leaders, and the Department of Education all have important and interconnected roles in ensuring the potential of mobile devices as pedagogical tools is realized and supports the capabilities of all learners.

Recommendations for Future Research

The study indicates that fifth-grade students can provide powerful insights on how a technology-rich classroom can be transformed into a technology-enhanced learning environment. However, as this limited PAR study focused on one fifth-grade class in Alberta, further research in this area is warranted. YPAR with students in additional grade levels, as well as other subject-specific content areas, is recommended. YPAR elevates the importance of youth voice, including their involvement in the research process. Capacity building is an

essential element of YPAR, involving training of young people to “identify major concerns in their schools and communities, conduct research to understand the nature of the problems, and take leadership in influencing policies and decisions to enhance the conditions in which they live” (Ozer, Ritterman and Wanis 2010, p. 153).

It would be useful to use additional research methods that are conducive to including a large, representative sample of students. For example, survey research focused on student use of mobile devices in core curricular areas would give a broader understanding of student perspectives regarding how they currently are permitted to use mobile devices to support and enhance their learning in schools. It could provide information on the extent of the use of mobile devices within core curricular areas, including student perceptions of frequency of use, type of use, and student expertise in using various apps.

Further exploration into what high-quality teaching enhanced with one-to-one access to mobile devices looks like would also be beneficial to educators. Additional studies including mobile devices other than the iPad, such as ChromeBooks, would provide valuable knowledge for educators striving to design technology-enhanced inclusive learning environments. With the growing trend towards Bring Your Own Device (BYOD), studies where students use a variety of mobile devices, rather than a class set of one type of device, would be an important addition to what was learned through this research. While research in recent years has investigated how mobile learning can be leveraged for teaching and learning through the BYOD model, the inclusion of student voice would add to this body of knowledge.

My study indicates that some fifth-grade students perceive themselves as better learners when they customize the iPad to provide them compensatory support with reading and / or writing. iPads are protean devices; they can be both mainstream educational technology as well as assistive technologies. As such, the iPad opens new opportunities for participation and inclusion. Continued research in this area, such as a longitudinal study on student use of the

iPad as an assistive technology, will assist educators to better understand how to leverage one-to-one access to mobile devices in inclusive classrooms and the impact on student learning.

Finally, one minor contribution of the current study, is it highlights the importance of the seventh component of TPACK, that is, contexts, and reveals a limitation of the TPACK Framework in K–12 educational settings. Merging the TPACK Framework and Bioecological Model may help ensure both *zooming in* and *zooming out* so the examination of teacher practice considers the socio-technical networks and systems at both the school and wider educational system levels. Additional research to help further understanding of the contexts component of the TPACK Framework in K–12 education will assist with removing systemic barriers to technology integration and support teachers' capability to design technology-enabled classrooms.

Researcher's Reflection

The research presented in this study is the culmination of my doctoral journey. Conducting this research has been an honour and a privilege. The PAR approach was integral to my study of iPads as a one-to-one mobile device. However, it led to challenges.

A significant challenge in this study was securing a research site. My research invitation to spend extended time spent in the classroom, observing and assisting, as well as the active involvement of students was a deterrent for some educational leaders and teachers as I was recruiting potential participants for my study. I had to approach multiple school jurisdiction leaders and classroom teachers. Eventually I had to adjust my plan to focus this research on just one classroom teacher and her students. Even that classroom teacher initially had reservations. However, after I had spent a few weeks in her classroom Ms. H mentioned in an email "thank my lucky stars I was smart enough to take you up on this experience." To address the challenge of participant recruitment, I recommend relationship building with potential participants and clearly communicating the potential benefits of the time they would invest as a participant in the study.

Another challenge was the time of year this study occurred. Due to difficulties with securing a research site, this study occurred during the last two months of the school year. School year-end activities led to changes in routines and some scheduling issues. Fortunately, most of these changes occurred in June, after I had the opportunity to develop a relationship with the classroom teacher. She valued the time I spent in her classroom so was open to rebooking the days I would attend, and I had the flexibility to accommodate most of the scheduling issues. I recommend avoiding the first month and last month of school, if possible. School start-up and year-end activities often lead to changes in schedules.

While the timeline of the study caused some challenges, it also contributed to the success of the study. The extended time spent at the school was integral to building trust with the students and the teacher. Building trust and credibility with the students helped ensure they would be open and honest with me. Building trust with Ms. H, their classroom teacher, helped create an environment where she felt safe to be open to student suggestions and take some risks with our co-design of the Wetlands Ecosystem unit. For example, this trust coupled with time for reflection helped Ms. H move from worrying the Minecraft app would “be a royal pain” to embracing the students’ suggestion and eventually acknowledging her initial assumptions were wrong. “I’m so grateful that they came up with that because they really, really used it as a learning tool.”

This experience has fueled my passion for supporting all learners and using technology in powerful ways to enhance teaching and learning. I have gained a deeper understanding of the complex relationship between what teachers and students do with technology and the contexts of their learning environment, particularly the socio-technical networks and systems at both the school and wider educational system levels. This passion remains guided by the Capability Approach which is concerned with entrenched social injustice and inequity, especially capability failures that are the result of discrimination or marginalization.

Conclusion

This study provides insight into the experiences of fifth-grade students and their science teacher during the integration of the iPad as a one-to-one device in their classroom. A limited PAR approach was used to examine iPad challenges and celebrations, as well as identify ways this mobile device could allow them to build knowledge and show what they know; accordingly, PAR served to help create change. According to the finding of this study, system challenges can impede the shift from technology-rich classrooms to technology-enabled learning environments.

Student perspectives can be helpful in ensuring the technology in today's classrooms are truly leveraged for learning. Zander shared "it's actually pretty cool 'cuz I know, like I helped create the change and that. It was kinda fun 'cuz we got to teach the teacher." John was proud he helped and mentioned "it was helpful 'cuz it was easier for the teacher." Justin was adamant that "people would not have been able to have these certain apps [Minecraft and Scribblenauts] if you did it by yourself and didn't create the focus group." The teacher acknowledged that "the biggest challenge was getting over, ah, my control issue." When reflecting on what she will continue next year because of participating in this research, Ms. H noted the lasting impact of the student input on the design of the Wetlands Ecosystem unit. "[My science units] were so linear but this was you can go in this direction, or this direction, or this direction and you're still going to build the same knowledge." While children, especially those with learning difficulties, are often marginalized within society, opportunities for collaboration between students and adults in designing technology-enhanced learning environment should be encouraged. Ms. H's advice to teachers is "Don't underestimate them…Let them give it a shot. Let them try because they are going to shock and to amaze you." Students, as primary users of educational technology in classrooms, have important perspectives that can help create technology-enhanced learning environments.

Classroom teachers need better support to create the enabling conditions for them to leverage ubiquitous student access to mobile technology. Too often teachers have limited

opportunities to connect and learn together as they integrate emergent technology into their classrooms. As Ms. H shared when reflecting on her first year and a half with a class set of iPads, “I feel that we were lucky to get them, but they were such a new, relatively new technology used in school…I wish we could have done much more collaboration with like sitting down with groups of other teachers.” When discussing her participation in this research, Ms. H shared “I feel like this was professional development…We’ve had such a push for project-based learning, but never the support. I think I’m much more capable to design a project from beginning to end and it would be solid.”

To gain a deeper understanding of the potential of emergent technologies to enhance student engagement and achievement, particularly of those students who have traditionally not done well in school, it is essential to spend time with students and their teachers to explore what they can do and who they can be with an iPad as a pedagogical device. For iPads to be a disruptive innovation in the educational setting, it is imperative for researchers, educators, and students to build knowledge around their use to design technology-enhanced learning environments and facilitate change in a cooperative way. Contextual factors need to create enabling conditions, so teachers and students can learn their way forward.

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Appendix A: Focus Group Agenda

Focus Group #1

1) Rules & Expectations
    - Welcome to our first iPad meeting. Thank you for agreeing to participate in this research. Before we begin, I want to remind you that: 1) all comments are valued and 2) what is shared in this room stays between us. Please be supportive of each other and do not talk about things people share at our meetings with others.
2) iPad Celebrations:
    - You've had a class set of iPads for almost two years now. Tell me about what you really like about using iPads to help you learn.
3) iPad Challenges:
    - I know you are grateful for the iPads and appreciate all the iPad celebrations you have shared. I am wondering if there also have been challenges you have experienced when using iPads in your classroom.
4) iPad Wishes:
    - If you had a magic wand that would give you control over iPads in your school, what would your wishes be?
5) Show What You Know:
    - Your teacher let me know that your next unit in Science will be the Wetlands. She's excited for your advice on how you could best learn about wetlands and show what you know.

Appendix B: Student Interview Questions

Opening

Thank you for meeting with me today. Before we begin I want to remind you of the promise made at the beginning of this research; you can decide to stop participating at any time, even

today. Are you comfortable with answering some questions about yourself, iPads, and science?

Student Warm-up

1. Tell me a bit about yourself.
    - Age?
    - Language(s) spoken at home?
2. What types of things do you like to do when you are not at school?
3. What is your favourite subject in school? Why?

Tweens Tech Use

4. What types of technology do you think most students your age use at home?
5. What do you think they use it for? How often?
6. Do you have any of these technologies?

First Thoughts About the iPad as a 1:1 Device

7. Think way back, to grade 4 when you first learned your class would be getting a class set of iPads- what were your first thoughts about using iPads in school?
8. Was there anything you were nervous about?
9. What were you most excited about?

Typical Classroom iPad Use

10. Before I started volunteering in your classroom, how did you usually use the iPads in your class?
11. What was one of your favourite learning activities or assignments? Why?

12. What were some challenges you faced when using iPads in your classroom?

Typical iPad Use (Science)

13. Before I started volunteering in your classroom, how did you learn your science units?
14. What did your teacher do?
15. How did you learn the unit content?
16. How did you Show What You Know?

PAR

17. How do you feel about our Focus Group and the change you helped plan (Wetlands Science Unit)?
    - Celebrations?
    - Challenges?
    - Surprises?

Digital Repository

18. What was using the Weebly to access the wetlands unit resources and materials like?
    - Celebrations?
    - Challenges?
    - Surprises?

Wetland Ecosystems Unit

19. What was it like to learn about wetland ecosystems by using a combination of videos and websites with graphic organizers to write notes instead of a textbook with a worksheet of short-answer questions?
    - Celebrations?
    - Challenges?
    - Surprises?

Reading on an iPad (Science)

20. What was reading on your iPad for the Wetlands Science Unit like?

- Celebrations?
- Challenges?
- Surprises?

21. Did you use Speak Selection? If so, tell me about it.
22. Do you think you read differently on an iPad than a textbook? (hyperlinks? images?)

Student Experience: Classmates (Wetland Ecosystems Unit)

23. How do you think your classmates felt about the Wetlands Science Unit, in particular the Show What You Know activities?

Student Experience: Personal (Wetland Ecosystems Unit)

24. How did you choose to Show What You Know about wetland ecosystems?
    - individual or group?
    - If group, how did you decide which learning activity to do?
    - How did your group collaborate?

Advice

25. What advice about using iPads for teaching and learning would you like to give your teacher for Grade 6 next year?

Final thoughts

26. Is there anything else you would like to share with me before we finish this interview?

Closing

Thank you for answering all these questions. When I finish this research and write up what we found out, some of your answers today will be included. I will not use your real name. What would you like your pseudonym to be?

Appendix C: Teacher Interview Questions

1. Tell me a bit about yourself.
    - What types of things do you like to do when you are not at school?
    - What is your favourite subject to teach? Why?
2. Think way back, to grade 4 when you first learned your class would be getting a class set of iPads- what were your first thoughts about using iPads for teaching and learning?
    - Was there anything you were nervous about?
    - What were you most excited about?
3. Before I started volunteering in your classroom, how did you usually use the iPads in your class?
    - What were some challenges you faced when using iPads in your classroom?
    - What continues to be challenging about using iPads at your school?
    - What are some key 'celebrations'?
4. Before I started volunteering in your classroom, how did you design your science units?
    - How did you teach?
    - How did students demonstrate their learning to you?
    - How did you assess science assignments?
5. How do you feel about the change you and the student Focus Group helped plan (Wetlands Science Unit)?
    - Celebrations?
    - Challenges?
    - Surprises?
6. What was using the Weebly as an online repository for the wetlands unit's resources and materials like?
    - Celebrations?
    - Challenges?

- Surprises?

7. Describe your students' learning during the wetlands unit versus the other science units.
8. What was it like for you as the teacher when your students learned about wetland ecosystems by using a combination of videos and websites with graphic organizers to write notes instead of a textbook with a worksheet of short-answer questions?
    - Celebrations?
    - Challenges?
    - Surprises?
9. Has your Technology Knowledge changed during this research project? If so, how? Please give examples.
10. Has your Science Content Knowledge changed during this research project? If so, how? Please give examples.
11. Has your Pedagogy Knowledge changed during this research project? If so, how? Please give examples.
12. What will you do differently with your grade 5 class next year as a result of participating in this research project?
13. What advice about using iPads for teaching and learning would you like to give your students' teacher for Grade 6 next year?
14. Final thoughts?

Appendix D: Teacher Consent Form

Name of Researcher, Faculty, Department, Telephone & Email:

Belina Caissie, Faculty of Education, XXX-XXX-XXX, XXXXXXX@XXXXXX

Supervisor:

Dr. Sharon Friesen, Faculty of Education

Title of Project:

In Our Hands: Designing for and with Mobile Tablets in an Inclusive Classroom

This consent form, a copy of which has been given to you, is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

Purpose of the Study:

The purpose of this research study is to explore the potential educational benefits of one-to-one mobile tablet deployment. In particular, to investigate the design of technology-enabled learning environments, more specifically designing for and with the iPad, and its impact on teaching and learning as well as teacher and student agency. The main use of collected data will be to inform the researcher's Doctor of Education dissertation.

What Will I Be Asked To Do?

This research would be conducted in conjunction with you as you explore how to integrate and leverage a class set of iPads. I anticipate working alongside a key informant teacher and other teachers of the students for a period of two months (one full day or two half days per week). During this time the key informant teacher will have the opportunity to become a collaborator in the research study with the researcher; planning a change (an iPad-based learning activity),

acting and observing the process and consequences of the change, reflecting and, if time permits, re-planning.

You will be asked to:

- allow me to observe and assist in your classroom (one full day or two half days per week for six to eight weeks)
- provide me access to classroom artifacts and documents such as student assignments completed using the iPad, Report Cards, and Individualized Program Plans (IPPs)
- complete a pre-survey in February and a post survey in June (survey takes 20-30 minutes to complete). You will be emailed a link to the survey online. The online survey is being administered by Surveymonkey©, an American software company. As such, your responses are subject to U.S. laws, including the USA Patriot Act. The risks associated with participation are minimal, however, and similar to those associated with many email programs, such as Hotmail© and social utilities spaces, such as Facebook© and MySpace©".
- participate in an individual interview, which will last 30 45 minutes, where you will be asked questions related to iPads, educational technology, teaching and learning. This interview will be audiotaped and transcribed by the researcher.

If chosen as a key informant, you will also be asked to:

- co-plan a lesson or unit with the researcher

Your participation is entirely voluntary. Your decision not to join or to withdraw part way through the study will have no negative consequences for you in terms of resources or employment.

What Type of Personal Information Will Be Collected?

Should you agree to participate, you will be asked to provide your name, gender, age and academic degree(s) including major(s). Confidentiality will be assured by using pseudonyms and other literary devices to disguise the identity of the participants as well as that of the school in which you teach. Due to the nature of data collection absolute confidentiality cannot be

guaranteed and it is probable that your participation in this study will be recognized by other teachers and by students.

Are there Risks or Benefits if I Participate?

Participating in research involves potential risks to participants. This research study presents minimal risks to teachers as they will have control over how they use mobile tablet technology in the classroom. However there is the possibility that the ergonomics of using an iPad in the classroom for extended periods of time may cause you to experience neck or eye strain.

It is possible this research will contribute to the developing understanding of leveraging iPads in an educational setting to support the learning of all students. This would benefit the participants, the research community, and society at large.

What Happens to the Information I Provide?

No one except the researcher and her supervisor will be allowed to see or hear any of the raw data collected. All information will be held private, except when professional codes of ethics or the law requires reporting. Paper-based information collected will be kept in a locked filing cabinet in the researcher's home. Any digital files will be stored on a password-protected external drive. Only the researcher will have a key to the cabinet and know the password to the external drive. This information will be kept for five years after the research is complete. All paper-based raw data will be shredded and the digital raw data will be permanently erased from the external drive by June 30th, 2018.

Participation is completely voluntary and confidential. Outside the context of the classroom (i.e. dissertation, papers, and presentations) the researcher will ensure the privacy, anonymity, and confidentiality of all participants through the use of pseudonyms. You are free to discontinue participation at any time during the study. Your decision not to participate or to withdraw part way through the study will have no negative consequences for you in terms of classroom resources or employment. Data collected up until the point of consent being withdrawn will be used in the research study.

Signatures (written consent)

Your signature on this form indicates that you 1) understand to your satisfaction the information provided to you about your participation in this research project, and 2) agree to participate as a research subject.

In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from this research project at any time. You should feel free to ask for clarification or new information throughout your participation.

Participant's Name: (please print) _____

Participant's Signature _____Date: _____

Researcher's Name: (please print) _____

Researcher's Signature: _____Date: _____

Questions/Concerns

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Ms. Belina Caissie, EdD Candidate

Faculty of Education, University of Calgary

XXX-XXX-XXX, XXXXXXX@XXXXXX

Dr. Sharon Friesen, Faculty of Education, XXX-XXX-XXX, XXXXXXX@XXXXXX

If you have any concerns about the way you've been treated as a participant, please contact the Senior Ethics Resource Officer, Research Services Office, University of Calgary at XXX-XXX-XXX, XXXXXXX@XXXXXX.

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

Appendix E: Parent Consent Form

Name of Researcher, Faculty, Department, Telephone & Email:

Belina Caissie, Faculty of Education, XXX-XXX-XXX, XXXXXXX@XXXXXX

Supervisor:

Dr. Sharon Friesen, Faculty of Education

Title of Project:

In Our Hands: Designing for and with Mobile Tablets in an Inclusive Classroom

This consent form, a copy of which has been given to you, is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

Purpose of the Study:

The purpose of this research study is to explore the potential educational benefits of one-to-one mobile tablet deployment. In particular, to investigate the design of technology-enabled learning environments, more specifically designing for and with the iPad, and its impact on teaching and learning as well as teacher and student agency. The main use of collected data will be to inform the researcher's Doctor of Education dissertation.

What Will I Be Asked To Do?

Parents will not be asked to participate. You will not be asked to do anything in addition to giving consent for your child to participate.

What Will My Child Be Asked To Do?

I anticipate working alongside your child's teacher for a period of two months (two half days per week). During this time key informant students will have the opportunity to become a

collaborator in the research study with the researcher; participating in focus groups that will involve planning a change, reflecting and, if time permits, re-planning.

Your child will be asked to:

- allow me to take notes about my observations of him/her in the classroom while I am the teacher's helper,
- allow me to review their Report Cards, Individualized Program Plan (if they have one), class work and assignments

If chosen as a key informant, your child will also be asked to:

- participate in an individual interview, which will last 30 45 minutes, where he/she will be asked questions related to iPads, educational technology, teaching and learning. This interview will be audiotaped and transcribed by the researcher.
- participate in up to five, 45 minute focus group discussions with the researcher and a small group of their classmates which will be audiotaped and transcribed by the researcher. These focus group discussions will be held during the school day, potentially over the lunch hour, in a private room. A summary of each focus group discussion, based on the transcription, will be written by the researcher. Your child will receive a two week period in which to review his/her contributions to this summary and request changes. If he/she does not respond within two weeks, I will interpret this as an indication of approval as is. Due to the nature of this data collection absolute confidentiality cannot be guaranteed and it is probable that your child's participation in this study will be recognized by teachers and other students.

Your child's participation is entirely voluntary. Your decision not to allow him/her to participate or to withdraw part way through the study will have no negative consequences for your child.

What Type of Personal Information Will Be Collected?

Should you agree for your child participate and they assent, your child will be asked to provide their name, gender, age and any special education needs (if any). Confidentiality will be assured

by using pseudonyms and other literary devices to disguise the identity of the participants as well as that of their school.

Are there Risks or Benefits if I Participate?

Parents are not being asked to participate.

Are there Risks or Benefits if My Child Participates?

Participating in research involves potential risks to participants. This research study presents minimal risks to students as they and their teachers will have control over how mobile tablet technology is used in the classroom. However, there is the possibility that the ergonomics of using an iPad in the classroom for extended periods of time may cause your child to experience neck or eye strain.

It is possible this research will contribute to the developing understanding of how to effectively use iPads in an educational setting to support the learning of all students. This would benefit the participants, the research community, and society at large.

What Happens to the Information I Provide?

Participation is completely voluntary and confidential. This research will occur throughout the school day. If you choose not to give consent for your child to participate, your child will not be excluded from the regular classroom programming or research intervention. Rather, research data specifically on your child will not be collected.

No one except the researcher and her supervisor will be allowed to see or hear any of the raw data collected. All information will be held private, except when professional codes of ethics or the law requires reporting. Paper-based information collected will be kept in a locked filing cabinet in the researcher's home. Any digital files will be stored on a password-protected external drive. Only the researcher will have a key to the cabinet and know the password to the external drive. This information will be kept for five years after the research is complete. All paper-based raw data will be shredded and the digital raw data will be permanently erased from the external drive by June 30th, 2018.

If you allow your child to participate, outside the context of the classroom (i.e. dissertation, papers, and presentations) the researcher will ensure the privacy, anonymity, and confidentiality of all participants through the use of pseudonyms. No real names will be used in any papers or presentations. Your child is free to discontinue participation at any time during the study by emailing the researcher. You do not provide a reason or explanation for withdrawing your child. Data collected up until the point of consent being withdrawn will be used in the research study.

Signatures (written consent)

Your signature on this form indicates that you 1) understand to your satisfaction the information provided to you about your participation in this research project, and 2) agree for your child to participate as a research subject.

In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from this research project at any time. You should feel free to ask for clarification or new information throughout your participation.

Participant's Name: (please print) _____

Parent's / Legal Guardian's Name: (please print) _____

Parent's / Legal Guardian's Signature: _____Date: _____

Researcher's Name: (please print) _____

Researcher's Signature: _____Date: _____

Questions/Concerns

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Ms. Belina Caissie, EdD Candidate

Faculty of Education, University of Calgary

XXX-XXX-XXX, XXXXXXX@XXXXXX

Dr. Sharon Friesen, Faculty of Education, XXX-XXX-XXX, XXXXXXX@XXXXXX

If you have any concerns about the way you've been treated as a participant, please contact the Senior Ethics Resource Officer, Research Services Office, University of Calgary at XXX-XXX-XXX, XXXXXXX@XXXXXX.

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

Appendix F: Student Assent Form

Name of Researcher, Faculty, Department, Telephone & Email:

Belina Caissie, Faculty of Education, XXX-XXX-XXX, XXXXXXX@XXXXXX

Supervisor:

Dr. Sharon Friesen, Faculty of Education

Title of Project:

In Our Hands: Designing for and with Mobile Tablets in an Inclusive Classroom

This consent form, a copy of which has been given to you, is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

Purpose of the Study:

The purpose of this research study is to explore the potential educational benefits of one-to-one mobile tablet deployment. In particular, to investigate the design of technology-enabled learning environments, more specifically designing for and with the iPad, and its impact on teaching and learning as well as teacher and student agency. The main use of collected data will be to inform the researcher's Doctor of Education dissertation.

What Will I Be Asked To Do?

I anticipate working alongside your teacher for a period of two months (two half days per week). During this time key informant students will have the opportunity to become a collaborator in the research study with the researcher; participating in focus groups that will involve planning a change (an iPad-based learning activity), acting and observing the process and consequences of the change, reflecting and, if time permits, re-planning.

You will be asked to:

- allow me to take notes about my observations of you in the classroom while I am the teacher's helper,
- allow me to review your Report Cards, Individualized Program Plan (if you have one), class work and assignments,

If chosen as a key informant, you will also be asked to:

- participate in an individual interview, which will last 30 45 minutes, where you will be asked questions related to iPads, educational technology, teaching and learning. This interview will be audiotaped and transcribed by the researcher.
- participate in up to five, 45 minute focus group discussions with the researcher and a small group of your classmates which will be audiotaped and transcribed by the researcher. These focus group discussions will be held during the school day, potentially over the lunch hour, in a private room. A summary of each focus group discussion, based on the transcription, will be written by the researcher. You will receive a two week period in which to review your contributions to this summary and request changes. If you do not respond within two weeks, I will interpret this as an indication of approval as is. Due to the nature of this data collection absolute confidentiality cannot be guaranteed and it is probable that your participation in this study will be recognized by teachers and other students.

Your participation is entirely voluntary. Your decision not to participate or to withdraw part way through the study will have no negative consequences.

What Type of Personal Information Will Be Collected?

Should you agree to participate and your parents provide consent, you will be asked to provide name, gender, age and any special education needs (if any). Confidentiality will be assured by using pseudonyms and other literary devices to disguise the identity of the participants as well as that of their school.

Are there Risks or Benefits if I Participate?

Participating in research involves potential risks to participants. This research study presents minimal risks to students as they and their teachers will have control over how mobile tablet technology is used in the classroom. However, there is the possibility that the ergonomics of using an iPad in the classroom for extended periods of time may cause your child to experience neck or eye strain.

It is possible this research will contribute to the developing understanding of how to effectively use iPads in an educational setting to support the learning of all students. This would benefit the participants, the research community, and society at large.

What Happens to the Information I Provide?

Participation is completely voluntary and confidential. This research will occur throughout the school day. If you choose not to participate, you will not be excluded from the regular classroom programming or research intervention. Rather, research data specifically on you will not be collected.

No one except the researcher and her supervisor will be allowed to see or hear any of the raw data collected. All information will be held private, except when professional codes of ethics or the law requires reporting. Paper-based information collected will be kept in a locked filing cabinet in the researcher's home. Any digital files will be stored on a password-protected external drive. Only the researcher will have a key to the cabinet and know the password to the external drive. This information will be kept for five years after the research is complete. All paper-based raw data will be shredded and the digital raw data will be permanently erased from the external drive by June 30th, 2018.

If you participate, outside the context of the classroom (i.e. dissertation, papers, and presentations) the researcher will ensure the privacy, anonymity, and confidentiality of all participants through the use of pseudonyms. No real names will be used in any papers or presentations. You are free to discontinue participation at any time during the study by emailing

the researcher. You do not need to provide a reason or explanation for withdrawing. Data collected up until the point of consent being withdrawn will be used in the research study.

Signatures (written consent)

Your signature on this form indicates that you 1) understand to your satisfaction the information provided to you about your participation in this research project, and 2) agree to participate as a research subject.

In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from this research project at any time. You should feel free to ask for clarification or new information throughout your participation.

Participant's Name: (please print) _____

Participant's Signature: _____Date: _____

Researcher's Name: (please print) _____

Researcher's Signature: _____Date: _____

Questions/Concerns

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Ms. Belina Caissie, EdD Candidate

Faculty of Education, University of Calgary

XXX-XXX-XXX, XXXXXXX@XXXXXX

Dr. Sharon Friesen, Faculty of Education, XXX-XXX-XXX, XXXXXXX@XXXXXX

If you have any concerns about the way you've been treated as a participant, please contact the Senior Ethics Resource Officer, Research Services Office, University of Calgary at XXX-XXX-XXX, XXXXXXX@XXXXXX.

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the assent form.