Technology Disruptions and Related Problem Solving Experiences of Mid-career Elementary Teachers

by
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Abstract

Elementary teachers have increasing access to classroom digital technologies but barriers to classroom technology use continue to be reported. In this case study of one urban British Columbia school district, the researcher uses multi-case analysis to explore the experiences of 7 mid-career elementary school teachers who are implementing digital technology in their classrooms. Findings indicate that disruptions continue to necessitate the use of problem solving strategies and supports by teachers. Further, teachers’ choice of problem solving techniques does not always ensure continued use of the technology they incorporate into their plans. The discussion examines some of the more common disruptions reported by teachers and how context shapes the success with which they address disruptions.

Keywords: technology implementation; elementary teachers’ technology use; teacher problem solving; technology problem solving; technology disruptions; teachers support
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<td>Mid-career teachers</td>
<td>Teachers with between 4-20 years of teaching experience</td>
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<td>Pedagogical technology</td>
<td>The skills necessary for a teacher to use technology in the classroom as part of their approach to teaching subject matter (e.g. how to use a digital blog with students to support writing growth).</td>
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<td>Problem solving</td>
<td>A teacher’s actions to overcome a technology-related disruption through the use of their own knowledge and skills, or by seeking the support of others around them to meet an immediate goal.</td>
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<td>Professional Development</td>
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Chapter 1. Introduction

Over the past 10 years I have become increasingly interested in the use of information technology in classrooms. At first, in my role as a resource teacher in a large urban school district in BC, I was mainly interested in how I might use information technology with individual students to support their learning needs in classrooms. Later, I became interested in using technology to support those who struggle to access the curriculum through traditional means because of particular personal limitations. Through my experiences, I began to believe that there was an important role for technology in every classroom, not just to enhance student-learning opportunities but to offer a means of levelling the playing field for struggling learners through the use of assistive features in existing tools, and specialized tools for accessibility.

Beyond my own observations, a quick internet search for “news on technology in the classroom” provides a wealth of articles from all over the world which imply that more technology in classrooms will offer teachers and students increased choice, engagement and access to information (e.g. West, 2013). Terms like “21st Century Skills” and “The Digital Age” suggest that we are in a new age that necessitates entirely new skills and knowledge in order to succeed in life (e.g. Tapscott, 2016). Both the academic and professional literature are thick with articles on why digital technology is good for classrooms, teachers and students (along with a few on why it might not be) but little to no discussion on where resources to support additional technology use in schools will come from.

The challenge of improving access to digital technology in order to make a difference in student learning is one that I have personally faced. The elementary schools in which I worked were equipped with a shared computer lab and usually one functioning teacher computer per classroom. Beyond that, however there was a high degree of variability from school to school and classroom to classroom. In some schools, mobile labs of laptops and iPads were being purchased to supplement or replace computer labs, thereby increasing the options for teachers and students. Other
schools, however, were slower to make these large-scale purchases because of competing financial pressures such as playground equipment, community gardens or other equally important school needs.

While every year, I was asked by administration to conserve paper, share textbooks and find ways to work with reductions in staffing, the hopes of new technology purchases were left to the Parent Advisory Councils and funding sources outside the immediate school district budget lines. Keen technology teachers around me sought ways to acquire technology without cost to the school through ‘Computers for Schools’, special fund raising projects and the rare special technology acquisition projects (Government of Canada, 2015). In 2011, I was able to participate in a project that provided a small number of digital devices for my classroom. While what I observed during the project further reinforced the benefits that technology brought to students, it also highlighted what an unusual situation having a dedicated classroom set of devices was within a typical public school in BC. There were benefits but it also came with challenges.

Bringing a set of digital tools into a school environment required me to have a certain level of tenacity, problem solving skills, patience, and at times a singular focus on the goal of having access to these tools for my students. While the district technology department was happy to help, their limited resources made it difficult for them to respond quickly to new technologies and to support devices outside a preapproved set of platforms and manufacturers. It was necessary for me to develop my technology skills in order to deal with minor problems like basic installations of hardware, file transfers and software functions that arose, so the IT department could be left to work on the larger systemic problems like security and internal communications systems. In my busy resource classroom, taking the time to problem solve and learn new technology tools was often not possible. To develop my ability, I often needed to spend many hours outside the typical school day playing, setting up, testing and planning.

During this time, I also began to look more closely at the technology use that was happening around me in schools. I observed that my colleagues had a wide range of abilities and interest with regard to the digital technologies available to them. Some were excited to include technology in their classrooms, were skilled with it, and willing to
try new things; while others were more hesitant, or even refused to consider it. I also observed that while some elementary school classrooms were using digital technology daily, others had extremely limited access. This variation also seemed to coincide with the availability of professional development opportunities. Some schools were offering specific and regular formal and informal opportunities to learn about technology, while others relied on the availability of generic offerings at the district level. The resulting range of student access to technology in schools seemed to contrast with the availability and proliferation of digital technology in the consumer marketplace and in students’ homes.

My observations were not new or unique; researchers have been studying teachers’ varied response to the use of technology innovations as part of their teaching for some time (Cuban, 1986). Information technologies, well suited to learners and appealing to educators, are available for classroom use, but availability does not consistently translate into effective implementation in classrooms. Cuban, Kirkpatrick and Peck (2001) studied two well-funded and technologically-advanced high schools in California’s Silicon Valley. They observed that easy access to computers and lab time did not always guarantee that teachers would use technology in every subject or even every day, as might have been hoped for by technology advocates. One explanation for this contradiction may be that the process of incorporating technology into an existing teaching program is fraught with challenges that are not easily resolved using available resources. It is timely to consider these questions here in British Columbia, since in the latest curriculum; technology is no longer a subject to be visited every few days in the computer lab down the hall. Rather, it is woven into the fabric of the learning goals as both a tool for students to access and present learning (British Columbia Ministry of Education, 2015). In order for education leaders to fully support teachers’ use of technology as a tool to enhance student learning, there needs to be a clear understanding of the existing and potential barriers to that goal, as well as pragmatic solutions designed to assist teachers in overcoming those barriers.

Ultimately, I began to wonder if my personal experiences and my observations of other teachers implementing technology were typical of other elementary schools. What were other teachers with experiences similar to mine doing? What was their decision making like around the selection of technology, were they experiencing similar
challenges to mine, and were they able to successfully move past the challenges they encountered? These beginning questions and my experiences as a teacher in a large urban school district have informed the framework for my research study. For the purposes of this research, I narrowed my questions to the following:

1. What variety of disruptions do mid-career elementary teachers experience when they decide to implement or use technology as part of their classroom practice?
2. What strategies and supports do teachers rely upon when they experience disruptions?

In the following Chapters I will describe the process through which I have addressed these research questions. The chapters are divided into general subject matter, which are then divided into smaller subsections of increased detail to assist the reader in more fully understand the thinking, methods and analytical methods that have contributed to this research.

Chapter 2 will explore existing research, theories and frameworks that helped to guide my research. The review of existing literature on the subject of technology integration in classrooms is organized into three larger sections. The first section explores research that identifies barriers to technology implementation, including those related to resources in school systems and to the teachers themselves. The second section explores the complex interactions that researchers suggest are in play when technology implementation is considered within the larger context of a school or school district. The third and final section explores research on how to support teachers who are implementing technology, as well as the existing research on how teachers manage change and problem solving.

Chapter 3 provides a detailed description of the design of my research. I begin by describing how and why the particular group of participants were selected and recruited. I then describe both the methodology and methods that were employed during data collection and analysis. As this research uses a qualitative approach, this Chapter also contains a complete list of the themes developed from the data and frames the results sections.
The results of the data collection are summarized in Chapters 4 and 5, through themes and illustrations derived from the data. Chapter 4 goes into detail on two findings of this research related to the first research question. It is divided into two major sections and six sub-sections representing the disruptions that were reported by participants. Chapter 5 identifies three more findings related to the second research question. This Chapter is divided into two sections, which identify some variation between potential and actual problem solving strategies. Actual problem solving is then divided into four sections representing the problem solving, or support selected by teachers. This second and final results section will also relay the reported success of each of the problem-solving strategies.

In Chapter 6 I discuss my interpretation of the findings from Chapters 4 and 5. In particular I will discuss some of the most frequently reported disruptions and how context shaped the participants’ reported successes in problem solving. In this Chapter, I also caution the reader on the limitations of this research as presented.

In the final Chapter of this thesis, I discuss some of my conclusions about the experiences of mid-career elementary teachers implementing technology in the school district examined, their problem solving strategies and the success of those strategies. Chapter 7 also includes several suggested areas for future research.
Chapter 2. Literature Review

My observations and experiences inspired questions that were a starting place for a survey of research on the topic of teachers’ experiences integrating technology into their classroom practice. With my professional interest in working with students with learning challenges, my initial search focused on research related to teachers’ implementation of assistive technologies (AT). I began by searching Education Source for relevant peer reviewed articles using keywords like ‘assistive technology’ and ‘technology implementation’. Reading articles on this topic, I began to see similarities in the reported experiences of teachers using AT and those that I had observed among my colleagues using less specialized classroom technologies. Given the similarity, I chose to expand my survey of existing research to include all digital technologies. Using search topics such as ‘teacher decision making’, ‘technology integration’ and ‘technology adoption’, I was able to explore the reported experiences of a more general population of teachers using and implementing technology. In addition to database searches, at times I used the footnote chaining method by exploring references both forwards and backwards as inspired by relevant articles I had found. Through this process, I found articles which not only inspired my research but also guided my choice of methods for my own study, and the eventual interpretation of my results.

My literature search inspired and created a foundation for this study in a few ways. First, the volume of current research on my topic indicates that teachers’ integration of technology is a concern for other researchers as well as myself. For example, when I search Education Source for articles from 2011 to 2016 on the topic ‘teacher technology integration’ there are 256 published articles. Second, the range of approaches to this topic in the existing literature helped me to better define the lens through which to explore the subject matter that I wished to study. As mentioned earlier, my experiences as a teacher in the school system had led me to wonder about how teachers were experiencing technology use and implementation. As I surveyed the research available, I found a clustering of articles, which discussed teachers’ and
instructors' use of technology and more specifically, how their use was connected to their environment, their individual dispositions, education, experiences, the availability of training, and how variations in resource availability might be connected to the process of technology implementation. Although my research focused on the experiences of teachers in the K-7 system, I found it helpful to include research on technology implementation at both the K-12 and postsecondary levels because it increased the number of articles available but maintained a focus on the process of implementing technology for educational purposes. With my research questions in mind, I focused in on studies that identified the disruptions teachers were experiencing while implementing technology, and what they might be doing to overcome these challenges.

2.1. Research on technology implementation

Before going any further, it seems appropriate to define the term technology. Cuban (1986) considers the educational technologies historically available to teachers very broadly, including innovations such as textbooks, chalkboards, radios, film and television (p. 2). While such a broad definition of tools used in the classroom seems appropriate in Cuban’s historical consideration of classroom technology, I decided to constrain my search to more recently introduced digital technology innovations. In so doing many articles that come up focus their study on teachers’ use of computers (Ertmer, 1999) or other digital classroom technologies (Chen & Jang, 2014). Using the Merriam-Webster online dictionary (n.d.), the word “digital” is defined as “using or characterized by computer technology”. Therefore, the word “technology” throughout this thesis will refer to digital tools used in the classroom, whether created specifically for classroom use or appropriated as such.

2.1.1. Disruptions to technology implementation

Again, using the Merriam-Webster online dictionary (n.d.), disruption is defined as something that “cause(s) (something) to be unable to continue in the normal way”. While I looked at a variety of research on technology implementation, I found that researchers used a variety of names for the events and phenomena that may interrupt implementation. Some researchers used the word challenge (Bouck, Flanagan,
Heutsche, Okolo & Englert, 2011; Lee, Vega, & Ashton, 2005). Many others talk about barriers to implementation (Chmiliar, 2007; Ertmer, 1999; Chen & Jang, 2014). Throughout the literature review, I will use these three terms interchangeable; however for the purpose of my research, I will use the term disruption to describe a problem related to a technology tool that interrupts the planned implementation or use of that technology in a teachers’ classroom. A broad definition of disruption, which includes challenges that are related to technical, environmental, personal and social factors is consistent with existing literature (e.g. Ertmer, 1999). This section of the literature review will describe the impact of technical, environmental and personal disruptions on teaching. Later sections will examine prior research on social factors and the conditions needed to support effective implementation of classroom technology.

At the most basic level, teachers need to have access to supported functioning digital technology in order to use it with their students. To access technology, teachers require funding to purchase it, as well as infrastructure and available support to use the tools in their classrooms (Donnelly, McGarr & O’Reilly, 2011; Sheppard & Brown, 2014). School budgetary limits hinder both the purchase and support of classroom technologies (Dexter 2011). Bouck, et al. (2011) used qualitative methods to better understand the experiences of 13 middle school social studies teachers during technology implementation. The researchers found that technology access impacted implementation as well as sustained use of technology by teachers. Limited numbers of computers and slow or out of date models created feelings of frustration, vulnerability and a reluctance to use the software provided.

As might be expected, access to quality technical support has been identified as a help to teachers experiencing variability in the quality of available technology. To support this logic, Teo (2011) used data from a self-report questionnaire to test a newly developed model for analyzing correlational data on teacher’s intention to use technology in their classrooms. His quantitative research, suggests that teachers who had access to quality technical support had a higher intention to use the technology. Relatedly, in a cross-case analysis of five middle schools Dexter (2011) found that adequate support was important; where support was limited, so was the number of teachers who integrated technology in their classrooms. Park, Lee and Yi (2011) also found evidence to support this assertion using a survey of business students. They
found that while individual supports were important, supports at the group level make a difference to the individual’s use and perceptions of the technology. The research seems to indicate that factors like quality technical support and access to up to date functioning tools impact a teachers’ intentions and therefore possibly their decision to implement available technology tools.

Technology tools designed for classrooms offer unique features that may require different specialized training from that designed for workplace settings or the consumer marketplace. Software packages such as Office 365 and Google for Work, as their names suggest, were not originally designed to support teaching and learning, but are now being modified to support school needs through Office 365 Education and Google Classroom (Microsoft, n.d.; Google, n.d.). Although tools for business and home use have found their way into classrooms, the development of specialized classroom technology tools by for-profit companies indicates a need to differentiate tools for teaching environments. Software developers are not just modifying office technologies for classrooms, they are also creating specialized classroom technology for teachers and students. Tools such as Freshgrade, a web-based student digital portfolio tool, and Showbie, a secure file storage service for teachers, were designed in Canada with elementary teachers in mind (Freshgrade, n.d.; Showbie, n.d.). Classroom technologies such as these offer support for specific teaching environments. Other tools provide support for the general student population, while some even offer specific supports to address student with special needs; as in the case of Assistive Technologies and Accessible Information Technologies. Where the aforementioned challenges associated with general access and support for technology has the potential to disrupt implementation, use within the specialized environment of the classroom has other complications, which require special consideration and perhaps specialized training (Chmiliar, 2007).

To use the available technology effectively, teachers need to know what technology is both suitable and available to them, as well as how to use those tools (Pool, Reitsma & Mentz, 2011; Courduff, Szapkiw & Wendt, 2016). Wisdom et al. (2007) interviewed teachers, parents and administrators to explore a systems approach to implementing assistive information technology. Education system participants indicated a number of challenges resulting from limited training, experience and participation in the
technology selection process, which impacted implementing the tools effectively with students. Lee et al. (2005) surveyed hundreds of California special education personnel about their perceptions of assistive technology and barriers to using it. Educators indicated that limits on time and poor pre-service training had replaced funding as the most significant barrier to implementing AT in their classrooms. It appears that in some cases, teachers may not be receiving adequate training to keep pace with the technology they have available.

The Province of British Columbia recognizes the importance of on-going teacher training through the provision of opportunities for teacher professional development during five non-instructional days per year. The BC Teacher’s Federation emphasizes, “professional development is a process of ongoing growth, through involvement in programs, services, and activities designed to enable teachers, both individually and collectively, to enhance professional practice”. During these professional development days, teachers may choose from a variety of topics to explore through self-directed as well as formally offered learning opportunities (BC Teachers Federation, n.d.). The new BC curriculum discusses “ICT enabled learning environments” (p. 6) as a means for offering differentiated access to the existing curriculum, however it does not discuss how interested teachers might find the additional time needed to gain the required skills or knowledge needed to support this foundational element (British Columbia Ministry of Education, 2015). While the expectation to keep pace with pedagogical innovation is known and accounted for as part of professional learning, technology use to better enable students to access content could be considered to require specialized training.

For administrative purposes, a professional development workshop is a resource that educational leaders can observe being provided, can take attendance at, and can even gather evidence of growth from through communication with participants; but time for a teacher to practice a new skill informally outside of a training program or event would seem to be a much more difficult thing to track. One more clustering of research articles indicates that there is an inadequate provision of time to support the necessary exploration of technology to prepare for its use with students (Kersaint, Horton, Stohl, & Garogalo 2003; Chmiliar, 2007; Pool et al., 2013). Time during the workday but away from students requires paid release from teaching duties, and therefore becomes a budget line item that schools will have a limited ability to offer interested teachers. In
this way, time can be viewed both a resource and one of many barriers to technology implementation in classrooms.

Ertmer (1999) categorizes the barriers experienced by teachers implementing technology in a way that has been used to frame others research (Donnelly et al., 2011; Bouck et al., 2011). Although she states that her paper is not a research report, her ideas summarize and categorize teachers’ experiences based on a series of her own previously completed studies. She divides the barriers teachers face into two categories: first-order barriers (external) like those listed above are resource-based and can effectively be eliminated by an influx of money; and second-order barriers (internal) are based in the belief systems of the teachers themselves, including their beliefs about their own abilities, how students learn, and the usefulness of the technology available.

More recent research supports Ertmer’s assertions that her second order barriers influence a teachers’ ability to implement technology. Teo (2011) found evidence that teacher intention is more affected by their beliefs of the usefulness of the technology than subjective norms (influences from other persons). Baylor and Richie (2002) found that one of the best predictors of an individual teachers’ ability to use technology, as part of their classroom program was their openness to change. Howard (2013) also suggests that teachers’ predispositions around technology use are impacting their ability to implement tools and should be addressed directly through support and program design. Ertmer (1999) suggests that second order barriers are much more resistant to change than first order barriers (p. 5) but admits to the complex interplay that can exist between the two (p. 7).

### 2.1.2. Conditions for technology implementation

Staub (2009) also discusses the complexity of the changes that are necessary to implement technology in a school system. He suggests that “the predictors of the behavioral changes necessary can be understood through contextual, cognitive, and affective factors” but that researchers tend to look at these factors separately (p. 627). In the next section, I survey research that has examined the interactions between the various factors involved in technology implementation.
Drake (2002) suggests there is an important interplay between career stage or “years of formal teaching experience” (p. 313). While the availability of focused training on technology is a resource, career stage as defined is individual to the teacher but is also situated in time, the classroom or greater school context. Despite its complexity, Drake (2002) looked at career stage as it is related to a teachers’ ability to accept and make change. He theoretically sampled from a larger previously collected population to do an in depth qualitative study of 6 teachers. The results indicate that career stage impacted teachers’ ability to implement certain types of change. In their two-person case study, Chen et al. (2009) also observed that their participants career stage more than technology knowledge made a difference in their ability to make change specific to implementing technology.

Another complex interplay is the one between the individual teacher and their social environment, where a teachers’ social environment contributes to their ability to enact change (Hargreaves, 2001). Li and Choi (2014) studied the change associated with implementing technology when they surveyed over one thousand teachers in Hong Kong. Their quantitative results pointed at a connection between the existing social environment in their school and a teachers’ openness to using the technology being implemented. Perotta (2013) also reviewed survey data from over 600 teachers in the UK and found that their social environment influenced teachers’ perception of the usefulness of technology. More survey data from Moghavvemi and Salleh (2014) may indicate that technology users in general, not just teachers are affected by their environment. They surveyed 326 entrepreneurs and found that certain precipitating life events played a role in their ability to turn intentions into technology use behaviour. As the research discussed here suggests, the interplay of factors like career stage and environment may be influencing teacher beliefs, intentions and ability to make change.

During the review of existing research on technology implementation, I also found quite a few articles on the topic of technology adoption. “Adoption theory examines the individual and the choices an individual makes to accept or reject a particular innovation” (Staub, 2009, p. 626). There are a number of different models and theories in use by researchers who are exploring technology adoption, including the stages of concern model (Chen & Jang, 2014), concerns-based adoption model (Hosman & Cvetanoska, 2013), unified theory of acceptance and use of technology
theory (Park et al., 2011), the technology acceptance model (Teo, 2011) and diffusion theory (Rogers, 1997). Although these theories and models focus on different variables and use different methods of measurement, they all examine the individual's decision-making behaviour with regard to an innovation. In the following section, I survey some of the research available that looks at factors affecting adoption of innovations as they relate to technology implementation in classrooms.

Once the bells that signal the beginning of the school day have rung, many classroom teachers, particularly at the elementary school level, spend hours at a time with students away from the immediate help and social environment where they might receive the support or influence of other adults. Doyle and Ponder (1977) examined a combination of teacher discussions and interviews as well as existing studies on innovative projects in classrooms in an effort to create a model that might guide understanding about how practicing teachers make adoption decisions and respond to innovative classroom practices. The resulting frame, The Practicality Ethic, suggests that the isolating nature of individual classrooms and the resulting autonomy, not only reduces the influence of systemic changes; it impacts the way teachers respond to the change around them. They further suggest that teachers making decisions about classroom innovations consider many other factors like ease of implementation, fit for them and their students as well as the costs and benefits. The idea that teachers may be using a cost-benefits analysis is consistent with Howard's (2013) case study on one teacher's risk analysis of implementing technology. For the teacher at the focus of the study, who had minimal technology experience and negative feelings about using it, the costs of implementing technology outweighed the benefits.

The Practicality Ethic as well as Howard's risk analysis approach echo some of the themes presented in Everett Rogers' (1995) *Diffusion of Innovations*, which looks more closely at the process of individual adoption decisions within a social system. In particular, Rogers' four "perceived attributes of an innovation" (p. 208) seem very similar to that of Doyle and Ponder's three practical classroom procedures (p. 7). Rogers' "relative advantage" (p. 212) is very similar to Doyle and Ponder's concept of "cost" (p. 8). Both authors (as well as Howard, 2013) suggest that adoptees decide to adopt after considering the relative gains that will result. Rogers' "compatibility" (p. 224) shares the idea of the importance of best fit and beliefs of the adoptee with Doyle and Ponder's
“congruence” (p. 7). Finally, Rogers’ “trialability” (p. 243) and “observability” (p. 244) seem to serve the same intentions as Doyle and Ponder’s “instrumentality” (p. 7). These attributes are related to how easy it is for the adoptee to test out and observe the new innovation in their conditions. For Rogers, a teacher would be more likely to try a new tool if they could test run it and/or observe the benefits while Doyle and Ponder emphasizes not only the test run but the ease of use. Both Rogers “attributes” and Doyle and Ponder’s “procedures” offer guidance for designing the introduction of technological innovations to classroom teachers, that would impact the success and speed with which the technologies will be adopted. Supporting teacher technology use and implementation is another method that researchers have explored as a means of impacting the success of adoption.

2.1.3. Supporting technology use and implementation

The previous sections discussed existing research that explores disruptions that interrupt implementation as well as some of the conditions present during successful technology use and integration. This section will survey the research available regarding effective strategies for problem solving during technology use in classrooms.

As discussed in the previous section, teachers often work in isolating environments that impact their ability to make the informed decisions required when faced with technology problems (Doyle & Ponder, 1977). Literature searches on “teacher technology problem solving” often result in studies that focus on problem solving behaviours and strategies as required for academic problem solving, such as the solving of math equations (e.g. Kuzle, 2012; Zsoldos-Marchis, 2014). In the isolated classroom environment, when faced with a barrier to technology use such as the inability to print a document, teachers will likely require different problem solving skills and behaviours than they may have learned for teaching mathematics. For this reason, the phrase problem solving in the context of this research will refer to a teacher’s actions to overcome a technology related barrier through the use of their own knowledge and skills, or by seeking the support of others around them to meet an immediate goal.

Teacher training is the suggested solution to failed technology problem solving in many of the studies in which limits to knowledge and skill have been identified as
general barriers (Sheppard & Brown, 2014; Chmiliar, 2007; Hosman & Cvetanoska, 2013; Wong, Swee & Osman, 2013). Other researchers examine existing solutions to limits on teachers’ technology knowledge and skills by following along during teacher training initiatives and reporting on the positive impact (Gunn & Hollingsworth, 2014; Ciampa & Gallagher, 2013; Hosman & Cvetanoska, 2013). Teacher training opportunities have been reported to have a positive impact on teachers’ ability to implement technology (Baylor & Richie, 2002; Teo, 2011).

Research that examines teacher training as a way to support technology use in classrooms also uses different terms to identify the level of experience of the teacher being trained. Pre-service training refers to the training provided for teachers before they are employed as fully licenced teachers, and is typically provided by a post-secondary institution such as a college or university (as in Pool et al., 2011). In-service training typically refers to training for teachers who are currently employed by a school district (as in Chmiliar, 2007). In-service training is also often called professional development, as in Dexter (2011), Ertmer (1999) and Anderson, Wood, Piquette-Tomei, Savage and Mueller (2011).

As discussed in section 2.1.1, in the Province of British Columbia, teachers have five designated non-instructional days for both formal (organized and coordinated during a specific window of time) and informal (self-directed and/or over an undefined period of time) in-service professional development during the school year. Several methods of in-service training seem to be agreed upon as beneficial, such as modelling, reflection and collaboration (Pool et al., 2011; Ertmer, 1999). These suggested methods seem to reflect a belief that technology knowledge and skill in teachers is developed through a process of observation, discourse and self-reflection to create understanding. This type of training could occur either formally or informally. Other suggested methods seem to reflect a view that technology knowledge and skill should be developed through knowledge transfer and practice during formal workshops for training on specific devices (Chmiliar, 2007) and by spending time using new tools or techniques (Kersaint et al. 2003). Although this list of methods may vary in application, the common intention is to build knowledge and skill in teachers to better enable them to successfully use technology tools in their classrooms.
Researchers who have studied teachers’ developing knowledge and skills during some form teacher training identify different categories of knowledge and ability required for using technology as part of teaching (Ciampa & Gallagher, 2013; Pool et al., 2013; Baylor & Richie, 2002; Buss, Wetzel, Goulger, & Lindsey, 2015). Although these researchers divide the types of knowledge necessary for teaching technology into as many as 7 different categories, two types of knowledge in particular are relevant in the contexts considered in the present research. Pool et al. (2013) labelled the skills related to how to operate the technology “subject related skills”, while they labelled the skills related to how technology is used during the process of teaching “pedagogical subject skills” (p. 459). For clarity in the context of this study, the term technology skills will be used when discussing a teacher’s understanding of how to operate a piece of technology and pedagogical technology skills will refer to a teacher’s ability to use the technology in the classroom as part of their approach to teaching subject matter.

Although the present research is focused on practicing teachers, due to the limited number of articles available I found it helpful to include some research on pre-service teacher training, which also focuses on effective teacher training methods. For example, Buss et al. (2015) used a mixed methods approach to examine the technology skill development of pre-service teachers in two differently designed teacher-training courses. One was a stand-alone educational technology course with the purpose of teaching the use of up-to-date technology so that it could later be integrated into classroom use. The second kind of course had the same intentions but the technology use was infused in the methods content. The researchers found that the pre-service teachers learned technology skills; how to use technology and pedagogical technology skills; how to use it as part of their teaching method most effectively in the stand-alone education technology course. In addition, the pre-service teachers indicated a desire for modelling of technology use and a larger exposure to different types of technology, both of which were more available in the stand-alone course. Although this research was completed with pre-service teachers, it provides insight into one proven way that technology skills and pedagogical technology skills can be developed. If generalized to an in-service environment, these findings may indicate that teachers may benefit from opportunities for focused, up-to-date training, modelling and discourse of technology, as may be available in a university course.
In contrast, Courduff et al. (2016) looked at in-service special education teachers, who would not necessarily have the luxury of signing up for a stand-alone technology course while working in a classroom. The teachers in the study reported using a small-steps or a gradual approach to learning the technology skills necessary to integrate a new technology into their classroom practice. The small steps approach is described as voluntary independent learning taken on by the teachers themselves in response to an observed need in their classroom (p. 32). Although the teachers in this study were selected for participation because of their exemplary performance, and therefore may not represent all teachers, their small steps, voluntary learning approach may be explained as simply a practical solution to a limitation of formal training events in the work of Anderson et al. (2011). This team of researchers used observations and surveys of teachers engaged in a specially-designed training and support program and found that the variety of software problems encountered by teachers using classroom technology could not adequately be addressed in a training session (p. 34). As discussed above, the variety of technology tools available to teachers is large, and while some tools are specialized to the educational environment, teachers may be required to develop some technology skill without a specific training event, in a small steps manner as suggested by Courduff (2016).

The Courduff et al. (2016) research also looked at some of the pedagogical technology skills that exemplary special education teachers used while implementing technology, such as understanding a technology tool enough to know if it would be a good fit for students, knowing how to teach independent and responsible use of the tools to students, and evaluating the effectiveness of a tool in use (p. 33-34). While the context of this research was special education, the ability to assess good fit for students, to teach independent and responsible student use and to assess the effectiveness of a tool, appear to be generally useful teacher pedagogical technology skills.

As was suggested earlier by Doyle and Ponder (1977), a teacher’s ability and inclination to make a decision regarding a technology problem does not stem merely from the training they receive during a professional day, but also from what they perceive as realistic and possible for them in the context of their environment. Argyris and Schon (1974) offer a framework to explain learning in the context an organization (as cited in Argyris, 1976). Their models suggest that individuals engage in different
types of problem solving or learning depending the quality of feedback they get from the organization and how receptive they are to that feedback (p. 365). In *single-looped learning*, the individual works within the constraints of the organization, such as a school, while *double-looped learning* the individual questions those constraints and seeks out new solutions to problems (p. 367).

The constraints of the organization that Argyris (1976) refers to are the “processes that limit exploration and information and so help provide stability but also inhibit learning in fundamental organizational issues (p. 367).” The structure and predictability of the roles of staff and students are part of a school’s organization and therefore impact the type of problem solving available. The theory suggests that in order for change to happen, it must occur at both the individual and organizational level (p. 371). In the context of teacher problem solving during technology implementation, the implication would be that in order for the most effective problem solving to occur, the teacher and organization must work together, sharing power and leadership (p. 369).

Dexter (2011) supports the idea that effective technology support is most likely found where a team of people shares technology leadership. In her qualitative study mentioned previously, she found that while technology leaders needed to have a vision of technology implementation, they also were most successful when they worked using a distributed leadership model. Distributed leadership, as outlined by Spillane and Diamond (2007), is as the title suggests, an approach to leading an organization that takes advantage of the strengths of the stakeholders by distributing decision making power to those willing and able to take on leadership roles. Using this lens, Dexter (2011) found that effective school-level leadership, which includes a vision for technology implementation, prevents teachers’ struggles to maintain access and support. Dexter suggests that with a clearly communicated, strong, clear vision, technology leaders will be able to share what needs to happen, when and by whom which can also be a measure of success and a way to better determine how to individualize the support to individual teachers (p. 186).

Some researchers have examined programs that have a clear vision to determine their effectiveness. Anderson et al. (2011) worked closely with 10 primary teachers in a Canadian school to determine the kinds of instructional supports that were
requested when implementing a new web-based reading program within the context of a specialized technology support program. They initially provided instructional sessions to support implementation, then later, three to five facilitators were available in person to teachers for just-in-time support while the software was in use in the classroom. In addition, a reading specialist was available for contact by email and teachers were given the contact information of their school board Information technology support staff. When participants sought support, the kind most frequently sought was with regard to software issues, the next most frequent was hardware issues, followed by classroom management. Despite the presence of the support team to help with the reading instruction, requests for support around reading were minimal. Although the researchers reported that requests diminished over time, they noted that they never completely disappeared. Aside from the types of issues reported, it is interesting to note that Anderson et al. (2011) stated that the majority of issues were resolved through just-in-time, in-person support, thereby enabling teachers and students to carry on with the lesson as intended. The success of the just-in-time supports is a strong argument for increased support for teachers as they implement a new technology tool; however such close and dedicated support is not typical in elementary school classrooms. It is worth noting however that there were some problems that could not be resolved except by involving district level help, because they proved beyond the abilities of the support team that was supplied.

As has been demonstrated by the research listed in this section, teachers in a variety of settings continue to encounter barriers to their use of digital technologies in the classroom, stemming from limited knowledge and skills. These needs are being supported through a variety of approaches. Although it seems that increasing knowledge and skill may be a good way to support technology integration, decision making and even change, it is unclear if the methods listed above also impact teachers’ ability to employ effective problem-solving strategies for use in addressing the disruptions they may encounter in the course of their planned technology use and implementation. The limited research available specific to the process of teachers’ technology problem solving leads me to believe this is an area worthy of further study. Further, no research that I have found specifically addresses the success of different problem solving techniques used by teachers to address barriers to technology implementation. While Anderson et al. (2011) did evaluate the success of teachers’ implementation of
technology, their measures, *none, partial* and *full*, refer to the number of students in the class using a specific piece of software, not the successful use of the technology by the teacher.

The literature on technology implementation in classrooms indicates that teachers typically encounter a variety of disruptions that must be overcome in order that technology use can continue as planned for instructional purposes. Researchers also have suggested that the context and the resources available to support teachers impact their problem-solving ability. My research will explore what problem solving strategies and supports teachers see as available to them, which ones they are actually using when they encounter a disruption, and what results are achieved with these strategies with regard to the teachers’ planned technology use.
Chapter 3. Study Design and Methodology

The technology available to teachers for use with their students appears to be constantly changing and evolving, and will likely continue to do so (Staub, 2009). For this reason, teachers will always face new challenges as they attempt to integrate technology. While the research undertaken in my thesis had to examine some the challenges teachers faced with specific technologies, its main objective was to examine at a more general level how they attempt to overcome those challenges. To do so, I took care to design this study in such a way as to eliminate some of the barriers related to the use and implementation of technology as has been identified by past research.

3.1. Selection of participants

As indicated in the literature review, there are many factors that have the potential to impact a teacher’s ability to implement technology in their classroom. Through theoretical sampling (Creswell, 2012), I have tried to mediate some of the variables that might impact teachers technology use within the sample population. Specifically, I selected participants who had similar career stage, beliefs regarding the usefulness of technology, access to tools and experience.

Some research suggests that mid-career teachers may be more capable of making the changes necessary to successfully implement technology in their classrooms (Drake, 2002; Chen et al., 2009). The goal during participant selection was to work with teachers who were part of a mid-career group. Drake (2002) identified teachers with between 4 and 13 years experience as “early mid-career” teachers (p 320). She found that the California teachers surveyed, who had between 4 and 20 years experience, were the most able to implement the changes in teaching practice that were being studied. Through the interview data I collected, I was able to confirm the number of years of teaching experience for each participant. The participants of this study each had
a minimum of 5 years and a maximum of 13 years teaching experience and therefore will be considered mid-career teachers for the purposes of this study.

Based on my experiences and evidence in the existing literature there are a number of other factors that impact teachers use and implementation of technology. Teacher’s beliefs in the usefulness of technology (Baylor & Richie, 2002; Teo, 2011, Courduff et al., 2016), access to resources (Donnelly et al., 2011; Sheppard & Brown, 2014) and experience (Hosman & Cvetanoska, 2013; Chmiliar, 2007) were all variables the impact of which, I felt I could limit through design. In order to control for these factors I sought out participants through collegial recommendations, who had implemented technology in their classroom recently. To confirm that the participants had similar experiences with regards to these factors, some of the interview questions were designed to explore and thereby confirm participants’ similarities. All participants confirmed that they had introduced a new piece of technology into their practice within the last year. They confirmed that they had access to a minimum of a teacher computer and at least one half-class sets of shared technology in the form of a mobile iPad lab for use with students. Finally each of the teachers shared that they had been using technology with their students for 3 or more years and had completed a minimally a Bachelors degree while some had also completed their Masters. Based on their reports, this group of teachers were interested in using technology with students, they had access to tools to use with students and had some pre-existing experience implementing technology into their classroom practice.

3.2. Access to Entry

I found there were both advantages and disadvantages to being both a researcher and a teacher of similar-aged students in the same school district as the participants. The advantage of having had a shared experience such as I describe is one that Rogers (2003) calls homophily: a similarity “in certain attributes such as beliefs, education, socioeconomic status and the like” (p.19). Rogers indicates that this kind of similarity in background creates elements of increased trust. In the role of researcher and colleague, I found that participants were able to speak of their experiences with and use of technology with fluency, knowing that I might have had similar experiences with
the systems and tools available. Participants also seemed to openly discuss their challenges and successes with students, community members and their own personal development with the knowledge that I too might have had these experiences.

On the other hand, as suggested by Creswell (2007), as a teacher employed in the same school district, I recognize that “a researcher’s own particular ‘stance’ within the group may keep him or her from acknowledging all dimensions of the experiences” (p 139). Where my experiences may have been similar, my feeling of frustration at some of the barriers to technology use and my desire to support teachers who want to make change for themselves and their students may have had some impact on my data collection and interpretation. Knowing this, I used member checking (Creswell, 2012, p 47) for my interpretation of participant’s passages to confirm their intended meaning. In all cases the passages were identified as a correct interpretation of the teachers intention. I also worked closely on the data interpretation with my supervisor and had my committee review the results early on to reduce the potential for bias.

Research approval was provided by Simon Fraser University, the school district under study, and a provincial agency prior to approaching participants (see Appendix A). Based on the design submitted for approval, the first step in contacting participants for the research was to approach school district administrators and provincial agency directors for support in finding suitable candidates. A letter was provided which outlined the research and requested recommendations of teachers who had begun to use a new piece of technology in their classrooms within the last 5 months and who might be willing to participate in the research (see Appendix A). One administrator was particularly helpful, and provided a substantial list of potential participants. All of these candidate teachers were initially approached by email with the request and consent to participate (see Appendix A). Teachers who responded in the positive to the email request were then contacted a second time by email to arrange an interview appointment and to sign a participate consent in advance of the interview or observation (see Appendix A). On one occasion, a participant was being observed in the presence of a non-participant colleague who was recorded in conversation with the participant. This individual volunteered as an observation-only participant provided research consent for this purpose (see Appendix A). No data from the observation-only participant was used in the study.
Recruiting research participants was more challenging than I had originally expected. Despite the help of school district administrators, data collection could not begin until the end of the 2014/2015 school year. Initially, teachers were too busy wrapping up the school year, and then many were not in contact over the summer break. Once school began again in the fall, a few more of the recommended teachers responded to email requests. Some of these participants also provided collegial recommendations (i.e., snowball sampling) while a seventh participant indicated an interest during a collegial discussion with me outside of school hours.

3.3. Methods

Although there is substantial research exploring teachers’ experiences implementing technology, no research has been identified that considers how mid-career teachers are currently experiencing disruptions, how they are problem solving during those disruptions, and what level of problem solving success they are experiencing during technology use and implementation. Given the unknowns at the outset of this study, it is appropriate to begin the exploration of this topic using qualitative methods so that potential patterns, if they exist, may be observed (Creswell, 2012).

I chose to employ a case study methodology because my interest was a group of teachers that all belong to one school district and therefore can be defined as one case “within a bounded system” (Creswell, 2007, p. 73). Recognizing that I am viewing my case as a system, I have collected data in the form of interviews and observations so that I might more fully explore and understand how the teachers are experiencing technology implementation in their context (Simons, 2009). Stake (2006) states that a multiple case method is appropriate where “one small collection of people, activities, policies, strengths, problems or relationships is studied in detail” and “each case to be studied has its own problems and relationships.” (p. vi). Multiple case study is therefore appropriate for my research design because data consists of the reported and observed experiences of several teachers in one school district as they plan and implement technology use in their own classrooms and schools. While individual participant quotes may provide a sense of the individuals’ experience through illustration, “the official
interest is in the collection of these cases or in the phenomenon exhibited in those cases” (p. vi).

3.4. Data Collection

In total, seven elementary school teachers from one urban school district in British Columbia provided research permission and participated in one-on-one interviews and observations at a meeting at a time and place convenient to the teacher. The interview was designed to provide data from a guided discussion through a series of pre-determined questions and probes. The questions sought to explore teachers’ experiences both past and present, of existing technology use and its implementation as well as participant’s experiences as a technology user within the school district. In addition, as suggested by Stake (2006), questions also explored the teachers’ context for other potential influences such as the availability of professional development, communication within the school community, and the availability of school supplied technology. The observations were open-ended with the intention of gaining information and observing how participants typically used technology, their relationship with it and how it was being employed as a tool to support student learning. These two methods of data collection were used to create a more holistic account of the context in which participants were being studied (Creswell, 2012, p 186).

As a result of the design and a desire to observe in as naturalistic an environment as possible, all but one of the observations occurred within the participant teacher’s classroom during non-instructional hours (Stake, 2006). Before visits to schools, as a courtesy to the principal, teachers were given letters describing the purpose of the study to share with their administrators. Five of the interviews also occurred in the teachers’ classrooms. In the two instances where the observation or interview was not held in the classroom, they were conducted in a coffee shop. In all but one instance, the interviews occurred on the same day as the observation. For five of the meetings, the observation occurred first, followed by the interview. In total, the meetings lasted approximately two hours. A table describing the participants, along with the types of data collected, the dates, times, locations and durations can be viewed in Appendix C.
The interview portion on the meeting was more formal than the observation. I used a prepared list of questions that were grouped into related categories with some probes to encourage elaboration (See Appendix B). The interview questions were written and pilot tested, then modified for flow and clarity before being used with the participants in this research (Creswell, 2012, p. 226). The questions attempted to examine both the experiences of the teachers in reference to specific technology use and implementation, and the context in which they were using the technology -- including the types of strategies and supports that were available to them in the event of a technology-related problem (disruption). As suggested by Simons (2009), to create a more comfortable equitable relationship, I used a “conversational interview” where questions were used to guide the discussion in a more conversational manner, including interactions in which the participant asked questions of the researcher (p. 44).

For the observation portion of the meeting, participants were asked to use the time as they typically would to prepare for their next day with students. Although many chose to demonstrate their use of technology during that time, technology use was not a requirement or stated purpose of the observation. During the observations, I had a changing observational role (Creswell, 2012, p. 215). Similar to the interview, my intention was to keep the observed activity as authentic as possible, but also to ensure my understanding of the situation as presented. At times I was a participant observer, as Simons (2009) suggests, engaging in the environment in a way that provided adequate information to interpret what was being observed. As a participant observer, I found a level of equality with the participants that encouraged them to share their experiences with me as they would any teaching colleague. At other times, it was appropriate for me to watch and take notes. In this role, I was able to minimize my impact and silently observe the teachers’ actions in the naturalistic context of their teaching environment. Still other times, when participants encountered a problem, I worked alongside them, collaborating to produce a solution to the challenge they faced. During these situations, I considered myself a colleague and a part of their problem solving methods.
3.5. Data analysis

Both the observations and interviews were digitally recorded and transcribed verbatim, then copied into NVivo 10.2.2 for analysis. The first reading of the transcripts was completed as part of an initial exploration of data using a short list of codes, inspired by the literature review. Additional open codes were created as necessary to achieve complete coverage of the data and help identify phenomena of interest within the scope of the study. The initial reading resulted in over 80 codes across a wide range of categories such as the teaching environment, new technology use, professional development, decision-making, hurdles etc.

Through consultation with my thesis committee members, I decided to narrow the focus of the coding to include only three general categories: actual technology use (i.e., not including planned use), disruptions related to the technology use, and strategies employed by the teachers to deal with those disruptions. Although these code categories were similar to some of those used during the first reading, I felt unsure that the data had been adequately reviewed with the necessary focus on these specific code assignments. Subsequently, I reviewed and recoded all of the transcripts.

Once recoded, I used what Simons (2009) calls data reduction to narrow the cleaned data set (p. 120) by culling quotes that did not meet the strict criteria and definitions. At this time technology was more formally defined as programmable digital tools used by the teachers as part of their educational program. Disruptions were defined as those events that stopped implementation from progressing in the manner originally planned by the teacher. Next, I re-sorted the quotes representing their new codes. Each quote was coded for the type of disruption it represented, the strategy employed by the teacher to overcome the disruption, and the end result of the disruption experience (no use, modified use or full use). A more complete list of the resulting codes can be found below.

One final step of data organization occurred during the process of reporting the results. Despite the work that had gone into organizing the disruptions into six general topic areas, it became clear that this level of code needed to be grouped into two larger categories: technology-related disruptions and specific environmental disruptions. I had
noticed a difference between the sources of the disruptions participants had described. Some of the disruptions appeared to be beyond the teachers' control, while others were more local in their source. I began by labelling the two types of disruptions 'hard' and 'soft'. The hard disruption was one that was related to the resources that were being provided by the school district (e.g. professional development, pieces of technology, IT support). The soft disruptions were more within the influence of the teacher, and related to people and relationships (e.g. personal choices, student behaviour, parent requests).

In an attempt to clarify my terms and through discussion with my supervisor, we established that these two groups of disruptions could be named for their sources; hence I chose to name them 'technology-related' (disruptions related to having and using specific pieces of technology) and 'specific environment' (disruptions that were the result of events that occurred within an elementary school setting specifically).

The final coding scheme developed was as follows:

Disruptions experienced by technology using teachers
  Technology-related disruptions
    Access to technology
    Limits to teacher knowledge and skills
    Problems with technology functioning
  Specific environment disruptions
    Student related concerns
    Parent-teacher interactions
    Professional choice

Problem solving
  Potential problem solving resources
    Personal problem solving
    Within school support
    District support
    Outside district support
  Actual problem solving decisions
    Personal problem solving
    Within school support
    District support
Outside district support
No use
Modified use
Full use

In the following chapters, I will present the findings of this study in two sections, the first of which describes the findings related to the participants’ reported technology disruptions and the second of which will elaborate on teacher-reported problem solving strategies and supports.
Chapter 4. Disruptions Experienced by technology using teachers

This chapter will identify and provide detail about the first two findings from the data collected. The findings will then be examined in more detail using excerpts from the interviews and observations.

• **Finding 1**: All of the teachers interviewed reported experiencing a disruption on one or more occasions while implementing or using classroom technology.

• **Finding 2**: The reported disruptions can be grouped into two categories: those associated with the technology itself and those associated with the elementary classroom teachers’ environment.

As described in previous sections, I define *disruptions* as problems related to a technology tool or tools, which stopped implementation from progressing in the manner originally planned by the teacher. To qualify as a technology disruption, the event needed to meet a number of criteria. First, the teacher needed to report that the specific digital tool was being used as part of the teaching program, either by them or their students. A disruption could not involve a plan for the distant future. Second, the teacher needed to indicate that they had encountered a problem with continued use of that tool. The problem needed to be related to the specific technology tool, but was not limited solely to its function or design. Rather, the problem could be associated with the use of the tool in the school environment, where environmental and social factors may be in play. Finally, and most important, teachers needed to report a change in planned implementation or use of the tool following the problem event. In total, teachers involved in my data collection reported experiencing over 90 such events.

During the process of analyzing the data, six codes were developed to capture disruptions experienced by the participants while implementing and using classroom-based technology. Three of the disruptions were related to the use and functioning of classroom technologies themselves. The technology-related disruptions originated in limits to access to technology, limits to teachers’ knowledge, and problems with
technology functioning. The remaining three types of disruptions were specific to the environment in which the technology was being implemented and employed – in this case, the elementary school classroom. The specific environment disruptions identified were connected to student-related concerns, professional choice, and teacher-parent relationships. The two most frequently mentioned categories of disruption, their related sub codes, and the frequency with which participants reported them are summarized in Table 1. The sub categories will be presented in the following section in order of frequency, beginning with technology-related disruptions followed by specific environment disruptions. For each category, related quotes are included to illustrate the variety of disruptions as reported by participants. Each quote is labelled with either “participant #” or “P#” to indicate the particular data source. Detailed information about the data collection can be found in Appendix C.

Table 4.1 Summary of reported disruptions.

<table>
<thead>
<tr>
<th>Disruption type</th>
<th>Technology-related disruptions</th>
<th>Specific environment disruptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Access to technology</td>
<td>Limits to knowledge</td>
</tr>
<tr>
<td>Frequency</td>
<td>30</td>
<td>17</td>
</tr>
</tbody>
</table>

4.1. Technology related disruptions

The technology-related disruptions were grouped into three codes that described the types of challenges encountered by the participants. These disruptions are not specific to teaching, are independent of the environment, and in many cases are non-negotiable in the sense that they are connected to the functioning of the technology selected. Technology-related disruptions are the result of limits to access to technology, limits to teachers’ knowledge, and problems with the functioning of the technology itself.

4.1.1. Access to technology

Despite the careful selection of participant for a certain level of technology access, every participant interviewed shared at least one occasion when his or her
access to technology was disrupted. Access disruptions seemed to be linked to three different environmental conditions: an unexpected loss of access, technology sharing within a school, and functional limitations of the available technology.

In several cases, teachers experienced an unexpected loss of access to technology. Participants talked about a variety of circumstances creating unexpected loss of access such as when technology broke down, went missing, suddenly had additional costs, or became unavailable to the teacher. Two participants who had recently changed schools found that not every classroom is supplied or set up in the same way. The following participant moved back and forth between schools over a number of years. When she was given a SMART board to use at one school, she sought out professional development to learn how to use it as a teaching tool. Later, however, she needed to change schools and left the SMART board behind.

Researcher: So, when did you stop using the SMART board?
Participant 7: Well, when I switched schools because when I was here they had a SMART board in the room for me but when I switched schools there was nothing in that room.

Sharing technology between classes in schools also created disruptions for teachers use and implementation. All of the participants reported that their schools shared technologies such as desktops, carts of mobile technology (e.g. iPads or laptops), cameras and projectors. Although many of the participants reported disruptions that were linked to sharing technology, some teachers reported feeling this more acutely because of the technology skills of their students. In this example, a kindergarten teacher shares her rationale for minimally using the shared iPad cart. The short stints of access are inadequate to meet her learning goals given the amount of time it will take the students to learn to use the tool effectively.

If I can only sign [iPads] out once for a three week period and then I have to give it back then sometimes I felt like it was just a little bit hairy because it was... I felt that maybe the amount of time I spent training them would overtake the amount of time that we were actually doing something meaningful and so I hadn’t started [using them] that much. (P6)

The excerpts above demonstrate that, at times, teachers in the district have difficulty getting physical access to the tools they are interested in using. Access to
district technology infrastructure was also reported as a disruption. Mobile technology such as laptops, iPads and tablets use a wireless signal to offer their full function to teachers and students. At times, participants reported that some devices were not able to connect or communicate with the district system. In other instances, wireless signals were inadequate in both signal strength and capacity. For one teacher, access is limited while her school is under construction and a temporary system is in place.

We have a bit of a problem at (school). We have unreliable Wi-Fi. I think all the schools across the district have it wired, we don’t. ...because our school is going through the seismic upgrade process they are not setting it up for us in the same way that the other schools are. What they have done for us is we have these big white...(she points to a white box mounted on the classroom ceiling) ... to get us better access and they are in various places around the school but our classroom is very unreliable.... I would like to use technology more but we don’t have access to it. A lot of the time, we will spend 20 minutes just trying to get the signal. (P2)

As can be noted in Table 1, disruptions related to access to classroom technologies were the most frequently experienced disruption and one that was reported by every participant. The second most reported disruption was one that came from limits in the technology knowledge of participants.

4.1.2. Limits to teachers’ knowledge and skills

During the interviews and observations, 5 out of 7 participants shared disruptions to technology implementation or use that were related to limited or developing knowledge of the software, hardware, it’s setup, functions and at times how to use it with students effectively. The interview questions used during this study focused on teachers’ technology skills more than their technology knowledge. As a result, participants described disruptions that were associated with their skills. As stated in the literature review, there are a few different terms that can be used to describe the knowledge and skills necessary to implement digital technology in a classroom: for the purposes of this study technology skills refer to the skills and knowledge required to operate the technology and pedagogical technology skills refer to skills with using technology during the process of teaching. Limits to both these types of skills were found to be associated with disruptions reported by participants.
Despite having selected teachers who had had experience using technology in their classrooms for a minimum of 3 years, participants reported disruptions that were linked to limits on technology skills using the available software. Teachers may be familiar with a tool and know what it can do, but lack the experience using it to be able to use it the way they want to without support. In some cases the specific problem is with an operating system, a software’s features or functions, or as in the following case, which software will do the job desired. In this case, the participant would like to share students’ oral reading samples so they can be played on-demand using a mobile technology app. She has seen an app do this before, but she has not found it or a way to get the one she has to work for her.

One thing I am struggling with right now is learning how to use audio clips with the QR codes... the kids should be able to read the book, record themselves and make a QR code and stick it on the back of the book so anybody can hear ...I am struggling right now finding a QR code ... that is free and easy enough for kids to do on their own...its just these little steps and I have seen it done so many times so its just a matter of figuring it out (P5)

Technology skills for using existing classroom hardware were also a source of technology use disruptions. Though hardware was made available to participants, this did not always mean that it was utilized particularly when the teacher lacked the skills to get it to work. In this example, the teacher has access to a projector that is shared between several classes and would require set-up she has not had time to practice. Limited experience setting up and using the projector resulted in a disruption related to the hardware.

Researcher: I see a chalkboard on one side and whiteboard but I don’t see a projector.

Participant 3: We do have a projector I am embarrassed to say we do. We are supposed to share it with many classes. I don’t know how to use it....so, no.

In the examples above, teachers reported disruptions where they lacked the technology skills necessary to operate a tool. Disruptions were also reported when teacher’s lacked pedagogical technology skills or the knowledge and ability to use the available tools in the classroom for the purposes of meeting learning goals with students. As in this example, participants were cautious as they introduced technology to students.
This teacher expresses her need to know how to use a file management tool as part of her writing program but also to know the implications of using the tool with students in the classroom.

>[Using [that file management tool] was all sort of new to me and I was just starting to get the hang of it so I know that (Teacher 1) did her writers workshop and they were uploading [student work] all the time but I didn’t get there with my kids because we only started half way through the year. (P7)

Both technology skills and pedagogical technology skills varied across participants and tools, as should be expected within any population of varying interests and specialties. At times however, disruptions with technology use or implementation were less related to teachers’ knowledge and more related to when problems with the way the technology functioned.

4.1.3. Problems with technology functioning

Six out of seven participants reported disruptions that were related to problems with the functioning of the technology they had intended to use. The kinds of technology functioning problems that were reported included software function issues such as limitations to its design or malfunctions within the software, and problems with old or outdated technology.

System incompatibilities created disruptions in instances where the tool failed or had difficulty working, within the existing school or classroom system. In some instances, teachers reported that devices required special set-up, transportation or specialized accessories not typically available (such as microphones) to work as required. The participant in the following example had two different challenges related to her ability to access student work from devices. After starting a ‘bring your own device’ program she found that some brands of tablet were not compatible with the secure school Wifi network, while others lacked access to the specific app she planned to use to manage student assignments.

The iPad it worked well with the network. It didn’t get rejected and some of the other [mobile devices] did. And then some of the apps like Showbie wouldn’t go on some of the tablets and that was a bit of a
pain because I would have to have them email [their work] to me. (P7)

At times, teachers reported finding software design limitations, which resulted in technology use disruptions. Disruptions that were considered software function problems were the result of decisions made by the manufacturer or designer, and require specialized knowledge on the part of the teachers to change or repair. Depending on the teacher’s level of knowledge of technology availability and functions, these disruptions could eventually trigger a professional use decision to determine which might be the best fit, or poses fewer challenges associated with attaining an educational goal. Typical technology function disruptions included regular system updates, which created unpredictable and longer setup times. Other functional disruptions occurred when the selected tool did not have all the necessary features, or had features that malfunctioned or that created an inability for students to share work effectively, as in the following example. This teacher is experimenting with a web-based tool that allows students to create interactive stories but has awkward provisions for saving students’ work that makes it difficult for the teacher to collect it.

Twine…saves [student stories on-line] and if you have a laptop you can then download it and do more with it. And I have asked [students] to send [their story] to me but I can’t open it. It only works on [the students] iPad and their browser. (P8)

Finally, one participant reported that old, out-dated equipment was a source of disruption that ultimately meant reduced access to technology for her students. She had been able to obtain a handful of laptops for use in her classroom; however, using these out-dated laptops involved too much setup and demanded too much student support to justify their continued use.

Some of those, the white ones, are so old that you can’t even do anything with them. You have to use RTF I think with them when you are writing and you have to teach [file transfer]. Two years ago I tried that and you have to teach them how to save an RTF file onto web key and then put it on [a different] computer. That’s too many things. (P2)

In the larger category illustrated by this section (4.1) technology-related disruptions affected all the participants interviewed. Disruptions that were linked to the
technology intended for use or implementation included limited access to the technology, limited participant knowledge of the technology or its functions, and problems with the functioning of the technology itself. These disruptions, as recorded during the interviews and observations, were the more frequent of the two larger disruption categories. The second large category, specific environment disruptions, contains those disruptions that may occur independently of the type of technology because they are more closely related to the context where the technology is being used and who is using it, rather than the specific technology itself.

4.2. Specific environment disruptions

As mid-career practicing elementary school teachers, the participants worked with a range of grades from K to 7. Throughout the interviews and observations, the teachers shared their experiences implementing and using technology, which were at times disrupted by circumstances that might be considered specific to their context because of the age of their students and the types of professional decision-making required of teachers using technology. Specific environment disruptions were grouped into three codes: student skills, parent-teacher interactions and professional choice.

4.2.1. Student related concerns

Six of the participants discussed disruptions to their technology use that were related to student skills and disposition with regards to technology handling and use. The student related disruptions were identified as existing or potential student behaviours related to their skill development and disposition towards technology or technology use, which were a source of concern for the teacher. Upon closer examination of the student related concerns, these were divided into four areas: digital citizenship, self-regulation, security (including behaviour related to the safety of the technology) and executive skills.

Teachers’ classroom management strategies differ depending on students’ developmental age and maturity. A number of participants reported that digital citizenship was lacking in their students. On-line behaviour and digital safety created
disruptions for teachers' as they tried to find a balance between student technology use, supervision and protection. As described in the teacher quote below, strategies for younger students often include more supervision and scaffolding than for older students. She is using caution with a web-based blogging tool, not knowing if students are ready to be posting comments and pictures that anyone on the Internet can see and read.

For right now at the beginning of the year and especially this year with [me] only being here three days a week. I am not making as much of that personal connection to really talk to them about what they are putting on [their blogs] and explaining [why it is important]. (P5)

The participants also identified disruptions that were associated with their students’ ability to self-regulate during technology use. Students’ on-task behaviour when using technology, as well as their ability to monitor their own use behaviour, created disruptions for teachers as they tried to maintain a positive learning environment. At times, individual students’ ability to self-regulate in the context of whole class technology use made completing a project as intended difficult.

Last year with the class we looked at the Book Creator [for iPad] but it was more of an ‘explore’ and we didn’t actually do anything on it. We explored it and some of the kids practiced. They had learned how to take photos and they took photos and put it in [their book] but really they were such a bananas class that I just had to take it away because they were just being inappropriate. (P3)

The financial cost of devices, as well as the fragile nature of digital technology was an additional source of disruption related to student disposition. At times, students showed behaviour, which indicated a lack of understanding of how to care for digital technology, which was cause for teachers’ concern. One teacher’s negative experience prompted him to rethink a ‘bring your own device’ policy to address students’ behaviour variability in his class.

So 5 years ago someone got their laptop stolen because they left it in their bag and went and played basketball on the other side of the school, and that was a wake up call in that these people look like adults but they are children so if you are going to - I want them to bring a device if they can and their parents allow them. (P4)
The relative immaturity of elementary school students also influences their level of executive functioning, which in turn affects their use behaviour. Recalling passwords and navigating software at times required extra support, which resulted in disruptions to technology use and implementation. In the following example, the teacher knows that at the time of the interview, her grade 4 students do not have the skills to use or to choose the right technology tool for demonstrating their learning, but she is hopeful that this will change given some time.

I would say [we don’t use technology] every day. There are times when we can’t get to it because we have to do other things...I would love it if it could be more organic but we are getting there we are trying to learn some apps so that they can eventually make a decision. And though, it is only November right now, usually it is January when you really start taking off. (P2)

The age, maturity and disposition of elementary school students created disruptions to teachers’ use and plans for technology implementation. Elementary school students’ developing skills also necessitated on-going involvement by parents at school as part of students’ support around their skill development. At times, interactions with parents around technology use created additional disruptions for teachers’ plans.

### 4.2.2. Parent-teacher interactions

Six of seven participants shared disruptions to technology use that were related to interactions with their students’ parents. Some of the disruptions were connected to the way that parents and teachers communicated between home and school. Other disruptions came from expressed or perceived concerns of parents regarding technology use in school.

For elementary teachers in BC, communication with parents is a legislated responsibility; therefore, it is not surprising that the participants all made reference to an interaction with students’ parents on at least one occasion during the interview or observation. Teachers who reported parent-related disruptions regarding communication were concerned with best practices for managing the volume, frequency and content of communication with families. Two participants reported that the tools available to them disrupted communication. In their school communities, language
barriers and inconsistent levels of technology access on the part of parents made digital tools an unreliable method of communication. In contrast, teachers also shared concerns with managing too high a volume of communication. As illustrated in the excerpt below, asynchronous communication offers convenience at a cost, as the teacher must now create a different set of social rules to follow. Some participants shared concerns that the perception of instant access, instant reporting and instant response had increased the expectations of communication between parents and teachers. This teacher has opted not to include her assessment of students’ work on a digital portfolio where parents will have instant access. A colleague had reported to her that parents can use this new communication tool to address their concerns about their child at any time. Meeting with parents can be a time consuming endeavour particularly in younger grades when parents tend to be more involved in their child’s progress. Parent-teacher meetings can occur throughout the school year but teachers try to conduct the majority of interviews and now goal setting meetings during specific periods. Digital portfolios seem to risk spreading these meetings out reducing teacher time for other tasks.

This [digital portfolio] allows [assessment] capability but I have chosen not [to use it]. You can just write in assess (points to button) you can choose different formats. ...So if I write a comment say "Johnny knows this. Is strong here but is not so here" …What it does open up, which is hard for me and [why] I am not doing it is there is the comment issue, like [I heard an example] from the other class, (parent comment) “Oh I see he has done this, did he finish it, is that normal” then as teachers that is a huge… that’s really a conversation that we normally save for goal setting. (P6)

Related disruptions developed from the expressed concerns of the parents regarding the use of technology in the classroom. Parents express their concerns around increased screen time required at home for homework, and concerns around the use of social media tools. In other instances like in the example below, parents share concerns about the potential increase in “screen time” at school, asking that it doesn’t become the only literacy tool.

We did have some parents who were like "We don’t want everything to be on a device" (P8)
Parent-teacher relationship disruptions occurred for almost all of the participants. Although many reported experiencing a disruption of this kind, the frequency of parent-teacher relationship disruptions was not as high as many of the other disruptions. Parent-teacher relationship disruptions were similar in frequency to disruptions related to professional choice.

4.2.3. Professional Choice

The participants selected were all interested in implementing and using technology as part of their teaching program. Every participant was able to identify one or more tools that they had implemented in their classroom within the last year. For some of the participants, it was possible and became necessary to choose among a variety of tools and teaching strategies available to meet their goals with regard to student learning. Five participants indicated disruptions that were connected to a need to prioritize a variety of tasks and goals over specific technology tool use. The two types of technology use disruptions associated with teacher’s professional choice were connected to time management and a tool’s best fit for the intended use.

Teachers’ considerations when implementing technology in their classes included how to best manage the time available to teach with or use the technology with students. For participants with younger, less technologically experienced students, the instructional time budgeted for a project had to include time for students to learn to use the tools. For some teachers like the one in the example below, training students to use a tool is only one of many priorities to consider. This teacher was carrying out a personal inquiry into an early childhood teaching method, and ultimately found it a struggle to use technology with her students on top of this commitment.

I wish I could have used [the iPods] more but again I was also doing Reggio and doing a social justice with the kids. I used it mainly actually in conjunction with the Reggio. We used it with something called Story Workshop and we used the voice to record and then using QR codes, the kids were able to listen to their own stories. The retelling of their own stories [was] developing their own language but [using the iPods] was frankly very, very time consuming even with training [the students] to record. (P6)
Similarly, participants working with older students had difficulty juggling the addition of technology to their classes, but for different reasons. For teachers of older, more capable students, using digital and social media tools for in-class writing increased student engagement and writing volume, which in turn increased the time they were required to budget for marking and monitoring students’ work. For these teachers, at times disruptions were connected to how much time was available to assess and manage student output.

Three participants reported that, for them, technology use disruptions occurred when considering the best fit of the tool to the intended learning goals. Best-fit disruptions were reported when a technology was considered for use in the context of other strong alternatives. The decision involves not only the design of the tool, but also student use of the tool and its impact on the teacher in the environment. The disruptions reported occurred when the teachers realized that the tool no longer met the needs as intended. As mentioned in an earlier section, for the purposes of this study, a technology function problem can eventually become an issue of best fit, but only when there are more options available to the teacher to choose from. The excerpt below illustrates that at times, tools in use are not the best choice for a group of students. The teacher admits to liking the tool discussed, but when one group of students prefers to use other tools, he is open to other choices.

So three of the groups are using iMovie. [My class] kind of moved away from explain everything, we kind of found it was clunky, the students didn’t really like it, I liked it, the [other] teachers liked it....so another group is using iStopmotion and another is using SCRATCH and creating Pangaea and having it all separate so um but they are having so much fun. (P4)

Similarly, other teachers reported best-fit disruptions that were the result of considering tool design and how it might support the intended learning goals.
Chapter 5. Problem solving

This Chapter will explore the second set of research findings. Examples of the findings will be illustrated using excerpts from the data collected during the interviews and observations.

• **Finding 3**: All the teachers identified three or four different problem solving methods that could be used in the event of a potential technology disruption.

• **Finding 4**: Problem-solving methods identified by teachers included personal problem solving (e.g., troubleshooting, researching solutions online), school-based support, district support, and support from friends or family outside the school system.

• **Finding 5**: Following the use of one of the identified problem-solving methods, teachers reported varying degrees of technology use, including no use, modified use and full use.

Throughout the interviews and observations, participants shared their experiences implementing and using technologies as part of their teaching practice. While discussing technology use, all of the participants shared occasions when they experienced a disruption to that use. Chapter 4 illustrated the kinds of disruptions that were experienced. The following section looks more closely at Findings 3 and 4; the participants’ problem solving related to these disruptions to identify what strategies and supports participants relied upon when they experienced disruptions. To establish the potential strategies and support options available in the school district, participants were asked to share how they would typically deal with a technology disruption. The identified strategies and supports were coded based on their relative proximity to the technology use environment. To discover the strategies and supports being used during actual disruption-related problem solving, the events previously coded as disruptions in chapter 4, were sub-coded using the identified potential strategies and supports available in the district, as identified by participants.

In addition, this section will illustrate in detail Finding 5: the reported successes of the strategies and supports used by teachers. Each of the actual strategies or supports
identified will be discussed in terms of its frequency of use with specific disruptions, but also with regard to its success in supporting teachers’ on-going use of the particular technology. For every reported instance of use for a strategy, the codes *full use*, *modified use* or *no use* identify the level of on-going use that was obtained.

5.1. Potential problem solving resources

Interview questions were designed to develop a better understanding of technology implementation in this district. Questions asked participants to share their experiences implementing or using technology, their disruption experiences and the available supports and problem-solving strategies that might impact technology use. This section will explore the *potential* problem solving strategies and supports available in the district as identified by participants. The intention of this section is to establish the range of potential supports available in the district that each teacher knew about, and therefore could access.

The following interview questions were intended to help participants identify the strategies and supports available to them that could be used in the event of a potential technology disruption.

• Do you ever have problems with the technology? What do you do when that happens?
• Have you done any professional development for X?
• How else might you get support using X?

In many cases the responses to these interview questions included references to real situations.

Researcher: Do you ever have problems with the technology?
Participant 2: All the time.
Researcher: And so what do you do when that happens?
Participant 2: I try to model [behaviour] to show my students [despite] how frustrating it can be. Yesterday, I was trying to print three or four pictures and at one point you’ve got kids around and they’re all on task but they come and ask questions. They see I’m not hiding [my problem solving] …I’m writing a message to my vice principal, “Call [me], I’m
having trouble doing this please help me. I don’t know how
to do this.” But, of course before that I went through all the
steps [to solve the problem].

At times, however, responses also described hypothetical or potential problem solving.

Researcher: When you’re using the iPads how else might you get some
support for that Book Creator [app]?

Participant 3: Okay spit balling I could ask (teacher 2) if he could
come into class with me and I could ask a supervision aid to
goon and watch his class.

Participant responses to these questions were grouped into four different codes
representing the proximity of the strategy or support to the participant. The closest
source of support was participants, and their personal skills and problem-solving
strategies. Personal problem solving strategies also included Internet searches to
diagnose and troubleshoot problems. Next closest were within-school supports, which
included students, colleagues and school administrators. The next level of proximity
was school district support, including district administrators, teacher consultants and
mentors, as well as district IT specialists. The final and most distant source of support
identified was non-school personnel including personal friends, parents, software
vendors, online forum participants and non-district consultants. Table 2 summarizes the
total number of participants who identified each potential support as one they might use
when in need.

Table 5.1  Sources of potential problem solving support.

<table>
<thead>
<tr>
<th>Type of support</th>
<th>Personal</th>
<th>Within School</th>
<th>District</th>
<th>Outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant count</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

All participants identified resources at the district level to help solve disruptions in
technology use or implementation. Most participants felt that they could also use
personal or within-school resources to work through a technology disruption. Only three
participants talked about using support from outside the district as one of their potential
problem solving strategies. The support categories used to group potential problem solving
were also used to explore actual reported problem solving events in the next
section.
5.2. Actual problem solving decisions

Throughout the interviews and observations, participants shared close over 90 unique examples of disruption experiences related to implementing technology as part of their classroom program. While describing their experience, participants often included information about their response to the disruption, what strategy, if any they chose to address it, and what the outcomes were. This section will explore the context and effectiveness of actual problem solving decisions by this group of participants in response to actual disruptions within the school environment.

The codes listed in section 4.1 were based on the potential strategies or supports described by this group of participants, but upon further examination of the data it appears reasonable to use these same support codes to explore actual examples of participant problem-solving decisions. Each of the problem solving strategies or supports that were previously identified as ‘potential’ were found in use in the context of actual disruptions. Their frequency is summarized in Table 3.

### Table 5.2 Frequency of actual problem solving support selected.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Personal problem solving</th>
<th>Within school support</th>
<th>District supports</th>
<th>Outside district supports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution of disruptions</td>
<td>58</td>
<td>16</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

Each strategy’s frequency of use decreased progressively as the relative proximity from the teacher and their home classroom increased. In this section, each strategy is examined more closely for its relative success and use with the disruptions as coded in section 5.1. The sub-codes: “full use”, “modified use” and “no use” are used to identify the status of technology use following the solution strategy selected. ‘Full use’ was used when there was no change in the technology use following the disruption. ‘Modified use’ was used for instances where the technology use was reduced or was modified in some way that meant reduced functionality. Finally, the ‘no use’ sub-code was given to outcomes, where the technology was no longer in use by the teacher as a result of the disruption. In some instances, participants reported using more than one problem-solving strategy. In these cases, each strategy selected was coded separately to reflect the frequency of a strategy’s use and its relative success.
5.3. Actual strategies and supports

5.3.1. Personal problem solving strategies

Personal problem solving strategies were most used by this group of mid-career teachers in this district. Every participant was reported or was observed using personal problem solving during the interviews and observations. Of the total number of disruptions identified, personal problem solving strategies were employed for more than half. The types of strategies coded under personal problem solving included the use of personal knowledge and skill, experimentation, and research. The following table (4) identifies the types of disruptions that were addressed with personal problem solving strategies as well as their relative success.

<table>
<thead>
<tr>
<th>Success</th>
<th>Access limited</th>
<th>Limits to knowledge</th>
<th>Technology problem</th>
<th>Student concern</th>
<th>Parent interaction</th>
<th>Prof. choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>No use</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Modified use</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Full use</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

The success of personal problem solving ranged depending on the type of disruption. When personal problem solving was used to address disruptions involving access to technology, full use was maintained in more cases than resulted in no use or modified use. Participants often found and used personal, school or community resources, which created the access necessary for full use. The following two excerpts demonstrate two different ways that participants used their personal problem solving and their own resources to maintain their ability to use technology despite a disruption. In the first, the teacher has weighed out her need for the tool, its cost for purchase and the typical wait-time if she were to request it from her school or district. She manages to maintain full use because she decides to use her own personal funds rather than wait.

It’s the school iPad and so they need to load the apps and so sometimes it would be 2 months and so I would just end up buying them and so I would be like oh this is stupid and so I would be paying my own money and they are not going to return it to me but I needed it now and I am not going to wait for it. (P7)
The next quote demonstrates that keeping devices secure and charged has a simple solution if there is a locking cart that will plug into an outlet at the end of the day. Without that specially designed cabinet, the teacher has found a way to maintain use through a modification. She must spend time she might otherwise use for planning and marking to move devices between a locked cupboard and an oversubscribed electrical outlet then monitor a rotation to ensure they are all ready for use.

I manage everything I don’t really have a cart I have to just charge [the iPads]. I have to make sure they are all charged. I have my little station here with all the mates [cords]. I don’t have enough for all of them because some have disappeared over time but I kind of set it up and decide which ones are most important, the least charge because at night - if you have a cart then you can just lock it up and they charge overnight. R: and so you try to charge through the day because otherwise it is locked up and not chargeable in that section [where the locked cupboard is]. So you have eight sitting there. P: Two of them are from my class, they are the ones that a family member gave [to us] and I have 8 [total]. (P2)

When personal problem solving was used to address student skill disruptions, “modified use” and “full use” were the only two outcomes. The successful strategies often directly addressed the missing student skill through further education, or policies and procedures to guide appropriate use. In this example, the participant maintains full use because she has been proactive in her creation of contracts, which serve to both educate students and reinforce her expectations around mobile technology use.

Every now and then when a kid doesn’t understand what they are supposed to do, he will get off task and start searching what he is not supposed to but I have a digital responsibility contract that goes home at the beginning of the year.... then if the kids aren’t doing one of these check marks, I’ll call them up and say “OK lets look at the digital responsibility code, OK Use the internet for educational purposes, Ok, do you not understand?”(P8)

Personal problem solving strategies used to address technology function problems had mixed success, but did not often result in a complete loss of use. Where the technology design was not well suited for the intended purpose or audience, problem-solving strategies included modifications to the classroom set-up or the expectations for student use. As in this example, when a tool is not optimally designed
for the specific age group, students may resist using it for certain tasks resulting in modified.

I tried [using this blog for writing] last year getting the kids to put their stories up here but they found it kind of cumbersome to type the whole story on [the blog itself]. They would actually most of them would actually rather write it or do it in something like book creator and then post it... about half did it on [the app] Book Creator, about a quarter wanted to write it in their own book and do their own drawing and then nobody actually chose the blog. I think again it is that nervousness around I am putting it up in front of a big wide audience and I am not sure its what everybody is going to like - and I guess... two of them typed it on [MS} Word. (P5)

Personal problem solving strategies appear to be less effective for disruptions related to limits to teachers’ knowledge, parent interactions and professional choice. Typical solutions to parent interaction disruptions most often resulted in modified use of the classroom technology. The chosen strategies often included a compromise on the part of the teacher and therefore modified use so that technology use could continue in a manner that respected parents’ requests or needs. For this teacher, a parents’ request for no screen time at home means there will not be any homework assigned that involves the use of screen based technology.

I have one parent commenting on the, how she wants screen time at home to be kept to a minimum. So...that means that [we] are using it in the classroom only. (P2)

When the disruption was related to limited knowledge of the technology, some of the personal problem solving strategies addressed the knowledge limitation directly to develop the missing knowledge through research and exploration. Continued from the limits to knowledge disruptions section in Chapter 3, this teacher is working hard to find new ways to demonstrate student’s reading skills. She uses personal problem solving to address the knowledge disruption by doing research on her own time.

Yeah, its just these little steps and I have seen [QR codes used for audio clips] done so many times so its just a matter of figuring it out, last night I was doing a little bit of research and trying it myself. (P5)

As discussed in Chapter 2, five school closure days are distributed throughout the school year and are identified as days for teachers to participate in professional
development. Following the discussion above, the participant acknowledged that for her, learning about technology and how to use it often fell outside of district identified professional development times.

I find it a bit funny when they say “oh well you need to do professional development on this day at this time” like the Oct 21 one and I am like what do you mean, I have done so much I spend a weekend, I spend a whole weekend with Microsoft, what do you mean I have to do it at that time and so I end up doing self directed because...I just find it very interesting. I think we have to look at that as teachers and say I think we are really putting ourselves in a box by saying you can only do it on Oct 21 between 9 and 3 instead of valuing what teachers are already doing whether it is sitting at home looking at Pinterest or blogging with their kids, they are doing it, and just sort of acknowledging that we are doing professional development. (P5)

Other participants reported spending time beyond work and professional days to learn more about the technology they were using. Interest may be one explanation for working on technology problem solving outside the workday; however the following participant offered a different explanation for bringing work home.

I would like to say that a lot of the things that happen are behind the scenes, right? You talk about how you set up in the morning but everything else that you do -- reading, giving feedback, is all after school. Prep time doesn’t come often. We have 90 minutes.... Yesterday I had no recess, I had no lunch, I had a meeting before school and I had one after school, which I couldn’t make it to because I have to finish this residency [prep] and all this. I had lunch at four, so you go from like kids following you around needing you because you are more than just the teacher or the person that will deliver the information so you are the person that helps. We spent two days trying to print a paper, so then you’ve got that and then you try to go next-door and you try to go and print it and it doesn’t work. And then you go to the computer lab. So you have all this stuff happening, and in the day really you are there for the kids and after school you are doing your actual work, you’re planning, you’re marking, whatever you call it, giving feedback and everything else so it’s a really hard thing. (P2)

Regardless of the limited time in the work day and limited designated professional development time, teachers are using personal problem solving strategies to directly address their deficits and are building the skills necessary to implement and use technology with students. Subject-related skills include the ability to understand and
use tools effectively, but also the ability to diagnose and solve problems with the technology when they arise.

Disruptions due to teachers' limited knowledge were difficult to manage with personal problem solving when the knowledge necessary to diagnose and troubleshoot the disruption was limited in the first place. Technology-related disruptions that some might consider "known problems" with an easy fix were overwhelming to others due to varied experience and knowledge of the large number of technology tools in use. Despite this, at times such as that described in the following quote, modified use was attained. The teacher knows how to use most of the software program, but has not figured out some of the shortcuts that might save her time.

Researcher: I am noticing that you have to restart the computer.
Participant 3: Yes, because that is the only way that I know how to [open the program I am using] probably not the best way.

Disruptions that were related to professional choice were often the result of competing personal interests or prior decision-making by the individual teacher. When the teacher is experiencing a disruption of this kind, the personal problem solving had mixed end results with regard to maintaining use. Most often however, there was modified or (as was the case in this excerpt) no use.

Researcher: So when the cart was there, if I may ask, why did you choose not to participate at that time?
Participant 6: ...At that time, I was doing my own inquiry...each year [we] looked into our own inquiry and I was starting Reggio [teaching methods]. So I was looking at Reggio and... even though I was super interested [in using iPads], I didn’t want to put my fingers into every pie and then just not do anything.

Personal problem solving strategies were not only used by all the participants interviewed, they were also found in use as a response to all of the disruptions to technology use or implementation that were reported. Other strategies were not as extensively used, and were not used in response to every type of disruption.
5.3.2. Within-school support

Some technology disruptions prompted problem solving strategies that exploited existing resources within the teacher’s home school. As identified in section 5.2, potential within-school supports included students, colleagues and home school administrators. The following table identifies the types of disruptions that were addressed with within-school supports as well as their relative success.

Table 5.4 Reported success using within school support.

<table>
<thead>
<tr>
<th>Success</th>
<th>Access limited</th>
<th>Limits to knowledge</th>
<th>Technology problem</th>
<th>Student concern</th>
<th>Parent interaction</th>
<th>Prof. choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>No use</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Modified use</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Full use</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

There were no incidents reported when parent interaction disruptions prompted the use of within-school supports. There was only one instance in which a participant sought out within-school support for a technology function problem. In that case, the strategies employed ended in no use of technology – in other words, using the within-school support did not solve the technology problem.

There were two reports of within-school supports being used to address an identified disruption involving student skill. The within-school supports used in both cases involved collaborating with a colleague to create the necessary support for student skill development.

I think it was just a process for [students] to know that when you put things on the Internet and hand things in, it’s there, for good. Even if you have your own account, there is access to other things. Because I was really nervous about that so (Teacher 1) and I were just really drilling proper use of the technology which is, I think, a really good tool for them to have, seeing as the way the world is moving and how fast it is and if they can get that at a young age. (P7)

Disruptions related to professional choice also rarely resulted in using within-school supports. In both the disruptions noted, students were the within-school support used. In one instance, students as were part of a class community decision to end the use of a tool that was not the best fit for the educational goal. In the other case,
students had technology knowledge, and helped the teacher to maintain use by reducing instructional time through peer teaching. For the teacher involved, it felt that there were too many tools to teach to do the project she wanted, but within-school student support made full use possible.

A lot of that stuff it just takes so long to teach you can only get through a couple but the kids that didn’t know how, would partner up with someone that did know how and then they would both know how. It is just really crazy to see that the kids just know how. (P7)

Within-school supports were used most frequently for disruptions related to limited knowledge and limited access. The within-school support strategy was most successful when it was used to address limited access to the necessary or desired technology tools. The actual supports used were varied and included student, colleague and administrator support. Administrators were the support most often used in these cases, and were often instrumental in teachers gaining access to a new piece of hardware through the administrators’ unique understanding of school district initiatives.

I had a SMART board. Yeah, so maybe that actually is kind of what led to [my current interest in technology]. Our principal years ago said that the PAC wants to get some SMART boards and a lot of teachers were like no and I was like Yes! I didn’t know what it would involve but it just sounded so cool. I said I want one, I want one, I want one and she said, “OK why don’t you make a committee with the technology and make an application” because she had heard at the board level that you want the teachers that are really excited to get the SMART boards first. So, we came up with this system and slowly all of them got SMART boards. (P8)

When within-school resources were used to address disruptions related to limited knowledge, full use resulted in every case. Teachers used within-school support both to address knowledge and skill acquisition, and as a means of ensuring successful use of the tools available. The teacher in the following quote both trusts and relies on the teachers in her school for technology support around the creation of report card templates.

I can manoeuvre myself around in [the software program] but with my old team it was [teacher 2] who would do the initial setup I did a few times I tend to forget [how to set it up] really quickly so (teacher 1) started this [template] last week. (P3)
Supports that exist within a school are the closest and easiest to access, other than personal problem-solving strategies. As mentioned earlier, the number of reported uses of a support decreased as the distance from the teaching environment increased therefore, within-school supports were used less often than personal problem solving but more that district supports.

5.3.3. District support

The next-closest supports to the teacher, their classroom and the home school were those at the school district level. The supports used at these level included district specialist teachers, district administrators and IT specialists. The following table identifies the types of disruptions that were addressed with district supports as well as their relative success.

<table>
<thead>
<tr>
<th>Table 5.5 Reported success using school district supports.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>No use</td>
</tr>
<tr>
<td>Modified use</td>
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<tr>
<td>Full use</td>
</tr>
</tbody>
</table>

When used, district supports were found to be helpful and did not result in any instances of “no use.” For example, a district teacher specialist provided useful technology training and information when there was a disruption related to limited knowledge of SMART board software. In another instance, district IT specialists installed an alternative projection tool when the existing tool was not the best fit.

As with the previously mentioned support strategies however, district supports were more often used to address disruptions related to limited access to technology. When used as part of the solution to an access problem, district staff provided support in a variety of different ways. Specialist teachers acted as a resource to help with effective decision making within the constraints of the district. In the following example, a teacher who redesigned her program to work with a high mobile device to student ratio finds a solution to decreased access with the help of a district technology mentor teacher.
My technology mentor was amazing. I was constantly emailing him, picking his brain and asking him to come in. “I know [sharing iPad carts with the whole school] isn’t going to work next year so what do I do?” and he said, “bring your own device.” He is at [School], so he sent me tones of files. He just really got on it. (P8)

District support also helped teachers find technology that would support their teaching program for the long term and with short-term solutions when teachers experienced a sudden loss of access. In the quote below, a teacher describes the district response to her losing access to a projector when a bulb burns out and cannot be replaced through her school’s technology budget:

For about two months I didn’t have a SMART board. I didn’t have anything and so I was really struggling and so that’s how the district [iPad] cart came to me. I got the district cart and I was at least able to use the iPads with the kids, and I used it as sort of a whiteboard that was about it but I couldn’t do anything more with it. (P5)

As noted in section 5.2, all the participants identified district support as a potential support strategy with a technology use or implementation disruption. However, relatively speaking, district supports were not used often as part of problem solving. Further, reported disruptions related to student skill, parent interactions or professional choice were not addressed through district supports at all.

The frequency with which outside supports were used was similar to that of district IT, and had similar levels of success. Perhaps when teachers report disruptions, which prompt the use of more distant supports, it is because it is part of a success. It might also be the case that these technology experienced teacher only go to that effort when they are more certain of success. For example, the teacher in the following quote has had variable success using district support for what she considers non-crucial problems and therefore selects her support choice strategically depending on the intensity of her or her students’ need.

I think you would know that from working in a school. I pick my battles and if [a damaged monitor] is going to be a footprint thing then I have done the footprint before and nobody has ever come or it has taken like a year. I have bigger things to deal with and that is just not one of them. (P3)
Of the actual disruptions discussed by teachers in the study, a small portion used district resources for support during problem solving. Strategies involving the use of outside district supports for the problem solving process were similar in number to the use of district supports.

5.3.4. Outside-district support

There were only 9 disruptions reported that prompted the use of outside-district supports. The supports accessed outside the school district included software vendors, friends with technology experience and other community members. The following table identifies the types of disruptions that were addressed with outside-district supports as well as their relative success.

<table>
<thead>
<tr>
<th>Success</th>
<th>Access limited</th>
<th>Limits to knowledge</th>
<th>Technology problem</th>
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<tr>
<td>No use</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Modified use</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Full use</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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</table>

There were no instances of “no use” when outside district supports were the chosen strategy for a technology disruption. There were also no disruptions related to student skill, parent interaction or professional choice reported that made use of outside district supports as part of problem solving.

There were two instances reported that resulted in continued but modified use of the technology following problem solving for a technology function problem. Both technology problems were the result of best-fit design that needed troubleshooting, and in the following case a direct request to the software vendor to change the design of the student grading features.

So most students are [performing] in the meeting to fully meeting [expectation] range...but the students don’t get that on their side. There is not sliding scale on theirs it is just meeting so yeah so the most common message that I get “Am I fully meeting or meeting” so what I have decided, so what I have done is given an anecdotal note as well “you are fully meeting” as well....So I have told...I
mean...[Software vendor] is aware of it...I have done a couple of their webinars so they are going to make some changes. (P4)

Limited access motivated the use of outside district support strategies on two occasions. In both cases the tools available at the district were not suitable for the teachers’ needs. The solution chosen involved going outside the district to get the resources necessary to maintain the desired level of technology use. For this teacher it meant fundraising in the community.

We try and source out funds and I think we got about $10,000 so we bought another 15 [iPads]... That was nickel and diming, through the recycling here and uh just little things and we asked, just sent a letter with the Principal to the bank here....So we were able to buy another 15 so they are here in this cart. (P4)

Limited knowledge was the disruption that most often brought teachers to access outside-district support. In some cases the outside-district solution included building the necessary knowledge using the expertise of an outside district source such as a vendor website. In some instances, building the necessary knowledge was not as efficient as enlisting help from the community make using the technology possible. For this teacher who had not yet learned how to use video editing software, it was better to get help from a knowledgeable parent

I [made that video] before I knew how to edit or how to do any of that and now I am like I could’ve totally have done that with iMovie. But at the time a dad came so we did the whole [thing in one] shooting...it was a really cool thing. (P2)

The participants who were interviewed and observed for the purposes of this research used a variety of problem solving strategies and support in response to technology use and implementation disruptions.
Chapter 6. Discussion

The purpose of this study was to examine the experiences of mid-career elementary school teachers implementing technology as part of their classroom program through the lens of two questions:

1. What variety of disruptions do mid-career elementary teachers experience when they decide to implement or use technology as part of their classroom practice?
2. What strategies and supports do teachers rely upon when they experience disruptions?

This case study examined the experiences of mid-career teachers from an urban school district as they implemented and used technology as part of their personal teaching programs. Despite being purposely selected for the relatively advantageous conditions they had for technology implementation, all participants reported experiencing disruptions to their technology implementation and use that could be categorized as either technology-related or environment-specific. These disruptions, which pertain to question 1 above, were discussed in Chapter 4. Throughout the interviews and observations, participants also shared strategies and supports that they employed while they attempted to address disruptions to their implementation and use of technology. Chapter 5 addressed question 2 above and described these strategies and supports, grouping them into four categories based on the proximity of the support to the individual teacher. Although it is useful to examine the disruptions and the problem solving strategies individually, the two categories of data are undeniably linked. The research findings identify some of the patterns that were observed in the occurrence of codes for each category.

• **Finding 1**: All of the teachers interviewed reported experiencing a disruption on one or more occasions while implementing or using classroom technology.

• **Finding 2**: The reported disruptions can be grouped into two categories: those associated with the technology itself, and those associated with the elementary classroom teachers’ environment.
Finding 3: All the teachers identified three or four different problem solving methods that could be used in the event of a potential technology disruption.

Finding 4: Problem-solving methods identified by teachers included personal problem solving (e.g. troubleshooting, researching solutions online), school-based support, district support, and support from friends or family outside the school system.

Finding 5: Following the use of one of the identified problem-solving methods, teachers reported varying degrees of technology use, including no use, modified use and full use.

The five major findings result from an in-depth analysis of the both the interview and observational data, and provide more detailed answers to the two research questions. The first two findings regarding disruptions that were experienced by participants as they implemented and used technology, address question 1. The other three findings, related to the types of problem solving methods that were employed by participants and the success of the strategies selected, address question 2. This Chapter will offer further discussion and interpretation of these findings. The following sections will consider in more detail the sources of disruptions, the potential effects of context, teacher problem solving responses and successes with certain types of disruptions, as well as some limitations of this study.

6.1. Sources of disruptions

As discussed in the literature review, Ertmer (1999) presents the idea that the barriers that teachers experience can be divided into two categories; first and second order barriers. These groupings of barriers are very similar to the ones that evolved from the current study. By her definition, ‘first-order barriers’ are ‘those obstacles that are extrinsic to teachers” such as resources like professional development, equipment and support (p. 50). Ertmer’s first-order barrier and the current study’s finding with respect to ‘technology-related disruptions’ can be seen as parallel, because both are directly related to resources that can be made available by education leaders. Access to technology, knowledge-related and technology-specific disruptions are all challenges that could be alleviated with an influx of resources to support training, support and tools as is suggested by Ertmer (1999, p. 50).
‘Second-order barriers’ on the other hand, are “barriers that interfere with or impede fundamental change”, and are things like teachers’ beliefs about teaching and learning (p. 51). On the surface, second-order barriers appear to share many similarities with specific environment disruptions as described in the present study, making it difficult to unravel where the elementary school teacher’s beliefs can be separated from the nature of their specific environment; however I propose that the difference between the two ways to group barriers lies in the inclusion of student related concerns and teacher-parent relationships. Based on my understanding of Ertmer’s work, she would consider these two disruptions to be first-order barriers because they could be managed with an infusion of resources, specifically training and support; however to define disruptions, as I have, through a focus on the source of the disruption rather than the ability for change may help to highlight some of the different challenges teachers face depending on their students’ ability to use technology tools. The group of participants in this study was specifically selected for their interest in implementing technology. With student skills and parent-teacher relationship disruptions occurring with higher frequency than professional decision making, it may be that their beliefs in the usefulness of these tools are not as big an issue for them as how to go about using the tools with young students.

In addition to some of the similarities with the barriers listed by Ertmer, the order of frequency of the various disruptions identified by the participants in this study was fairly consistent with findings in other research. Anderson et al. (2011) found that participants who had good access to the tools and targeted professional development sought support most frequently for disruptions related to hardware, then software, followed by classroom management. The participants in the current study were not given perfectly equal access to technology or targeted training and support, and thus continued to experience disruptions related to access and professional development. However the next most frequent barriers, technology-related problems followed by students related concerns are parallel results to Anderson et al.’s hardware, software and classroom management challenges. Another group of researchers (Courduff et al., 2016) studied a theoretically sampled group of 10 exemplary special education teachers working with technology. Similar to the results of the current research, Courduff’s teachers’ experience and resilience did not prevent a variety of obstacles related to “student skills, available technology, information technology (IT) support, and lack of training” when implementing technology with their students (p. 35).
6.2. Influences of context

The interview questions used for this research were created to explore teachers’ experiences with implementing technology. In particular, questions were designed to encourage participants to share technology-related disruptions through direct questioning about the types of technology being used, the types of problems that might have been encountered and the conditions in place that might support or inhibit the implementation or use of that technology.

Despite the interview’s intended focus on technology disruptions, participants gave examples of disruptions that were related to the specifics of the elementary environment across the interviews and observations. Participants reported specific environmental disruptions with far less frequency; however they shared these in the absence of interview questions with that targeted topic area (see Appendix B). This may be further evidence to indicate that specific environment disruptions related to student skill, teacher-parent relationships and professional choice are an important part of mid-career elementary school teachers’ experiences implementing and using technology with students, that might warrant further investigation.

In addition, a number of the specific environmental disruptions identified appear to be related to the process of implementing tools that have only recently (in the last few years) become available to elementary generalist teachers. For example, mobile technologies such as iPads and other tablets were in use during disruptions in all three specific environment codes: student skill, teacher-parent relationships and professional choice. Other disruptions related to web 2.0 tools also appeared in all three environment-specific code areas. Mobile technology and web-based software are relatively new tools in classrooms, ones that require teachers to have recently acquired technology skill; how to use the tool and pedagogical technology skills; how to use the tool with students. As suggested in the literature review, new digital tools, including those that are being designed specifically for classroom use, may need to be identified as a new and distinct medium for student learning and the expression of their knowledge. Technologies used in classrooms therefore require specialized training that will illuminate the risks and challenges inherent in using these tools as part of an elementary school or perhaps any classroom program. Although such training could
offer some support for teachers using these relatively new and specialized tools, the Andersons et al. (2011) study of a support program for teachers should caution education leaders with the findings that not every problem can be anticipated during training but that “providing awareness training regarding the types of problems that are likely to occur, along with concrete examples drawn from classroom experiences would provide teachers with a greater understanding of how to navigate software and anticipate technical glitches” (p. 520).

The types of problem-solving strategies reported by participants when dealing with environment-specific disruptions never included district-level or outside-district supports. It is difficult to comprehend why teachers only reported using personal and within-school problem solving strategies in these cases; however given the nature of these disruptions being specific to the elementary school setting, the newness of the technologies being used, as well as the skills and interests of the participants interviewed, perhaps the environment-specific disruptions reported here are not yet being experienced with enough frequency in the population to justify targeted district or outside support. Another possible explanation is that colleagues and administrators, who not only share similar experiences but also have effective problem solving strategies in place within the environment where they are experienced, are considered to be more effective support for environment-specific disruptions. Perhaps, as Dexter (2011) recommends, distributed leadership within the schools provides adequate direction and support for these teachers to handle environment-specific disruptions. Finally, as suggested by Argyris (1976), it is also worth considering, given the variable success of these strategies, that teacher ability to address student skills, parent interactions or professional choices are affected by existing personal and organizational constraints. It is easy to imagine other reasons that might discourage teacher use of district or outside supports such as: limited or poorly communicated district specialist availability, trust issues with unknown district level staff or outside-school supports, or issues of privacy and safety with non-school district approved supports at the elementary school level.

Personal problem solving strategies and within-school supports were the only strategies used for disruptions related to student skill and for professional choice; however participants who experienced disruptions related to parent-teacher interactions
only used personal problem solving strategies. Six of seven participants reported having to manage a disruption related to their interactions with parents. Only disruptions related to access were more commonly shared among participants.

Despite being a common experience, the number of events of this kind of disruption reported was not particularly high: ten in total. Most teachers reported only one instance when parent-teacher interactions had an effect on their technology integration. The high numbers of teachers reporting this type of disruption, despite the low frequency of the reported disruptions, may indicate the importance of the role that parent-teacher interactions play in teacher decision-making with regard to technology in elementary schools. Some of the reported disruptions were related to an interaction with a particular parent, but most, such as balancing technology use and non-use activities, were inspired by the teachers’ awareness and consideration of parents’ wishes as stakeholders in classroom planning decisions. In an elementary classroom, where parent involvement can be observed as typically higher than in a secondary classroom, teacher decision making with regard to technology use is being affected, at times negatively, by interactions with parents. While the number of instances of this type of disruption is low in my data, further investigation may still be warranted because the frequency may be due in part to my interview questions as presented.

The interview questions were designed to examine teachers’ technology knowledge and related problem solving, therefore discussions regarding parent-teacher interactions were brought up incidentally as part of a larger story of technology use. In addition to the low frequency of reported disruptions of this kind, as mentioned above, participants only reported using personal problem solving strategies. This surprised me, since it is not consistent with my personal experience as a teacher. When challenges arise as part of a parent-teacher relationship, particularly with regard to communication or parents’ concerns, I have observed that problem-solving strategies often include seeking support of the home school administrator. The low frequency and the limited problem solving strategies reported by my participants lead me to believe that a different line of questioning is necessary to reveal a more complete picture of both the impact of parent-teacher interaction disruptions and the problem solving strategies used when teachers experience them. Another reason to take a closer look at parent-teacher interaction disruptions is the low rate of success following problem solving. In my data,
only two teachers were able to carry on with full use following a parent-related disruption.

6.3. Access disruptions

Looking back at some of the data more specifically, disruptions related to access to technology occurred with the highest frequency and were experienced by every participant. Not having the necessary technology or the technology that would adequately support a learning goal was a consistent challenge experienced by participants in the study, despite my recruiting procedure having established a basic level of technology access and interest in the population of teachers selected for the study. As a result, access disruptions were linked to the use of problem solving strategies more often than other disruptions.

In this case study, the participant group utilized each one of the ‘potential’ problem solving strategies and support categories (as listed in Chapter 5) on one or more occasions to deal with limitations to access. Looking more closely at the access disruption sub-codes, it is interesting to note that the limitations to access sub-code occurred most frequently and was most often dealt with using personal problem solving, but was also addressed with district supports. Personal problem solving strategies were used to address smaller, less expensive challenges such as too few cords, secure storage, or suitable apps. For these disruptions, the participants were often able to use resources at their disposal to solve their problems. This finding is consistent with results from Anderson et al. (2011) regarding the success of just-in-time supports where, when available, teachers were able to eliminate a number of problems related to hardware and software.

In contrast, district support was used for issues such as a lack of devices that likely could only be funded by a special program or request at the district level. Though district supports were the strategy least used of all those available to teachers, they were used most in this category. Of the ten instances in which participants reported using district supports for any disruption, eight of those were due to access. Doyle and Ponder (1977) suggest as part of their theory of the Practicality Ethic that teachers make
decisions to implement technology to some degree on a cost-to-benefit ratio (p. 8). Extending this thinking, it seems logical that teachers are using problem solving supports that are furthest away and would require the most effort, such as those at the district level, when they are more assured of success, or when they believe their time accessing the technology will be well spent. The purposeful sample used for this study may also have influenced the success of the participants who chose to use district supports. As established technology users, who were identified as such by other educators in the district, the participants of this study may already have discovered paths of least resistance and therefore could make better use of district resources when faced with a disruption.

Another access challenge that teachers reported resulted from the need to share technologies with other teachers. Sharing technology among classes and teachers seems, from the outside, to be a sound choice for education leaders looking to stretch limited funds across many classes and schools. The participants in this study indicated that they do not use technology at every moment of every day, which means that expensive mobile devices may be sitting idle while other teachers and classes are doing without. These reports are consistent with the findings of Cuban, Kirkpatrick and Peck (2001), who found that access to technology did not result in constant, or in some cases, even daily use. However, while the devices might be sitting idle at times, more than half of the teachers reported access disruptions related to sharing devices within a school community. This means that sharing devices among multiple classes or a whole school was not a workable solution for these teachers. Those who were able to maintain ‘full use’ had overcome this shared use disruption by seeking out and getting 100% access to a set of devices in their own classrooms. Some teachers did indicate a range of need; for some it needed to be 1:1 ratio of devices to students, while other teachers were satisfied with a 2:1 ratio. If sharing technology is the strategy of choice for districts and schools, then the question becomes how many devices are adequate to allow teachers to accomplish their educational goals as they strive to incorporate technology into their teaching programs.

As in any school community, the educational programs of the member teachers are highly varied and had the potential for rapid change. Timetabling challenges, special events and absences are just a few of the reported circumstances that prevented
participants from adhering to the rigid schedule required when sharing resources between classes. In addition, the use of laptop or desktop technology with younger students was made more difficult by the developmental stage and executive functioning of the elementary school age group. Teachers reported that remembering passwords, how to log on, and how to filter the information on the desktop took much more practice for newer users. Typing skills in primary and early intermediate are also a barrier, making writing with technology a more time-consuming choice. It is therefore no surprise that iPad apps, which provide alternatives to writing and rarely require a login were a popular choice among several teachers involved in the study.

Based on the data collected during this study, it would appear that teachers who are interested in implementing technology need to have a higher level of access than might typically be provided in this district. Teachers who were able to employ problem-solving strategies to address issues related to access were able to maintain ‘full-use’ when they could establish a 1:2 or 1:1 device-to-student ratio within one classroom. This was the case for both the primary and the intermediate teachers interviewed. Teachers who reported ‘modified use’ also had 1:2 and 1:1 device-to-student-ratios part time, but were sharing the devices with the whole school, or between several classes. The participants interviewed only discussed the two extremes of single-class and multi-class device sharing. In my own experience as a teacher, I have observed colleagues making good use of a 1:2 device-to-student ratio shared between two classes. In two-class sharing, the number of devices is cut in half compared with single-class sharing. A two-class sharing model would be easier to organize for teachers, would allow more access during the school day, and could even encourage collaboration and sharing between to the two technology-using teachers.

Administrators making purchasing and scheduling decisions must balance supply and demand in a community within which desires are constantly growing and changing depending on the tool. Another set of considerations may be selecting technology for purchase that is sustainable (that is manufactured, purchased and disposed of with both environmental and financial sustainability in mind). In the late spring, teachers are often asked to request their school supplies for the following September. What if technology usage was part of this resources supply list? The information requested of teachers could include windows of intense usage for project-based learning, daily usage for skill
development or predicted periods of need for research, such as social studies and science projects. Requests in this form would allow administrators to better predict and balance usage, which might necessitate purchasing, prioritizing, replacing and retiring shared technologies, as is commonly the practice with both texts and library books.

The findings discussed above also may be cause to reconsider Provincial initiatives that prioritize technology as a foundational component of the curriculum if funding is not earmarked for technology to ensure that learning goals can be met as intended. Disruptions related to access were a common experience for participants in this study, and often required them to devote their time and resources to technology acquisition. For every day that a teacher spends scheduling, arranging, negotiating and finding shared technology, or for the days spent coordinating fundraising and applying for grants that might increase their classes’ access, they could be planning for, supporting, guiding and instructing students in the use of that technology – not to mention meeting other curricular goals. Teacher time spent dealing with access to technology disruptions is a silent cost, but one that if compared to the cost of the technology itself might be equivalent to one iPad mini per day.

6.4. Limited knowledge disruptions

Disruptions related to a teacher’s limited knowledge have the potential to create a vicious cycle unless the teacher chooses to use problem-solving strategies beyond those that they already know. As discussed earlier in reference to Argyris’ (1976) single vs. double looped learning, if teachers are unable to move beyond established problem solving techniques, they limit their decision-making effectiveness (p. 367). When a teacher is using a new tool, they not only are learning how to use that tool effectively with students, but are also building their own skills using the technology, including their personal problem-solving strategies. The data in this case study indicates that these teachers used personal problem solving strategies most often when they experienced a technology disruption. When the disruption was related to teachers’ limited knowledge and the teacher chose a personal problem solving strategy, the end result had limited effectiveness; resulting in ‘no use’ or ‘modified use’ of the technology. The data collected during the interviews for this research occurred during one meeting for each
teacher therefore it is difficult to determine an established pattern of behaviour that would last over time. However; if this pattern of behaviour was shown to be persistent, the reported ineffectiveness of personal problem solving strategies when used for disruptions of limited knowledge could indicate a limitation in teacher’s receptiveness to external feedback in the system and/or a limitation in the accuracy of the feedback being offered in the system (Argyris, 1976). Further investigation of how teachers develop personal problem solving over time is necessary to confirm the source of the limitations reported here.

As illustrated in Chapter 4, a teacher with limited experience using a tool such as a projector may choose not to use it at all; or as in Chapter 5, may use their limited personal problem-solving strategies to create a solution that works but is not an effective use of the tool or the teacher’s time. The need to quickly discontinue use or find a way to work the problem out independently seems consistent with the logic behind Doyle and Ponders’ (1977) theory of teacher’s Practicality Ethic. As the theory suggests, the isolated nature of the teacher’s environment and “very unpredictability of classroom environments would foster the ability to make on-the-spot judgments based on instinct rather than prolonged deliberation” (p. 6). Participants also reported feeling a lack of confidence and being embarrassed when they did not or could not use a tool that they had access to. In this study, disruptions related to limited technology knowledge were the second most frequent disruption reported, and the most successfully solved using problem solving beyond the teachers themselves. Knowing how to use a tool and how to solve problems when they arise may require that teachers reach out for support in order to maximize their success when implementing and using technology.

When teachers are using personal problem solving to directly address a limit to knowledge through practice, experimentation and research, they may often be doing so outside of the workday. A number of participants reported doing research and exploration of technology on their own time, outside of designated prep periods and identified professional development days. As illustrated by quotes in Chapter 5, demands on teachers through the day may make it difficult for them to explore new technology in the moment. In addition, it may not be practical or reasonable to wait for the next identified professional development day to build the necessary knowledge required for addressing problems that develop during the implementation and use of
technology in the classroom. As stated in Chapter 2, professional development is teacher training for in-service teachers, which typically occur outside the school day. The small steps approach, as described by Courduff et al. (2016), in which the teacher works away at learning a technology skill solely using their own personal problem solving skills takes time and while it might be considered learning, it seems to fall outside both the definition of professional development and the time provided to teachers by districts. Teachers and educational leaders who are advocating increased access to and use of the ever growing variety of technology tools in schools may need to revisit how and when technology learning and problem solving occur across the school day and year in order that the necessary resources can be made available to adequately support teacher personal problem solving.

In most cases, the participants responded to limits to their knowledge by accessing supports beyond their own personal problem solving. Of the 17 reported disruptions related to limited knowledge 12 employed a support beyond the teacher themselves. The success of these strategies was also strong; full use was maintained in all cases. Notable, however is the absence of formal professional development events as a potential support for limits to knowledge at the district level. Considering the amount of research suggesting professional development as a way to mitigate the disruptions related to limits on teacher knowledge (Sheppard & Brown, 2014; Chmiliar, 2007; Hosman & Cvetanoska, 2013; Wong et al., 2013; Gunn & Hollingsworth, 2014; Ciampa & Gallagher, 2013; Hosman & Cvetanoska, 2013), it seems unusual that teachers would not list this as a potential support and/or more frequently as a actual problem solving strategy or support. Professional development was available; during the interviews, teachers were asked about their recent use of professional development and while they were all able to talk about professional development they had attended at their school and through the district, none had used that particular support for their most recent limited knowledge disruptions. This result may be related and perhaps support some of the discussion above regarding the way that the teacher participants are developing technology skills. The absence of district professional development as a potential support for limits to knowledge may indicate that this form of support is ineffective with regards to learning technology skills.
It might also be that these teachers are not naming professional development as a potential or actual problem solving strategy because of their beliefs about how technology knowledge and skills related to the reported disruptions should be developed. When asked about their most recent professional development activity, participants shared topics with large-scale applicability such as communication skills, and teaching methods rather than on developing skills of the features and functions of specific technology tools and applications. Modelling, reflection and collaboration, methods suggested by Ertmer (1999), were reported but were not part of a formal professional development event, rather were organized between colleagues or specialists as a reaction to a disruption. As indicated by the results in personal problem solving, many participant also seemed to be learning the functioning of the specific tool on their own and may believe as Anderson et al. (2011) found; that the number of potential problems that are experienced cannot adequately be addressed during a training session. Given the number of tools available to teachers, the variations in classroom environments, the limited funds available to districts and the availability of web-based resources on technology tools, it may be that many mid-career technology-using teachers do not see professional development as a practical problem solving tool and therefore are no longer reliant on districts for formal training on certain technology tools or functions. If participant 4’s statement “its just a matter of figuring it out” (see Chapter 4) is becoming more common, she may be sharing more than just a momentary thought but instead a change in practice with regards to the way teachers are approaching learning how to use the tools for teaching. If this is the case, education leaders need to explore how they can best support teachers who will need time to learn technology functioning beyond the school day and designated professional development days. And if it is part of the vision of technology use within the district, that teachers learn certain aspects of tool use on their own, it is important as Dexter (2011) suggests that the vision be clearly communicated. Therefore it may be valuable to develop best practice statements that detail districts beliefs and intentions regarding learning about technology use and implementation and share this vision widely with teachers so that new technology users know the kinds of support they might expect.

Another possible explanation for participants limited use of district training resources, is the participants of this study may be in a special category similar to Courduff et al.’s (2016) exemplary special education teachers or what Rogers (1995)
might call *early adopters*; members of a group that are known to be adopting and evaluating an innovation ahead of many in the group (p. 264). In this role, they would be considered technology specialists in the district as evidenced by the fact that some participants shared during the interviews that they were providing support for others. This also might explain the high reliance and personal problem solving skills. Although researchers such as Pool et al. (2011) identify the value of providing educators with formal opportunities to investigate new knowledge, in cases where the educator is ahead of the curve, it would be difficult for education leaders to adequately anticipate specific needs. In this case, it may be more appropriate to make funds available to allow teachers to access outside district specialists.

### 6.5. Limitations of this study

This research study is not without limitations. The first limitation of this study worth mention is that of myself as both the researcher and a teacher who has experienced disruptions implementing technology in the same provincial school system as the participants. While being part of the same system has the potential to quickly build trust and rapport with participants it also has the potential to effect the way the researcher views the same system (Creswell, 2007). I hesitate to call this fact a limitation but more of a reminder to the reader that while I took measures to remain objective during both coding and interpretation of data, my observations of the data are interpretative and based in my previous experiences (Stake, 2009).

The reader should also keep in mind the sampling methods used in this multiple case study while considering the outcomes of this research. Seven mid-career elementary school teachers were selected from one urban school district in BC and the experiences expressed by them provide valuable insight within their context. By choosing a qualitative multi-case study approach, purposeful sampling method was a trade off “between potential for learning and representativeness” (Stake, 2006, p. 25). Members of the school district staff identified the participants because they had already shown interest in implementing technology and had implemented a new piece of technology within the last year. Therefore, the teachers selected were not new teachers or new to technology and were committed technology users. With their
experience, they very likely had developed skills including personal problem solving strategies that would impact their success navigation of disruptions to use and implementation of technology. Despite the specific nature of this sample, it is valuable to learn that disruptions to technology use and implementation are still an on-going issue for teachers with experience and a foundation of technology usage but that personal problem solving skills play an important role in maintaining use of technology. This idea is consistent with the results found by Courduff et al. (2016) work with exemplary special education teachers. The researchers observed resilience in teachers, which impacted the frequency of teachers’ reports of obstacles and the negative affect of the obstacles reported. Further studies using similar procedures but with different populations (e.g. beginning teachers, new technology users etc.) are necessary to increase the generalizability of the results here.

As previously discussed, it is also worth considering the results in context of the interview questions (Appendix B). The questions used were designed to explore the types of technology in use, the context of its use and the experiences of teachers using technology within their classrooms. The questions did not include anything specific about student skill development, maturity or impact on parent relationships. Despite the fact that transcripts of the observations were included in the data, the narrow nature of the interview questions should form the backdrop for the interpretation of the results presented and may have impacted the choice of reported and therefore the frequency of disruptions found and by association the problem solving methods employed.
Chapter 7. Conclusions

This research study suggests that mid-career technology teachers in a large urban school district in British Columbia continue to experience disruptions related to technology use even when they are relatively established in their teaching careers, have regular access to current tools, demonstrate an interest in the tools, and have prior experience with technology. Although the disruptions appear at times to be more sophisticated than less experienced teachers would have (e.g. managing created content across multiple devices or establishing safe use behaviors), many continue to be the result of disruptions such as access, training, support and beliefs, which have been identified by many other researchers in other contexts.

Categorizing disruptions into groups based on their source may be a valuable way of identifying the different challenges faced by teachers of different grade groups which in turn can help guide district support initiatives. The participating elementary school teachers identified disruptions related to their specific environment like the age and maturity of their students that should be considered when education leaders are planning for the needs of teachers. In addition, while professional development continues to be a term used to identify in-service training, as would be used by mid-career teachers, this research suggests that these teachers require different and more flexible options in order to effectively problem solve the technology related disruptions they encounter while implementing technology. As suggested by Dexter (2011) and others, a strong well-designed clearly communicated district vision is necessary. As the current research study shows, that vision needs to include well designed up to date support resources for teachers based in their contexts so they might access the necessary supports (including release time and training) that will improve their ability to problem solving technology related disruptions. While it seems a tall order that supports be designed to fit the seemingly infinite variations in teacher need, increased and flexibly designed release time may provided interested teachers with an ability to build their personal problem solving skills in a manner that will suit their needs and build their ability
to manage technology problems independently thereby alleviating pressure on overworked IT departments.

The problem solving strategies as reported by the participants’ of this study were resonant with and extend Doyle and Ponder’s (1977) theory of teacher’s Practicality Ethic. The most frequently used strategy, personal problem solving, seems consistent with strategies needed for teaching in an isolated environment where just-in-time support is limited. Other problem solving strategies such as within-school, district and outside-district supports seem to be employed strategically, in situations where the teachers are most likely to experience success thereby balancing a cost-benefits ratio. One area to consider for future research is the level of resource investment teachers are willing to commit to the various disruptions they encounter. In particular, it would be interesting to consider how much time is spent engaged in the different problem solving strategies and how that investment relates to the success of the technology use.

The findings with regards to the outcomes of teachers problem-solving techniques warrants further exploration. As identified in this research, teachers who choose to use or implement technology in their classrooms continue to encounter a variety of disruptions that require them to strategically select and employ problem solving in order to maintain technology use. The circumstances under which teachers are able maintain ‘full use’, have to settle for ‘modified use’ or in the end have ‘no use’ of the technology chosen seem to point to two specific opportunities for study. The first is the actual success of the particular problem solving strategy selected (e.g. how often a strategy such as using district IT support results in full use, modified use or no use) and the second is the relationship between the disruption being experienced, the strategy selected and the success of that strategy (e.g. a software stops working, a teacher seeks out a colleague and experiences modified use). A survey, presented to a larger group of teachers that collects information such as demographics, technologies in use, disruptions experienced, problem solving selected and the success of the strategy could be a source of valuable information and a basis to drive district decision making. It may also be helpful to divide the types of problem solving activities into routine and non-routine (Zsoldos-Marchis, 2014), depending on the familiarity or frequency of the technology problem to determine if there is an impact on success. By understanding these patterns, education leaders may be better able to identify those strategies that
warrant further investment and those that are not having the intended results for specific disruptions and specific groups of teachers.

Finally, it appears that even in 2015, within a population of mid-career elementary teachers who are enthusiastic and experienced technology users, in an urban school district, challenges related to access to technology, knowledge and quality technology support are still the most frequently reported disruptions being experienced. On the eve of the implementation of British Columbia’s ambitious technology-inspired new curriculum, it seems prudent that education leaders are not just writing curriculum to drive student learning, but that they are also investing in the tools and training to support the delivery of content in a way that will weave student technology skills and understanding into daily use – as appears to be their intention.
References


Appendix A.

Letter to principals and consents

Letter to Principals/Agency Directors

Information letter for School Principals/Agency Director

I am a teacher and Masters student inviting my colleagues to participate in my research project. Participants are being invited to take part in a research study on teachers’ experiences implementing technology in their classrooms. In particular, I am interested in their experiences as they implement a piece of technology, which they have only begun using in the past 12 months.

I would like you to identify teachers in your school to participate in the research study. Whomever you identify will be presented with the attached participant contact letter followed by consent at the time of the data collection.

This research will require about 1-2 hours of time. During this time, the participant will be interviewed about their experiences with technology. The interviews will be conducted wherever the participant prefers (e.g. in their classroom), and will be recorded using a digital audio recorder. In addition, an observation of a similar length may occur during a lesson preparation or collegial meeting with other teachers related to the technology.

There are no anticipated risks or discomforts related to this research. Participants may also find the interview to be very enjoyable and rewarding, as many people who experience technology implementation do not get to share their experiences with a skilled and nonjudgmental interviewer, as they will. By participating in this research, the participant may also benefit others by helping people to better understand what it is like to experience technology implementation, and what they have learned in the process.

Several steps will be taken to protect participant’s confidential information and identity. While the interviews and observations will be digitally recorded, the recordings will be destroyed once they have been typed up. The typed interviews will NOT contain any mention of names, and any identifying information from the interview will be removed.

Any names mentioned during interviews as well as the participants will be coded or given a pseudonym. Only I will keep a master list of pseudonyms along with the typed interviews in a locked filing cabinet at the Simon Fraser University, and only the main researchers and her supervisors will have access to the interviews. Digital information will be stored on a secure SFU server. All information will be destroyed after 5 years time.

Participation in this research is completely voluntary. Any participant may withdraw from the study at any time for any reason. If they do this, all information from them will be destroyed.

The results from this study will be presented in writing in as part of a Masters Thesis and may be read by individuals interested in the experiences of teachers implementing technology such as other researchers and education professionals. The results may also be presented in person to groups of researchers and education professionals. At no time, however, will names be used or any identifying information revealed. If participants wish to receive a copy of the results from this study, they may contact the principal researcher at the telephone number given below.
If you require any information about this study, or would like to speak to the researcher please call Elyssa Derban at XXXXXX. Or contact the research supervisor Kevin O’Neill at XXXXXXX at the Simon Fraser University. If you have any other questions regarding your rights as a participant in this research, you may also contact the Director, Office of Research Ethics XXXXXXXX or XXXXXXX.
June 2015

Dear Colleague,

You are being invited to participate in a research study on teachers' experiences implementing technology in their classrooms. In particular, I am interested in your experiences implementing the technology you have implemented in the past 12 months.

This research will require about 1-2 hours of your time. During this time, you will be interviewed about your experiences with technology. The interviews will be conducted wherever you prefer (e.g. in your school), and will be recorded using a digital audio recorder. These recordings will only be done with your permission and will be destroyed as soon as transcriptions are completed. In addition, an observation of a similar length may occur during a lesson preparation or collegial meeting with other teachers related to the technology if appropriate.

There are no anticipated risks or discomforts related to this research. You may also find the interview to be very enjoyable and rewarding, as many people who experience technology implementation do not get to share their experiences with a skilled and nonjudgmental interviewer, as you will. By participating in this research, you may also benefit others by helping people to better understand what it is like to experience technology implementation, and what you have learned in the process.

Several steps will be taken to protect the confidentiality of your information and identity. While the interviews and observations will be digitally recorded, the recordings will be destroyed once they have been typed up. The typed interviews will NOT contain any mention of your name, and any identifying information from the interview will be removed. Any names mentioned during interviews as well as the participants will be coded or given a pseudonym. Only I will keep a master list of pseudonyms along with the typed interviews in a locked filing cabinet at the Simon Fraser University, and only the main researchers and her supervisors will have access to the interviews. Digital information will be stored on a secure SFU server. All information will be destroyed after 3 years time.

Your participation in this research is completely voluntary. You may withdraw from the study at any time for any reason. If you do this, all information from you will be destroyed.

The results from this study will be presented in writing in as part of a Masters Thesis and may be read by individuals interested in the experiences of teachers implementing technology such as other researchers and education professionals. The results may also
be presented in person to groups of researchers and education professionals. At no time, however, will your name be used or any identifying information revealed. If you wish to receive a copy of the results from this study, you may contact me at the telephone number given below.

If you require any information about this study, or would like to speak the principal researcher, please call Elyssa Derban at XXXXXXXX or contact the research supervisor Kevin O’Neill at XXXXXXXX at the Simon Fraser University. If you have any other questions regarding your rights as a participant in this research, you may also contact the Director, Office of Research Ethics XXXXXXXX or XXXXXXXX.

I have read (or have been read) the above information regarding this research study on the experiences of teachers who have decided to use technology, and consent to participate in this study.

(Email version)

To consent to participate, please reply to XXXXXXXXXX

(Print/hardcopy version)

___________________________  (Printed Name)
___________________________  (Signature)
___________________________  (Date/dd/mm/yyyy)
Participant consent

Informed Consent Participant

**Principal Investigator:** Elyssa Derban
Research is being completed as part of a Master’s thesis in Educational Technology and Learning Design

**Why should you take part in this study?**
I want to learn more about the experiences of teachers who have decided to include technology as part of instruction with students. This study will help me learn about teachers’ technology experiences. I am inviting BC teachers like you, who have decided in the last year to include a new piece of technology in their teaching, to help us by sharing your experiences.

**Your participation is voluntary.**
You have the right to refuse to participate in this study. If you decide to participate, you may still choose to withdraw from the study at any time without any negative consequences to the education, employment or other services to which you are entitled or are presently receiving.

**What happens if you say “Yes, I want to be in the study”?**
If you take part in the research I will ask you about your experiences implementing technology in your classroom. I will also observe you as you prepare for or utilize technology as part of your preparation for your students for the purposes of learning or instruction. My observations will not include any observations of students. Following the completion of the consent procedures, I will arrange with you to complete one interview of approximately one hour and one observation of the same length. In total I would like to spend two hours with you sharing your experiences implementing technology.

The interview and observations will take place outside class time at a predetermined time and place convenient to you. Observations may include preparing teaching material, professional development or meetings with other teachers that support your work with classroom technology. These observations will not occur in the presence of students. All interview and observations will be recorded using a digital audio recorder. In addition, I will be taking notes throughout the interview and observation.

**Is there any way this study could be bad for you?**
I do not believe there is anything in this study that could harm you or be bad for you or your students.

**Are there benefits to participating?**
I do not believe taking part in this study will directly help you. I will not pay you for the time you take to be in this study. However, others may benefit from what we learn in this study.

**How will your identity be protected?**
Your confidentiality will be respected. All documents will be identified only by code number, and kept in a locked filing cabinet that only I have access to. Participants will not be identified by name in any reports of the completed study. All data collected, including permission slips, audio recordings, transcriptions and notes will be stored according to the Canadian Tri-Council Policy Statement: Ethical Conduct of Research involving Humans (TCPS 2) ethical standards. Audio recordings and data transcribed from those recordings will be stored in a device with a password only known by me until it can be transferred to a secure SFU server where it will only be accessible by my supervisors and myself. The data will be stored in these conditions for five years, after which it will be destroyed.

What if I decide to withdraw my consent to participate?
You may withdraw from this study at any time without giving reasons. If you choose to enter the study and then decide to withdraw at a later time, all data collected about you during your enrolment in the study will be destroyed. If you choose to withdraw, you can do so in person or by emailing me at XXXXXXX.

Organizational permission
Permission to conduct this research study has been obtained from XXXXXXX and School District XXXXXX.

Study Results
The results of this study will be reported in a graduate thesis and may also be published in conference proceedings, journal articles and books. If you would like the results of the research to be shared with you when complete, please provide an email address where an electronic copy can be sent.

E-mail result to the following: ________________________________

Who can you contact if you have questions about the study?
If you have any questions or concerns regarding your understanding of the study procedures, please feel free to contact me at XXXXXXX or my supervisor at XXXXXX.

Who can you contact if you have complaints or concerns about the study?
If you have any concerns about your rights as a research participant and/or your experiences while participating in this study, you may contact Dr. Jeffrey Toward, Director, Office of Research Ethics XXXXXXX or XXXXXXXXX.

Future Use of Participant Data
The research is being completed as part of a Masters of Arts in Education technology and learning design. The intended purpose of the data is to add to our understanding about teachers' use of technology in classrooms. Allowing for the guarantees made above regarding the destruction of the data, the research materials and data collected may be used to support future research projects, given your permission. The data collected may also be used to help education leaders better
permission. The data collected may also be used to help education leaders better understand how to support teachers as they use technology for educational purposes.

Future Contact

In the event that future researchers are interested in contacting you to gain more information about your experiences using technology in your classroom please indicate your willingness to be contacted below:

☐ Yes, I would like to be contacted for by researchers who are interested in finding out more about my experiences using technology in my classroom.
☐ No, I do NOT want to participate in future research regarding my experiences using technology in my classroom.

Audio Recording

☐ Yes, I consent to the use of a digital audio recording device during the interviews and observations.
☐ No, I do NOT consent to the use of a digital audio recording device during the interviews and observations

Taking part in this study is entirely up to you. You have the right to refuse to participate in this study. If you decide to take part, you may choose to pull out of the study at any time without giving a reason and without any negative impact on you or your technology project. Your signature below indicates that you have received a copy of this consent form for your own records.

<table>
<thead>
<tr>
<th>Participant Signature</th>
<th>Date/yyyy/mm/dd</th>
</tr>
</thead>
</table>

Printed name of the participant signing above
Participant Consent Form for Observations only

Principal Investigator: Elyssa Derban

Research is being completed as part of a Master's thesis in Educational Technology and Learning Design

The purpose of the study:
You understand that the purpose of this study is to understand more about the experiences of teachers integrating technology in classrooms. This is not an experiment. The researcher will not attempt to change any personal interactions.

You agree to the following during Spring 2015: The researcher will use a digital audio recording device in your presence for the purposes of recording another teachers' use of technology.

You understand that:
1. Participation is strictly voluntary. You can refuse to have your interaction recorded.
2. The information gathered will be confidential. Several steps will be taken to protect your confidential information and identity. Any digital recordings, once transcribed will be destroyed. The typed interviews will NOT contain any mention of names, and any identifying information from the interview will be removed. Any names mentioned during interviews will be coded or given a pseudonym. Only the researcher will keep a master list of pseudonyms along with the typed interviews in a locked filing cabinet at the Simon Fraser University, and only the main researchers and her supervisors will have access to the interviews. Digital information will be stored on a secure SFU server. All information will be destroyed after 5 years time.
3. You may opt out of the project at any time and for any reason you deem necessary with no repercussions if you give verbal notice to the researcher. If you choose to opt out, all of your data will be destroyed and excluded from the study.
4. Participation in this study will not directly provide any benefits to you. Declining participation in this study will not cause adverse actions to be taken against you or me.
5. The researcher will observe and record you using a digital audio recorder as you interact with other teachers preparing to use technology. The observations will last approximately 1 hour.

If you have any questions or concerns regarding your understanding of the study procedures, please feel free to contact me at XXXXXXXX or my supervisor at XXXXXXXX.

You understand that this research study has been reviewed and approved by the Simon Fraser University Office of Research Ethics. For research-related problems or questions regarding subjects’ rights, you can contact Dr. Jeffrey Toward, Director, Office of Research Ethics XXXXXXXX or XXXXXXXX.
You have read and understand the explanation provided to you. You have had all your questions answered to your satisfaction, and you voluntarily agree to participate in this study. You have been given a copy of this consent form.

Participant’s name PRINTED __________________________
Participant’s Signature __________________________
Date (dd/mm/yyyy) __________________________
Researcher’s Signature __________________________
Date (dd/mm/yyyy) __________________________

If you have any questions or concerns, please contact: Researcher: Elyssa Derban, XXXXXXXX, XXXXXX, XXXX, XXXX
Appendix B.

Interview Protocol

1) Tell me about the technology you are using in your classroom.
   I notice that you indicate that you have just started to try to integrate X (technology into your classroom. Why now and not before?
   Tell me about how you will be using X technology to support student (learning? (Curricular goals alignment)

2) Teachers’ technological and pedagogical content knowledge
   What kinds of digital technology do you use in a week?
   Tell me about your experience using technology personally – with students?
   Tell me about a typical lesson using technology that you might use with your (students? The last one you taught? One that you are excited about?
   Do you ever have problems with the technology? What do you do when that (happens? Prompt to big and small problems.
   Can you remember how you use technology with your students last year, two (years ago or 3 years ago?
   Are there other ways you have used technology with students? Prompt – (special needs, art, SMART, cameras, printers etc

3) Teachers’ personal influences that impacted their tech. integration
   What role do you think technology should play in a classroom?
   Why do you think your colleagues use technology with their students?
   What would you like to be able to do with technology and your students? ( 

4) Teachers’ experiences with technology support
   Tell me about how you have been using your professional development time (in the last year?
   Have you done any professional development for X (the piece of technology)?
   How else might you get support-using X (the piece of technology)?
   What did the support you were receiving look like last year, two years ago or (3 years ago?

5) School culture of communication
On the last full school day that you worked, on how many occasions did you talk to other teachers?

Can you tell me in what ways you communicate with other staff in the school? (Daily message at sign in?, announcements?, emails? staff meetings?)

How do you get information like pro-d workshops, committee meetings communities of practice?

6) Teachers’ experiences with technology leadership

How knowledgeable are the other staffs at your school? Is there anyone that you go to for help?

How do you think your principal thinks about using technology with students?

Who at your school knows a lot about X? What about other types of classroom technology?
### Appendix C.

**Interview schedule**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Data collected</th>
<th>Date (2015)</th>
<th>Location</th>
<th>End Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Interview</td>
<td>November 18</td>
<td>Classroom</td>
<td>3:53pm</td>
<td>72min</td>
</tr>
<tr>
<td>2</td>
<td>Observation</td>
<td>November 18</td>
<td>Classroom</td>
<td>5:07pm</td>
<td>39min</td>
</tr>
<tr>
<td>3</td>
<td>Observation</td>
<td>November 16</td>
<td>Classroom</td>
<td>4:20pm</td>
<td>56min</td>
</tr>
<tr>
<td>3</td>
<td>Interview</td>
<td>November 16</td>
<td>Classroom</td>
<td>5:11pm</td>
<td>50min</td>
</tr>
<tr>
<td>4</td>
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<tr>
<td>5</td>
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<td>Coffee Shop</td>
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<td>58min</td>
</tr>
<tr>
<td>6</td>
<td>Interview</td>
<td>October 9</td>
<td>Coffee Shop</td>
<td>3:11pm</td>
<td>56min</td>
</tr>
<tr>
<td>6</td>
<td>Observation</td>
<td>October 9</td>
<td>Coffee Shop</td>
<td>3:52pm</td>
<td>34min</td>
</tr>
<tr>
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<tr>
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<tr>
<td>8</td>
<td>Observation</td>
<td>July 16</td>
<td>Classroom</td>
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<td>32min</td>
</tr>
<tr>
<td>8</td>
<td>Interview</td>
<td>July 16</td>
<td>Classroom</td>
<td>5:03pm</td>
<td>53min</td>
</tr>
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