How Secondary Schools Transition into 1:1
Bring Your Own Device Blended Learning Environments

by

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A project submitted in conformity with the requirements

for the Degree of

Master of Education

Graduate Department of Education in the

University of Ontario Institute of Technology

Abstract

Many schools have implemented one device per student (1:1) programs. While the benefits of technology in education may not be fully realized until access is ubiquitous, 1:1 programs are often unsustainable. One way to make 1:1 technology sustainable is through the use of Bring Your Own Device (BYOD) policies. This study documented, via a historical case study, how staff of two secondary schools in Ontario implemented a 1:1 BYOD blended learning program. Through document analysis and interviews, this study revealed that staff focused on four areas including technology and infrastructure, professional learning, leadership, and adapting existing school tasks to implement a 1:1 BYOD program within their respective schools. Specifically, this research found that Wi-Fi networks, loaner devices and teacher devices supported access to technology and infrastructure. Professional learning offered to teachers at these schools focused on both learning digital tools and pedagogical change, and was largely teacher-directed. Participants also highlighted the importance of leadership development and distributed leadership throughout the implementation process. A final key finding reflected the need to adapt tasks that were already part of the school culture to support the implementation of the 1:1 BYOD program. Considerations for schools and school boards are described, along with implications for future research.

Contents

1   Introduction

1.1   Overview

Blended learning, sometimes referred to as hybrid learning, refers to the combination of the best features of online learning with the best features of face-to-face learning to support personalized learning (Johnson, Adams Becker, Estrada & Freeman, 2015). The Ontario Ministry of Education defines blended learning as making use of its own provincial learning management system, specifically the Virtual Learning Environment (VLE), to provide an online component for face-to-face classes. However, blended learning may not look the same within various classrooms (Ontario Ministry of Education, 2013). For the purpose of this research, the broader definition of blended learning as described by Johnson et al. (2015), will be used - combining online and face-to-face pedagogies, but not limited to one specific learning management system.

The Organization of Economic Co-operation and Development (OECD) report I*nnovating Education and Educating for Innovation; The Power of Digital Technologies and Skills* (OECD, 2016) examined the integration of digital tools into education worldwide. While teacher training and a shift in teaching strategies are important for success in digitizing classrooms to support innovative practices, adequate access to devices by students and teachers is also needed (OECD, 2016). Access to devices is seen as a barrier to or as a necessary first step to the effective use of technology in schools (Keane, Lang & Pilgrim, 2012; McKnight, O'Malley, Ruzic, Horsley, Franey & Bassett, 2016). One-to-one device programs have been seen as a potential solution to this issue (Keane & Keane, 2016).

Personalized learning supported through blended learning can be accomplished through many different device distribution models. For example, computer labs can be used in schools where students go to the computers when needed. Another example of a device distribution model is sharing devices that must remain in a classroom and cannot be used for personal study nor set-up according to personal preferences. A third option, is one-to-one initiatives, where each student has a device that they can take home, provides ubiquitous access (Crook, Sharma & Wilson, 2015). *The Horizon Report* found that bring your own device (BYOD) policies allow for students and employees to become more efficient in using devices established for their own workflow (Johnson et al., 2015). Levin and Schrum (2013) examined eight highly successful secondary technology initiatives in the United States and found that leaders from over half of the sites studied concluded that 1:1 programs where schools provided the devices for students were not sustainable, and the schools had planned to shift to a BYOD learning environment.

While BYOD programs can be initiated as a cost-saving measure to help schools and districts increase their ratio of devices to students (Hopkins, Tate, Sylvester & Johnstone, 2016), the benefits of a BYOD policy extend beyond financial savings. Johnson et al. (2015) found that:

> For schools, BYOD is less about the devices and more about the personalized content that users have loaded onto them. Rarely do two devices share the same content or settings, and BYOD enables students and educators to leverage the tools that make them most efficient and productive. (p. 37)

The Ontario Ministry of Education has committed to "invest in the technology, design and infrastructure required for the classrooms of the future to serve the needs of all communities" (Ontario Ministry of Education, 2014, p.6). This commitment to technology

funding combined with recent research predicting an increase in BYOD policies in schools worldwide (Johnson, Adams Becker, Estrada & Freeman, 2015; Hopkins, Tate, Sylvester & Johnstone, 2016) suggests that the examination of how schools transition to a 1:1 BYOD model is a worthwhile topic for study.

1.2   Background to the Problem

Literature can be found to support frameworks for general technology initiatives (McKnight et al., 2016), blended learning initiatives (Kaur, 2013; Barbour et al., 2011), and 1:1 device programs in secondary schools worldwide (Keane & Keane, 2016; Levin & Schrum, 2013). There is also research around BYOD policies where students may bring their own devices to class as desired (Johnson et al., 2015). There is a lack of research, however, explicitly focusing on BYOD programs where students are required to bring a device and are provided one to borrow if they cannot provide their own. At the time of this research, there existed very little documentation regarding benefits, challenges, or process for implementation for secondary schools looking for guidance in starting a 1:1 BYOD program.

1.3   Purpose of this Research

This research focused on 1:1 BYOD program implementation by exploring and describing the experiences of two publicly funded secondary schools in Ontario. The goals of this study were to identify the tasks required by school and school board staff from two secondary schools to implement a BYOD program and the potential sources of funding. Specifically, the main question guiding this case study was; how do secondary school and board staff prepare for a 1:1 BYOD blended learning program?

2 Literature Review

2.1 Overview

Bring your own device (BYOD) programs refer "to the practice of people bringing their own laptops, tablets, smartphones, or other mobile devices with them to the learning or work environment" (Johnson et al., 2014, p.34). The presence of BYOD policies in K-12 education are increasing around the world (Johnson et al., 2014). These policies are often mobilized when 1:1 laptop technology programs are found to be unsustainable, such as in a study of eight successful technology integration programs, where over half of the schools were considering transitioning to a BYOD model (Levin & Schrum, 2013).

There is currently little research about mandatory 1:1 BYOD device programs within secondary school environments. As a starting point, literature reporting on 1:1 laptop programs, 1:1 tablet programs, technology integration, blended learning programs, and optional BYOD programs in secondary schools was reviewed. To further support this work, studies investigating the use of BYOD devices and 1:1 programs in postsecondary were also examined.

For this review of the literature, the following terms found in Table 1 will be used to describe various types of technology programs in schools.

Table 1

Terms Relating to Types of Technology Programs in Schools

Term	Description
1:1 laptop	All students have the same or similar laptops provided to them by the school, including specific software required for the program.
1:1 tablet	All students have the same or similar tablets provided to them by the school
Optional or voluntary BYOD	Students are allowed, but not required to bring their own devices to class. Not every student has a device. Students have many different types of devices (phones, tablets, laptops)
1:1 BYOD	All students must bring their own laptop to school. If they cannot provide one, they are given one from the school. All students have devices, and the devices may vary.

When looking at technology integration in K-12 schools, McKnight et al. (2016) found

the following five roles of technology in classrooms that emerged from their research:

1. "Technology improves access" (p. 202) to learning resources and materials.

2. "Technology enhances communication and feedback" (p. 203).

3. "Technology restructures teacher time" (p. 204) away from whole-class instruction and

grading, towards one-on-one support for students.

4. "Technology extends purpose and audience for student work" (p. 204).

5. "Technology shifts teacher and student roles" (p. 205)

The OECD report *Innovating Education and Educating for Innovation, The Power of*

Digital Technologies and Skills (2016) uses both Programme for International Student

Assessment (PISA) data and recent research to investigate the impact of technology integration

in schools to student learning and achievement. The authors state that up until now, the integration of technology in classrooms worldwide has not delivered the much hoped-for improvement on student learning (OECD, 2016). The report, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills* (OECD, 2016), states that

> part of the explanation for this must lie with the dominant focus on technology and connectivity, both among suppliers of goods and services and among policy makers. Schools and education systems are not yet ready to realize the potential of technology, and the appropriate conditions will need to be shaped if they are to become ready. (p. 85)

> Similarly, when studying 1:1 laptop programs in K-12 schools, researchers found that simply providing digital devices to teachers and students was not enough to prompt transformative change to learning (Bocconi, Kampylis & Punie, 2013). Bocconi et al. (2013) found that:

> The 1:1 learning model may turn into a high impact innovation if it allows for the development of more effective ways for people to teach and learn, enabling new ways of using, creating and communicating information and knowledge. In other words, there is a need to progressively move the focus away from the devices and infrastructure to the learners and pedagogies, namely from 1:1 computing to 1:1 learning. This requires tackling questions related to dissolving the boundaries between the formal and informal/ non-formal learning spaces to re-engage marginalized learners and provide all students and teachers with opportunities to develop 21st century skills, such as problem-solving, inquiry, communication and collaboration. (p. 125)

A literature search using three different search techniques was conducted. First, "Quick Search" was used to search the databases available through the UOIT library. Initially, keywords used were 1:1, BYOD, secondary, and education. Filters were used to narrow results to peer-reviewed articles. Articles were used if they addressed 1:1 programs or BYOD programs in secondary schools or post-secondary schools. A secondary search was completed using Google Scholar, while connected to the UOIT library. The same keywords were used and article inclusion criteria. In addition to the above-mentioned article inclusion criteria, the articles were selected if they were available through the UOIT library. Lastly, the references section on recent articles that were cited or sourced in this study were used to identify articles that may have been missed in the searches.

Several major themes within the literature emerged. Using a spreadsheet, the major findings of articles were initially itemized and identified for themes. Over time, the major themes that emerged around implementing a 1:1 technology program included:

- Planning for effective technology integration;

- Teacher technology use & beliefs;

- Professional learning;

- Sustainability of 1:1 technology programs;

- Leadership;

- Benefits and challenges of every student having a device;

- Pedagogical changes with 1:1 access;

- Digital equity.

Each of these research areas is now briefly summarized.

2.2   Planning for Effective Technology Integration

Multiple frameworks highlighting what was needed for successful technology integration or 1:1 technology programs in schools were found in the research literature. Specifically, Levin and Schrum (2013) and McKnight et al. (2016) provide frameworks for successful technology integration initiatives in K-12 schools. Keane and Keane (2016) provide a framework for 1:1 programs in secondary schools. Common factors within these frameworks are outlined below.

When studying award-winning schools in the United States, Levin and Schrum (2013) identified eight components required for successful technology integration: "(a) vision, (b) leadership, (c) school culture, (d) technology planning and support, (e) professional development, (f) curriculum and instructional practices, (g) funding, and (h) partnerships" (p. 36). In addition to finding that all eight of these components must be present in any technology integration, they also found that the largest shifts in school culture happened after three or more years of a 1:1 technology to student ratio (Levin & Schrum, 2013). The finding of three years or more is important to consider from a planning perspective since their findings revealed that the technology had to be ubiquitous for that long to achieve the largest change in culture (Levin & Schrum, 2013). A different study examining technology integration projects in K-12 schools determined that "schools should attend to the combination of contextual factors, not the technology itself, to be successful in improving teaching and learning via technology" (McKnight et al., 2016, p. 208). In addition, they state, "our findings emphasize attention on supportive leadership, ongoing, teacher-driven PD and technology infrastructure" (McKnight et al., 2016, p. 208). In another study that investigated 1:1 technology programs in secondary schools, it was concluded that the four factors required for success of a program included, "stable

infrastructure, supportive teachers, delegated leadership, collaborative professional learning" (Keane & Keane, 2016, p. 1039).

2.3   Teacher Technology Use and Beliefs

In a 1:1 pilot program with elementary teachers, Bebell and Kay (2010) found that "although there often remained substantial variation in the frequency and ways different teachers chose to use the technology with their students, the majority of students and teachers altered their approach and practices since the introduction of laptops to the classroom" (p. 16). In addition to connecting technology integration to a shift in practice, this finding highlights how the individual teacher controls the level of technology integration in a class. Interestingly, Howard, Chan and Caputi (2014) found that technology integration differed by subject with secondary math teachers using it less than science and English teachers. When asked, the English teachers agreed the most, in comparison to those of other subjects, that technology use in class was important for learning (Howard et al., 2014). While not generalizable, one study determined those who integrated technology in their classroom the most often were those who used technology in their personal lives (Besnoy, Dantzler & Siders, 2012).

In a 1:1 elementary pilot laptop program, researchers found that "teachers need to be convinced that the time and energy that is required is warranted in terms of improved student outcomes" (Blackley & Walker, 2015, p. 114) and that "merely supplying equipment coupled with expectations of use does not support change" (Blackley & Walker, 2015, p. 114).

2.4   Professional Learning

The American Psychological Association states that "what and how much is learned are influenced by motivation to learn" (APA, 1997, p.4), which is "stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control" (APA, 1997, p.5). In keeping with this claim, Levin and Schrum (2013) stress the importance of professional development (PD) being differentiated for teachers. Zaka (2013) found that teachers need choice and guidance in their professional learning, which should be provided through in-school and out-of-school opportunities. These results about teacher choice are further supported by a recent study that examined professional learning across Canada. Campbell, Osmond-Johnson, Faubert, Zeichner & Hobbs-Johnson (2017) found that teacher voice and choice is important when working with teachers to shift teacher practice, although it must be aligned with system priorities.

When studying professional learning for teachers with 1:1 laptop programs in secondary schools, researchers found that the workshop model was inadequate for teacher learning and that teachers were asking for more time to work and practice together (Drayton, Falk, Stroud, Hobbs & Hammerman, 2010). Keane and Keane (2016) also found that in a secondary 1:1 program, the most valuable experiences occurred when teachers were allowed to work collaboratively. In a cross-Canada study about professional learning, Campbell et al.'s (2017) findings also stressed the importance of collaboration in professional learning. Their results supported "the value and prominence of a range of collaborative professional learning opportunities within and across schools and wider professional networks" (Campbell et al., 2017).

While looking for the common elements in highly successful secondary schools, Levin and Schrum (2013) found that "high-quality professional development was crucial, and that

purposefully revising curriculum and moving away from traditional, teacher-directed tasks toward more 21st century, student-centered instructional practices were critical pieces of the puzzle" (Levin & Schrum, 2013, p. 37). The same study found that teachers preferred to have technology facilitators on-site to support on-demand learning (Levin & Schrum, 2013).

Shapley, Sheehan, Maloney & Caranikas-Walker (2010) explored initiatives where the professional learning began before the implementation of the technology initiative. When studying these middle school 1:1 initiatives in Texas, they found that "professional development for teachers was a high priority. Training typically began before the first year started and was ongoing across implementation years" (Shapley et al., 2010, p. 46).

2.5   Sustainability of 1:1 Technology Programs

In an undergraduate iPad project, most students who initially brought their laptops to class, stopped bringing their own devices regularly, after being provided with iPads by the school (Mang & Wardley, 2013). However, they found that some students continued to bring their laptops because they preferred to use their own devices (Mang & Wardley, 2013). Researchers suggest that one possible reason for this small group of students not adopting the iPad entirely may have been the fact that they were required to return it at the end of the course (Mang & Wardley, 2013).

In addition to personalizing or a desire to use personally-owned devices, there may be financial reasons to adopt BYOD programs. For example, a project in Australia found that giving students $1000 computers when they had personal devices at home was not cost-effective (Crook, Sharma & Wilson, 2015). In a study of highly successful secondary schools, Levin and Schrum (2013) found that:

getting out of the hardware business as soon as possible and allowing students to use their

own personal computing devices is another lesson that the leadership learned in half the

schools we visited. What they told us was that funding 1:1 technology for every student

was not sustainable, and they needed to put their listed funds into infrastructure and cloud

computing because that meant they would have to rent or loan computers only to those

students who could not afford their own. They believed this would be a more sustainable

model for 1:1 computing for them. (p. 46)

2.6   Leadership

Leithwood describes leadership as, "all about organizational improvement; more

specifically, it is all about establishing widely agreed upon and worthwhile directions for the

organization and doing whatever it takes to prod and support people to move in those directions"

(Leithwood, 2007, p. 44). In earlier studies, strong leadership was identified as necessary for

successful technology integration initiatives (Shapley et al., 2010). While studying a 1:1

initiative, researchers determined "administrators demonstrated leadership through behaviors

such as involving staff in decisions, setting clear expectations for technology use, encouraging

and participating in professional development events, and providing resources and support"

(Shapley et al., 2010, p. 24). As introduced earlier, Levin and Schrum (2013) stress the

importance of distributed leadership for technology initiatives. In a more recent study Schrum

and Levin (2016) found that:

the award-winning leaders of technology-rich schools and districts we studied were

successful at improving their schools or districts because they attended to change factors

(nearly) simultaneously including collaboration and nurturing partnerships, visioning

together with all stakeholders, managing technology planning and infrastructure, providing professional development, improving instructional strategies and curriculum, implementation issues, attending to school climate and culture and keeping abreast of school and society trends. (p. 36)

2.7   Benefits and Challenges of Every Student Having a Device

Educational scholars have suggested that the full benefit of educational technology will not impact student achievement until technology can be used to personalize learning and therefore is ubiquitous or devices are no longer shared among many students (Bull, Bull, Garofolo & Harris, 2002, Papert, 1996; Papert, 1992). While there are challenges in classrooms where all students have their own devices, Kay and Lauricella (2014) found that benefits were reported 30% more often than challenges by post-secondary school students. Several benefits of 1:1 programs within a variety of learning environments appeared in the literature. For example, Crook et al. (2015) found that after three years with 1:1 laptops, student achievement in secondary school science classes increased, compared to those students who did not have laptops. The effect size was not large. A larger impact in physics courses compared to biology and chemistry was attributed to an increase in teachers adapting their instructional practices (Crook et al., 2015). Similarly, "when mobile devices or computers are used for delivering self-assessments to high school students, their overall motivation towards learning science (including intrinsic motivation, extrinsic motivation and self-efficacy) increases" (Nikou & Economides, 2016, p. 1246). When considering K-12 programs, blended learning allows for greater personalization of learning (Green & Hale, 2017). However, "there is a need for objective empirical research on academic outcomes for students engaging in blended and or online learning" (Green & Hale, 2017, p. 147).

When shifting to look at the impact of 1:1 programs beyond secondary schools, it was found that in middle schools, "student research skills and collaboration were enhanced by the improved educational access and opportunities afforded by the 1:1 pilot program" (Bebell & Kay, 2010, p. 22). When provided with individual devices, post-secondary students' attitudes regarding the use of tablets for learning was positive (Mang and Wardley, 2013). Looking at how students use the devices, researchers found that in a 1:1 laptop environment, postsecondary students used laptops for, "note-taking activities, in class laptop-based academic tasks, collaboration, increased focus, improved organization and efficiency, and addressing special needs" (Kay & Lauricella, 2011, p. 15). Highlighting the importance of teacher preparation and planning to maximize these benefits of 1:1 programs, researchers found that in classes where "instructors plan learning opportunities to use the devices in a meaningful way beyond PowerPoint lectures, the benefits of having laptops exceed the distractions" (Kay & Lauricella, 2014, p.18).

Through a review of the literature from 2001 to 2014, Kay and Lauricella (2014) found five main challenges faced by post-secondary students using laptops for learning. These areas include, "being distracted by other student's use of laptops, social networking, entertainment, surfing the web and learning performance" (Kay & Lauricella, 2014, p. 3). Distraction with 1:1 device programs is a recurring theme appearing in the literature as seen in several studies. Junco (2012) found that the frequency of multitasking with Facebook and text messaging during class were negatively predictive of overall semester GPA, while there was no correlation related to using some other technologies. The difference in impact on achievement indicates that the type of technology and distraction is important to consider when contemplating 1:1 programs. Mang and Wardley (2013) found that undergraduate student distraction in class occurred less

frequently with tablet use than it was with laptop use. When studying 1:1 tablet and BYOD programs in secondary classes, Selwyn, Nemorin, Bulfin and Johnson (2017) identified distractions such as games, music and video. In one study, researchers found that secondary teachers had no tangible strategies to deal with student distraction in a 1:1 environment (Andersson, Hatakka, Grönlund & Wiklund, 2014). This same study found that classes who have 1:1 technology had adopted an increase in independent learning (Anderson et al., 2014). However, this increase in independent learning led to weaker students struggling to remain focused (Andersson et al., 2014).

As previously mentioned, the literature is full of documentation around student distraction in class by personal devices. However, some interesting results have come from a survey of secondary students across Canada. When secondary students were asked about how they used their own devices in schools with BYOD policies, Kay, Benzimra and Li (2017) found that:

> while secondary students participate in a number of distracting behaviors, their primary focus is to use mobile devices to achieve the learning goals or tasks set out in class. These students appear to be more on-task when using mobile devices than their higher education peers. (p. 13)

In this same study, researchers asked secondary students for suggestions on how to reduce the distractions of personal devices. Over half of the students surveyed suggested rules and restrictions to be enforced (Kay et al., 2017). Surprisingly, the "second most frequent response to reducing distractions and increasing benefits was to improve the quality, structure, and meaningfulness of mobile device integration" (Kay et al., 2017, p. 16).

One other potential challenge that emerged from a study of secondary BYOD programs in New Zealand was choosing the most appropriate device for the particular learning environment (Hopkins, Tate & Sylvester, 2016). Hopkins et al. (2016) also found that many students brought more than one device to school, suggesting there may not be one perfect device for learning at this point.

2.8   Pedagogical Changes with One Device Per Student

More research is needed to determine the impact of 1:1 programs on student achievement and learning (Crook et al., 2015). Additionally, another theme is beginning to emerge through the research: the benefits of 1:1 programs will only be realized with a significant pedagogical shift involving the roles of students and teachers.

In their study looking at eight different highly successful secondary technology integration programs, researchers found "that purposefully revising curriculum and moving away from traditional, teacher-directed tasks toward more 21st century, student-centered instructional practices were important components of effective technology integration" (Levin & Schrum, 2013, p. 37). These findings build on the response from secondary students in schools with BYOD policies that state the key to decreasing distraction and "increasing benefits was to improve the quality, structure, and meaningfulness of mobile device integration" (Kay et al., 2017 p. 16). Australian researchers found that for secondary physics learners the presence of a laptop for each student supported the creation of conditions which acted as a "catalyst for a paradigm shift, providing students with the opportunities for more student-centered and personalized learning" (Crook et al., 2015, p. 289).

A sub-theme emerging is that of improved student talk and communication as an indicator of shifting pedagogy. In their study of successful secondary programs, Levin and Schrum (2013) found less teacher-centered instruction and more student-centered learning, with an increase in meaningful student talk related to the learning experience, as an indicator, when comparing to other schools. In their study, where graduate students each had a laptop with shared monitors (for taking turns projecting screens to small groups) and were given specific collaborative web exploration activities, Chang, Liu and Shen (2012) found an increase in quality and quantity of student discussion. The same findings were not present with shared computers (Chang et al., 2012).

2.9 Digital Equity

Middleton (2010) states that Wi-Fi access is required to reduce the digital divide between individuals with and without computer and internet access. Taking it further, Starkey, Sylvester and Johnstone (2017) identify three aspects of the digital divide in schools in New Zealand: access, capability and participation. They state that the first aspect, access, is often addressed in schools, however capability and participation must also be addressed (Starkey et al., 2017). Dolan (2016) suggests that once students have access to devices and connectivity, how they use this access creates another divide. Whether they use technology as a creator or producer (as opposed to a consumer) is partly influenced by the socioeconomic status of their home and school (Dolan, 2016). For example, how teachers use technology also impacts if students use technology as a producer or consumer (Dolan, 2016). Dolan (2016) explains that students "without access" act as consumers of digital technology. Those "with access" are empowered to be producers (Dolan, 2016). This divide is exacerbated where schools in high socioeconomic

areas tend to have more technology access compared to those in low socioeconomic areas. In conclusion, Dolan (2016) explained the complexity of the divide as;

> The urban myth teachers hold that low-income students do not possess ways to access the Internet appears to be a holdover from the past; rather, these students may access the Internet in ways not valued or understood by their teachers. Whether it is using a particular device (accessing the Internet through smartphones rather than laptops), the kinds of literacy practices they engage in (gaming rather than writing essays), or using technology outside of the home at the library or a community centre, it may be more about the lack of cultural understanding by administrators and teachers and their students, than the lack of a physical tool. (p. 33)

No matter how complex the divide and how prevalent digital technology becomes in day-to-day life, research shows that some students living on the lower end of the socioeconomic status spectrum continue to struggle to obtain access to devices and the Internet (Warschauer, Zheng, Niiya, Cotten, & Farkas, 2014). Educators need to consider that simple access to computers and Internet is a necessary initial step in balancing digital equity. However it is "how teachers and students use technology that impacts learning" (Warschauer et al., 2014, p. 47).

2.10 Limitations and Gaps in Previous Research

After conducting this literature review, there appears to be a lack of documentation regarding how a public secondary school might successfully implement a 1:1 BYOD blended learning program where each student has access to a laptop or tablet. While the reviewed research and frameworks used for effective educational technology initiatives are helping to guide the implementation process, more detailed studies around transitioning into a 1:1

environment with students' own devices would be helpful within the public-school domain. In addition, many of the studies looking at 1:1 secondary programs are based in the United States, New Zealand or Australia, and so a Canadian perspective is warranted. This study will contribute to the body of work by documenting how two secondary schools implement a 1:1 BYOD program. This study will also identify how students who cannot afford devices of their own are supported by the schools, and what tasks were completed by school board and school staff to administer such a program.

3 Methodology

This section provides an overview of the case study approach used in this research, as well as the rationale for selecting interviews and document analysis as the method of collecting data. The nature of the participants, the researcher's role within the study, as well as data collection and analysis strategies, are also provided.

3.1 Case Study

The nature of the research question steered this design towards that of a case study. A case study design allows the researcher to develop an in-depth analysis of the unique case (Creswell, 2014). The question of how school and school board staff prepare for a 1:1 BYOD blended learning program requires analyzing a specific, unique case. This historical case study examines the implementation of this program in two secondary schools within the Simcoe County District School Board and includes the perspectives of school board staff who supported the implementation of this program. All actions identified that led directly to the implementation of this program were considered and included within this unique exploratory case.

Yin (2014) describes the five components of case study research as being: 1) the case study questions; 2) its propositions; 3) its unit of analysis; 4) the logic linking the data to the propositions; and 5) the criteria for interpreting the findings. As already identified, the question guiding this research is: how do secondary school staff prepare for a 1:1 BYOD blended learning environment?

As Yin (2014) explains, exploratory case studies may not have explicit propositions, and yet still need to support why this method is appropriate to answer the research questions. The purpose of describing (through a case study) the process these two schools worked through to implement this 1:1 BYOD blended learning program, is to explore deeply the tasks required for the implementation of the program, and to develop formative ideas to shape future research. This exploratory, historical case study provides a potential framework to describe the processes, challenges, and opportunities the schools experienced. The case study is being completed through a historical lens for practical reasons. Since the program has already been implemented, participants will be describing and accessing archived evidence of tasks that were completed to support this program. The researcher sought to explore the processes and challenges of implementing this program retroactively.

The unit of analysis in this case study is the 1:1 BYOD blended learning program implemented in two schools. The actions by the school board and staff leading specific to its implementation have been included. The analysis of the actions gathered throughout the case study relied on theoretical propositions (Yin, 2014) to group or create themes for organizing the actions identified by documents (artefacts) and participant interviews.

3.2   Researcher's Position

The researcher maintains a mix of worldviews influenced by a broad range of experiences in medical research, working with Indigenous communities, and professional learning in education. Prior to entering education, the researcher was a research assistant at a research hospital. Research in this environment was entirely quantitative and developed through a post-positivist perspective.

Upon entering the field of education, the researcher spent most of her educational career focused on supporting the professional learning of teachers. In the report Learning Forward (2011), seven standards for professional learning are identified. These standards are defined as "the conditions, processes, and content of professional learning to support continuous improvement in leadership, teaching, and student learning" (Learning Forward, 2011). The seven standards are; "Learning Communities; Leadership; Resources; Data; Learning Designs; Implementation; and Outcomes" (Campbell et al., 2017). While previous professional experiences have provided exposure to all of these standards, the researcher has focused on the leadership standard through centralized, school district roles, and was responsible for building capacity and facilitating professional learning as a teacher leader. While discussing teacher leadership further, the Learning Forward Report highlights that "there is a distinction between when leadership is effectively delegated by formal leaders to distribute responsibilities contrasted with teacher-led leadership within and among professional communities" (Campbell et al., 2017, p. 32). While the researcher identifies with both formal and informal leadership, during this project, she was a teaching staff member at one of the schools and focused entirely on informal teacher leadership. Lastly, many years of work with Indigenous populations and

communities in education has also impacted the researcher's worldview about issues of social justice and specifically equity.

These experiences have led to a mixed worldview drawing on transformative, constructivist and pragmatic worldviews. A transformative worldview "focuses on the needs of groups and individuals in our society that may be marginalized or disenfranchised" (Creswell, 2014). The researcher's transformative worldview supported the interest in this particular program and its attempt to address issues of equity. Experiences in educational leadership and capacity building developed a constructivist worldview in which the "goal of the research is to rely as much as possible on the participants' views of the situation being studied" (Creswell, 2014).

Lastly, the researcher was a part of the implementation of this program and focused on the practical implications of the research question. Explaining that those who adopt a pragmatic worldview will "use multiple methods of data collection to best answer the research questions", Creswell (2016) indicates that pragmatists will select the data sources that directly relate to the problem being addressed.

While all three worldviews (transformative, constructivist and pragmatic) contributed to the researcher's interest in this specific technology initiative, the constructivist and pragmatic perspectives underpinned the specific research design. Pragmatism supports multiple methods of collecting data due to a "worldview that arises out of actions, situations and consequences" (Creswell, 2014). Constructivism leads to the creation of a theory through analysis of the data (Creswell, 2014). A case study design accommodated both of these worldviews. A transformative worldview prompted the researcher to explore these research questions so that it

might assist future planning and implementation of similar programs to ensure digital equity and access to assistive tools (example: text-to-speech) for all students.

Due to the historical nature of this case study, the focus of this research is descriptive and focuses on articulating a framework for the mechanics of program implementation as opposed to assessing the impact or effectiveness of program implementation on student achievement.

3.3   Participants

Participants in this case study included key individuals who had a role in organizing and implementing the 1:1 BYOD blended learning program within their schools. Participants were drawn from two small secondary schools who worked together to implement a program where every student was asked to bring their own laptop computer to school. The two schools worked together to implement this program for a number of reasons. The first reason was that one of the principals had supported a similar program in a different school board. The two schools were also in the process of an accommodation review. Only six kilometres away from each other, board staff predicted these two schools would be amalgamated and as such, worked together throughout this process. Since the inception of this research study, the two schools have since amalgamated. The second school also had teacher leaders and administrators who had expressed interest in implementing a similar program. The researcher was a teacher-leader at one of the schools and part of this program.

Eleven individuals including two superintendents, two principals, two vice-principals, four teachers, and one information technology services (ITS) manager (who were involved in the initial organization and planning stages of the BYOD program) received invitations to participate in this research study. Every administrator who was part of the planning was invited to

participate. Select teachers were chosen and asked to volunteer for interviews based on their increased level of participation in the implementation of the 1:1 BYOD blended learning program. Two teachers (one from each school) and one vice-principal did not respond to the request for an interview. The following individuals consented and participated in this research study: two superintendents, two principals, one vice-principal, one information technology services manager and two teachers (one from each school).

3.3.1 Demographic Information of Schools Implementing Program

Penetanguishene Secondary School had 314 students from Grades 9 - 12 (Penetanguishene Secondary School: About Us). It was located in Penetanguishene, Ontario, a town of approximately 9,600 people. The average income of individuals over 15 years old in Penetanguishene as of 2011 was $36,422 (Economic Development Corporation of North Simcoe: Statistics).

Midland Secondary School had 610 students from Grades 9 - 12 (Midland Secondary School: About Us), located in Midland, Ontario, a town of approximately 17,000 people. The average income of individuals over 15 years old in Midland as of 2011 was $34,157 (Economic Development Corporation of North Simcoe: Statistics).

These two secondary schools in the Simcoe County District School Board (Penetanguishene Secondary School and Midland Secondary School) implemented the 1:1 BYOD program in 2014. At the time of implementing the 1:1 BYOD program, both schools were facing declining enrolment. The schools were about 6 km from each other in two adjacent small towns. Immediately after the timespan of this case study, the two schools amalgamated into one new secondary school.

3.4   Data Collection

This section describes the processes and rationale for data collection strategies implemented in this study.

3.4.1 Consent

Initially, participants were invited to participate in the study via email. Written consent was obtained from all participants before their interview. The consent form is in Appendix A.

3.4.2 Document, Email and Calendar Event Collection

Data collection began by gathering, documenting, and sorting all of the researcher's emails, documents and calendar events about implementation of the program. To gather more evidence of actions and ensure no actions were missed, school board staff were interviewed.

Yin (2014) states that "for case study research, the most important use of documents is to corroborate and augment evidence from other sources" (p. 107). In this study, documents, emails and calendar events are used to corroborate and provide details on tasks described by participants in the interviews. The aim was to determine how school and board staff implemented a 1:1 BYOD program and how these tasks were funded, if applicable.

To start data collection via documentation review, the researcher collected emails relating to the 1:1 BYOD program from two years prior and one year after implementation (August 2012 - July 2015). Documentation review was done by systematically going through:

- emails saved in folders or the inbox;

- emails in the sent folder; and

- emails in the deleted or trash folder.

Calendar events relating to the implementation of the program were then collected by going through the researcher's calendar systematically for the previous three years. Lastly, notes and documents related to the implementation of the program were collected systematically by:

- sorting through and documenting notes from physical journals and notebooks; over the time period being studied;

- searching each folder of saved files on the researcher's computer; and

- searching notes made in the researcher's note-taking computer program.

The resulting number of collected artifacts for examination and analysis is as follows:

- 73 documents from the researcher's computer based on a search of "blended learning" and "BYOD";

- 112 emails from the researcher's email program based on a search of "blended learning" and "BYOD"; and

- 108 calendar events from the researcher's calendar August 2012 - July 2015 were archived. Anything connected to the Blended Learning, 1:1 BYOD program were saved.

3.4.3 Participant Interviews

To triangulate the evidence and capture the actions of other school and board staff required to implement the program, participants with varying perspectives were chosen to interview about their role in implementing the program. Two superintendents, two principals, one vice-principal, one information technology services staff member, and two teachers were interviewed.

In his book *Case Study Research: Design and Methods*, Yin (2014) describes interviews as a primary source of evidence. He further explains that interviews will be much like a guided conversation, to allow researchers to follow a line of inquiry related to their research questions

(Yin, 2014). In this case study, the researcher used the interview guide (Appendix B) to help guide interviews while allowing flexibility to explore areas more deeply as needed.

Interviews were largely unstructured in design but included the following two main questions as a guide:

1. In your role, what things did you do to prepare for the 1:1 BYOD Blended Learning program?

2. For each task you did, please provide a date or timeline and any funding sources, if required.

If clarification was required based on participant responses, the researcher asked clarifying questions as identified in the interview guide in Appendix B. Eight interviews were completed (and audio recorded) with two teachers, two principals, two superintendents, one vice-principal and one ITS manager, resulting in a total of 351 minutes (five hours and 51 minutes) of recordings.

3.5 Data Analysis

Each document, email and calendar event was converted into a PDF and entered into MAXQDA, a qualitative data analysis software purchased by the researcher. Each audio file was also uploaded to this master MAXQDA file and transcribed. The master MAXQDA file was stored on a password-protected laptop and a backup saved in a UOIT Google Drive.

Coding data is described as "reducing the data into meaningful segments and assigning names for the segments" (Creswell & Roth, 2017). An open-coding process was used to analyze the raw data in addition to starting with a base of theory-driven codes. DeCuir-Gunby, Marshall and McCulloch (2011) describe open-coding as that which the researcher creates codes or

concepts while analyzing the data. Open coding allows the concepts within the data to be explored by the researcher (DeCuir-Gunby et al., 2011). Codes determined through an *a priori* approach are "from the investigator's prior theoretical understanding of the phenomenon under study" (Ryan and Bernard, 2003 p. 88).

Using the results of the literature review as an initial framework, a list of general codes was created to start the coding process of the documents and interview transcripts. These codes were developed through an a priori or theory-driven approach (Creswell & Roth, 2017). Guided by the research questions, the codes needed to be actions that were done to prepare for implementing the 1:1 BYOD blended learning program. These initial codes included:

- teacher learning;

- student resources (creation of or sharing);

- communication (students, parents and community);

- technological improvements (infrastructure, hardware, software); and

- physical learning environment changes.

Starting with the documents, emails and calendar events, each relevant word or group of words was given a code based on the type of task (see list of initial codes above) it referenced. Once again, using the research questions as a guide, it was also important to examine "who" completed each action. Creswell and Roth (2017) describe lean coding as starting with a minimal list of codes and then adding new ones as needed. At this time need for another code for "who" emerged. It became apparent that there was one teacher in each school who was helping and guiding other teachers, students and administrators. The roles of these teacher leaders stood out and so a new teacher leader code was created.

A new set of codes relating to the person or team completing the action was also created. These codes included

- principal;

- vice-principal;

- superintendent;

- teacher;

- teacher-leader

- blended learning committee (a team of teachers volunteering to assist with implementation of the program);

- information technology services (the its department is centrally located within the school board but supports infrastructure, hardware and software in schools across the board); and

- itinerant resource teacher (an IRT is a teacher who works centrally for the school board and supports teacher learning in schools across the board).

Documents, emails and calendar events were coded with both an action and a person or team responsible for that action. New codes were added as they emerged through the iterative cycle of reading the materials using the original codes as a guide. According to the statement "repetition is one of the easiest ways to identify themes" (Ryan & Bernard, 2003), when a new theme or a subtheme of an encompassing theme occurred repeatedly, it was designated as a code.

Similarly, the interview transcripts were also broken into chunks of text that referred to an individual action and coded using the same codes as used to analyze the documents. The interview transcripts were also coded with a person responsible for the particular action.

It is important to note that not only were many documents, emails, calendar events and interview transcripts coded with two separate codes (i.e., one for the action and one for the person responsible for the action), but there were also cases where simultaneous actions were applied. For example, an email referring to a communication piece about a student transition day was coded with the actions "communication" and "student transition".

4   Findings

4.1   Overview

Table 2 displays all of the codes relating to the actions identified by participants in the interviews, and the number of times the codes appeared. The number of occurrences of a code does not directly indicate the importance of that action due to the nature of data collection. The documents, emails and calendar events were acquired from the laptop of the researcher. Any action completed by the researcher (a teacher leader) naturally resulted in more correspondence and documentation. Due to the role of the researcher, the high use of the teacher-leader code is obvious when looking at the codes for person or team responsible for the action in Table 3.

Table 2

Codes Relating to Actions and Number of Occurrences in Data

Code	Number of Occurrences
Teacher Learning	110
Communication	44
Student Transition (Gr8-9)	43
School Planning	33
Present Conference	31
Loaners	31
School Resource Distribution	30
School Culture (morale/engagement)	27
Teaching Resources	27
Board Planning	25
Teacher Choice	19
Leadership Development	19
Digital Citizenship	17
Students Technical	17
Proposal	15
Gather Info	15
Budget	13
Technical	12
Advocate	10
Troubleshooting	9
Student Voice	1
Booking Supply Coverage	1

Table 3

Codes Relating to Person or Team Responsible for an Action

Code	Number of Occurrences
Information Technology Services (ITS)	16
Vice Principal	2
Itinerant Resource Teacher (IRT)	15
Teacher Leader	159
Superintendent	13
Blended Learning Committee	63
Teacher	27
Principal	47

Initially, it was anticipated that the analysis would also include a set of codes to describe different sources of funding for various components of the program. However, there were only 12 references to financial sources, and so the code "budget" was used to cover them all. Four discrete sources of funding were identified. And included;

- school basic budget;

- information technology services budget;

- special grants; and

- miscellaneous sources for small individual activities.

Lastly, two codes (background information and reflection) were used to tag items that arose in interviews that were related but not directly connected to actions taken to prepare for the program. Background information refers to information shared about the school and why the program was initiated. The code "reflection" was used when participants reflected back on the implementation of the project and suggested things they would do differently or had done well.

Figure 1 displays a mind map of the coding results for the analysis of all documents, emails, calendar events and interviews, as well as the relationships between the codes. The red coloured tags identify one of the following eight roles that emerged through the interviews, emails and documents:

1. information technology services (its) staff;

2. itinerant resource teachers (irt);

3. principals;

4. vice-principals;

5. superintendents;

6. teachers;

7. blended learning committee, and

8. teacher-leaders.

Both schools had a blended learning committee consisting of teachers who volunteered to work with their respective principals to make decisions and to support the implementation of this program. Both schools also had teacher-leaders who took leadership roles in troubleshooting and supporting other teachers implementing digital tools as needed.

When considering how staff prepare for a 1:1 BYOD program, the codes identified collapsed into the following four broad themes or types of tasks:

1. technology & infrastructure;

2. adapted school tasks;

3. professional learning and;

4. leadership.

Technology and infrastructure, professional learning and leadership were themes identified in the literature review about "planning for effective technology integration". The adapted school tasks category emerged from the data collection and analysis. Findings for each theme are now described.

When looking at the data around how a 1:1 BYOD program is funded, three primary sources of funding were indicated; school basic budget, Information Technology Services (ITS) budget, and special grants and funds.
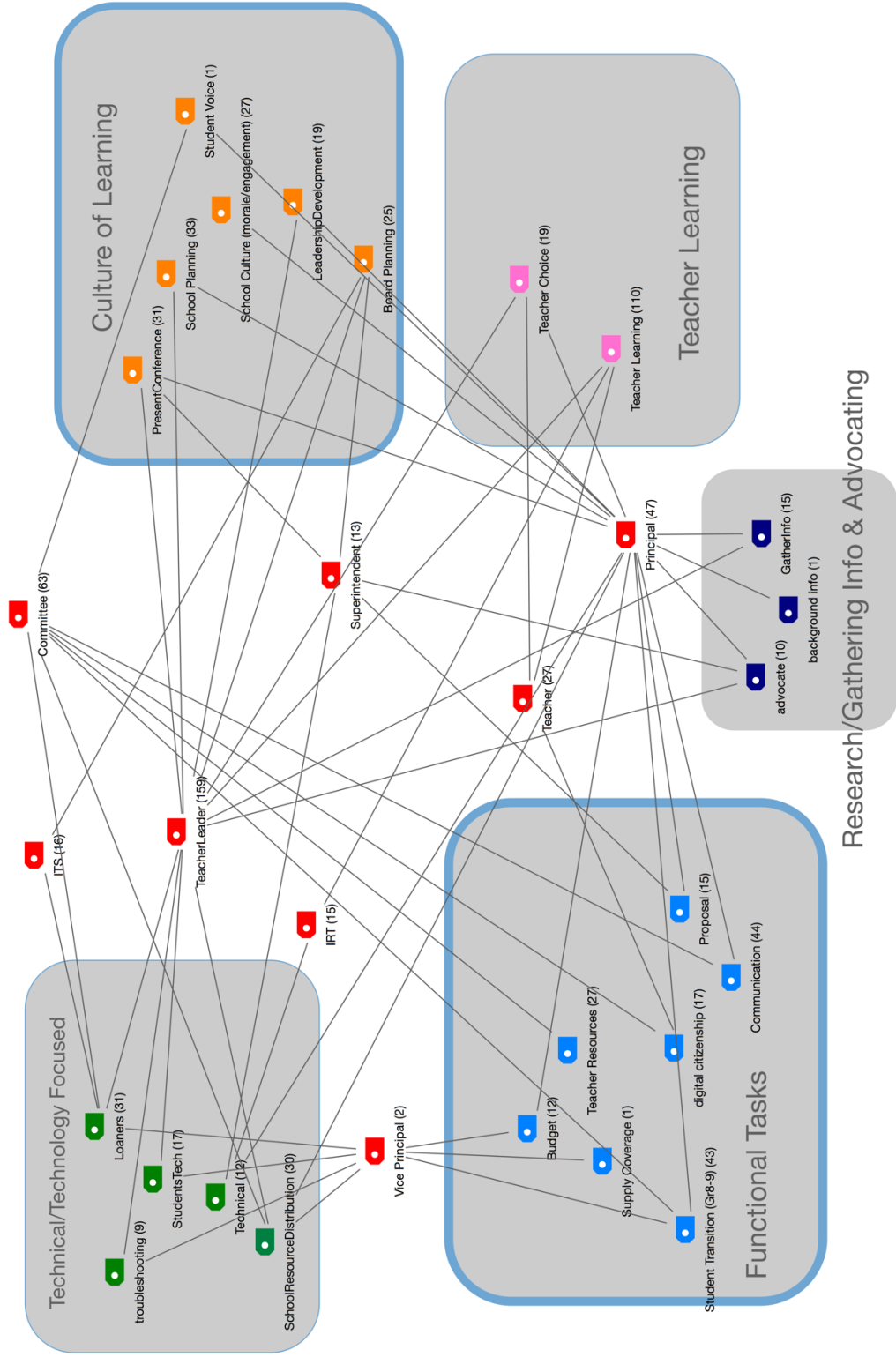
Figure 1: Mind Map of Codes Used for Tasks

4.2 Preparing for a 1:1 BYOD Program

4.2.1 Technology and Infrastructure

The *technology and infrastructure* category refers to tasks purely technical in nature that included tasks or consideration of processes related to getting functioning technology into the hands of the students and teachers. Document and interview data analysis revealed five key areas of foci: 1) loaner devices; 2) troubleshooting technology; 3) school resource distribution; 4) student tech help; and 5) technical planning.

4.2.1.1 Loaners

The code *loaners* was used 31 times to identify tasks that related to preparing the laptops that would be borrowed by students who did not have their own. In an interview, a superintendent described how they took six-year-old laptops about to be recycled and wiped them clean to use as loaner devices by students. The move to using refurbished laptops required a shift in thinking by ITS as described by one participant, "the refurbished ones went against the grain of IT, the idea of providing more to a place. Because everyone in a school always wants more" (audio file 004). The ITS and school board have policies on the ratio of students to computers supported in a school. For this program, these recycled devices were provided in addition to the normal ratio of students to devices, but without ongoing ITS support. The use of refurbished devices then required creating an image for these laptops which included the operating system Windows 8 (which was brand new at the time) and software that was either already licensed by the board or available through provincial licenses by the Ontario Ministry of

Education (audio file 005). One principal described this image: "it was a robust image. It was probably more than what I even envisioned putting on. But it was a good image" (audio file 005). Emails between ITS, principals and teacher leaders showed that ITS requested input from school staff as they set the image. Software on this image included an older licensed version of Microsoft Office and software provincially-licensed with student take-home rights such as text-to-speech software (document 149).

Interviews, emails and documents (such as meeting agendas and spreadsheets) outline how the loaner devices were distributed on a Grade 9 orientation day in August before the first day of classes. The distribution of loaners was coordinated by the blended learning committee, vice-principals and principals, and described as "at the front door. Grade 9 orientation day. As the students walked in" (audio file 004). If a student missed this day, they would get the device during the first week in September. Students with device issues needing to borrow a loaner throughout the year would go to the school principal at Penetanguishene Secondary School or to the vice-principal at Midland Secondary School. A vice-principal explained, "then if a student missed that day and as we increased the Grades (over the years), we were up to Grade 11 - students would come in and ask if we had an extra loaner" (audio file 004). Both schools gave out a loan agreement/contract to be signed by the parents or guardians of students (document 039). Emails showed that this contract was created by the principal at Penetanguishene Secondary School and shared between the schools. Emails and interviews demonstrated that schools considered the loaner devices "disposable" if something went wrong with one. However, the vice-principal or teacher leader did try to troubleshoot difficulties before disposing of them. The troubleshooting process included re-imaging the devices as needed using a

bootable USB drive created by ITS. A vice-principal described this as "I was taking back computers and giving them new ones as they were beyond their lifespan" (audio file 004).

Both of the schools tracked loaner devices by recording the ID code of the laptops in a spreadsheet (document 011). However, this tracking was not always kept up-to-date and ended up disorganized. In the larger of the two high schools of about 600 students, 52 laptops were loaned out during the first year (document 011). This school was expecting 138 Grade 9's to enter, but school staff did not track changes in this number. This number fluctuated with late registrations and students moving schools. The actual number of Grade 9's that year was not known by any of the participants being interviewed. However, a spreadsheet tracking the phone calls home to parents in June show 138 students were anticipated (document 032). Using the number of loaners distributed (52) and the expected number of Grade 9's (138), approximately 38% of students made use of loaner laptops at this school. The number of loaner devices went down in subsequent years (audio file 004), but again the exact number is not known. In the smaller school of about 300 students in total, only about 15 laptops were given out (audio file 005). Participants did not recall the number of Grade 9's that year either.

Once all Grade 9 students had devices, principals made the decision to place some leftover laptops in Grade 9 classes where Grade 10, 11 or 12 students were enrolled. Provisioning these classes with loaners allowed the older students to participate in all course work requiring access to technology (document 171).

The principal of the smaller school indicated that the second year of the program, the school transitioned into lending out Chromebooks instead of refurbished laptops. He stated, "I think I ended up buying 30 Chromebooks for kids to use" and then "even the Chromebooks, we

didn't have to use them all. The Chromebooks were sitting in the vault and as kids needed them"

(audio file 005).

4.2.1.2 Troubleshooting

The code *troubleshooting* was used nine times in interviews. From emails and interviews

it was documented that teacher leaders in both schools and a principal or vice-principal from

each school, worked with ITS, IRTs, colleagues, and students to troubleshoot technical issues

that arose. These issues included network logins, student information system syncing, and

managing Google Drive accounts and Desire2Learn (D2L) accounts (document 165). The board

was transitioning to single-sign-on which caused some unexpected troubles at start up (audio file

002). The principal at one school and vice-principal at the other indicated that they connected

with the Certified Network Technician (CNT) assigned to the school on a regular basis (audio

file 004 and audio file 005). While the CNT could not troubleshoot or touch students' personal

devices directly, they supported staff with general tips and tricks and educated staff as needed so

they could support students. CNTs are not allowed to touch student or teacher devices for

liability purposes since the devices are not board-owned hardware. The teacher leaders in both

schools identified becoming 'go-to' people for other teachers when staff struggled with

technology (audio file 002 and audio file 003). These teacher leaders used their expertise to help

colleagues work through strategies to troubleshoot issues. Principals in both schools worked

with teachers to find solutions to a general lack of electrical outlets in older school buildings

without causing health and safety issues such as overloaded outlets and other electrical hazards

(audio file 001 and audio file 005). Solutions included new power bars, extension cords, and

strategic reorganization of furniture in classrooms. From interviews and researcher emails,

teacher leaders in both schools actively networked with colleagues to understand how they were

using technology in the classroom. They walked through the school seeking to understand how teachers were incorporating the technology into courses to support the curriculum. Having an understanding of how teachers were using technology to support student learning allowed them to anticipate potential technical problems before they arose. One teacher leader described it as "then I would be like okay, knowing what I knew, and then I would trouble shoot any problems. So, my job was to find the problem before it occurs and this stems from industry" (audio file 002). One principal identified that her job was to 'become a sounding board, or to listen to teachers vent about technical issues when frustrated', even if they had little to offer regarding solutions (audio file 001).

4.2.1.3 School Resource Distribution

The code *school resource distribution* was used 30 times and refers to how digital tools including hardware, accessories and mobile devices were distributed throughout the school to support the program strategically. Many emails and purchasing orders showed that administrators and teacher leaders created accessory kits for teachers including projector adapters, power bars, and extension cords (document 132). Teacher interviews and emails among the blended learning committee described how the school librarian managed and kept track of school iPads (audio file 003, document 017). Interview transcripts (audio file 003) showed that the blended learning committee, along with the principal, determined ways of distributing school mobile devices (iPads and Chromebooks) in the school that complemented the program. This model changed throughout the prep year and implementation year as they experimented. At times, iPads were put in classrooms or departments in pods of 5 to support students' own devices. On other occasions, they were available for sign out through the library.

4.2.1.4 Student Technical Help

The code *student tech* was used 17 times to identify places where students needed technical help. Librarians and teacher-leaders became known to students as the go-to person for support with technology as needed, as articulated by one teacher who also worked in the library;

> My role in the library all sort of just integrated really well into that timing. I tend to be the tech troubleshooter in the building anyways and so this sort of just became yet... I don't want to say, 'yet another part of my job'. It wasn't added on, it was seamless. And, I think I'm in a much better position now for it. (003 Audio File)

One teacher leader created a handout for students with blended learning tips and tricks for logging into different tools, accessing guest Wi-Fi and file management (document 033). The handout was distributed to students and staff through the library.

4.2.1.5 Technical Planning

The code *technical planning* was used 12 times to describe tasks in which plans were made to enhance or support the technical components of the project. ITS improved the Wi-Fi within the schools by increasing the number of network drops in these two schools during the summer before the program started. The Wi-Fi enhancement was already in the planning stages for all secondary schools, but these two schools were flagged to be upgraded first. As one participant noted:

> We were in the process of replacing access points, and so I believe we made the commitment to upgrade those in those locations sooner rather than later. And, that included common spaces. Because it wasn't normally seen as a good idea to put an access point in the cafeteria at the time. But, we did. And we put them in the gyms too. (audio file 007)

In an email to staff, a principal stated, "Seventy Wi-Fi hubs were installed in the school over the summer in support of our blended learning initiative" (document 079).   ITS moved one of the two schools ahead a year for a teacher notebook (laptop) refresh. The other school was in year one of the refresh, and they added the second school. As explained by a superintendent, "Penetang was in the first round anyway and then Midland was in the second. And, the nice thing was that we were able to advance those timelines up a little bit just based on price" (audio file 007).

When looking at software and digital tools, ITS connected with one of the teacher leaders to share and discuss the roll-out of new tools such as Office 365, Google Suite, Desire2Learn updates (including single sign-on) and Windows 8 roll out. In turn, the teacher leader shared this information with teachers at both schools (documents 120, 102).

4.2.2 Adapted School Tasks

The *adapted school tasks* theme refers to actions that schools adapted or altered to support the 1:1 BYOD program. None of the codes that grouped into this area (e.g. student transition, communication, digital citizenship, teaching resources or supply coverage) are unique to schools running a 1:1 BYOD program. These tasks, however, required adaptation to support the implementation of the program.

4.2.2.1 Student Transition Grade 8 to 9

The code *student transition* was used 43 times. Tasks or actions to help students transitioning from Grade 8 to Grade 9 happened in these two schools before the implementation of this program. The tasks identified in documents, emails, calendar events and interviews are those that were adapted or altered to support this program. Both schools added extra Grade 8

parent nights during their first year (audio files 001, 004 and 005). In addition, a special blended

learning night was added in the early fall. The timing of these Grade 8 information nights was

earlier than normal to allow parents to purchase devices for students over Christmas and holiday

sales (audio file 005). On this evening, departments displayed blended learning activities at

stations around the cafeteria with current students leading these stations. Information about

types of devices was provided to parents (audio file 001 and 004). Parents of Grade 8 students

were surveyed during the parent nights. This survey asked if students already had a device and if

so, what type (audio file 003). During the 'regular' or traditional Grade 8 parent's night later in

the year, information about blended learning was also added. One principal described it; "in the

Grade 8 presentation, we also added a BYOD part because we needed people to know that the

expectation was that if at all possible for Grade 9 students coming into the school had some kind

of device" (audio file 001).

During the Grade 9 orientation day in August students worked through a variety of

teacher-led stations where they could get their personal devices connected to the school network

and get access to school accounts (document 027). Additional letters of explanation (about the

blended learning program) and device requirements were added to registration packages that

went out to students (document 030). The blended learning committee designed brochures to

distribute to parents during meetings about choosing a digital device and blended learning in

general (document 042). The blended learning committee also set up information booths at

elementary schools during parent-teacher nights (calendar events).

The Grade 11 leadership class at one of the schools ran webinars for Grade 7 and 8

classes of incoming students and included information about blended learning and the use of

technology (calendar events and audio file 001). The blended learning committee and front

office staff called each family of incoming Grade 9's in June to check that they had a device or if they would would need a loaner (calendar events). Both schools found a phone call was the best way to get accurate information and felt the personal connection was necessary (audio file 005).

4.2.2.2 Communication

The code *communication* was used 44 times to describe actions that were focused on communicating and messaging around the program. Both vice-principals and principals indicated that there was increased communication (phone calls) from parents concerned about their students carrying laptops around all day (audio files 001 and 004). Principals and vice-principals also sent out invitations or worked with various local media to join school events such as Grade 8 days, to highlight the program (audio file 004 and document 164). Document 169 showed that principals and teacher leaders invited superintendents for conversations and updates around the implementation of the program. Principals and teachers shared articles and resources pertinent to blended learning with other staff by email (documents 119, 084). Teacher leaders shared updates about new technology from the board with teachers and administrators (document 102).

The board communication department and a principal created a brochure about blended learning and created logos/branding for the initiative (document 083). This brochure was then shared with parents at events. Before course selection time, the blended learning committees created information paragraphs about the blended learning initiative for course calendars (document 038). Principals engaged the school councils in conversations around the program. The blended learning program became a regular agenda item at parent council meetings, where the principal provided updates regarding the program (audio file 001).

4.2.2.3 Digital Citizenship

The code *digital citizenship* was used 17 times and describes specific activities taken related to supporting the development of digital citizenship. One study describes digital citizenship as "using Internet resources to have youth (1) practice respectful and tolerant behaviors toward others and (2) increase civic engagement activities" (Jones & Mitchell, 2016). Two major actions were taken to support digital citizenship. Firstly, a Grade 8 visit day was added during the first year. Older student leaders ran digital citizenship activities for Grade 8 students during the day (audio file 001, document 070). These activities included creating videos, cartoons, and media around different digital citizenship topics (document 070). Secondly, blended learning committees from both schools worked together to create lessons for their teachers around blended learning topics to be used in the first few weeks of school. Topics included sourcing images, ergonomics, privacy, netiquette, and file management (audio file 003, document 159).

4.2.2.4 Teaching Resources

The code *teaching resources* was used 27 times and used to identify actions that resulted in the creation or sharing of teaching resources such as lessons or materials that could be used with students. Principals and teachers reported a general increase in teachers sharing resources to support learning (audio files 001, 002, 003). As mentioned above under digital citizenship, the blended learning committee created lessons for teachers to use during the first week around various digital citizenship topics. Teachers were assigned specific lessons to complete with their students within a broader schedule to ensure that every student participated in each lesson (audio file 003, document 159).

4.2.2.5 Supply Coverage

The code *supply coverage* was only used once. The vice-principal increased supply coverage to coordinate with the increase in teacher learning activities occurring in the school (audio file 004).

4.2.3 Professional Learning

Two major themes emerged within the umbrella of professional learning: teacher learning (accounts for all the tasks related to teachers learning about topics unique to the preparation of the 1:1 BYOD program) and teacher choice (in determining learning needs and activities).

4.2.3.1 Teacher Learning

The code *teacher learning* was used 110 times. A teacher leader surveyed teachers informally before and after the 'prep year' (year leading into the September when Grade 9 students came with laptops) to guide professional development (PD) opportunities to be offered through a Teacher Learning and Leadership Program (TLLP) project (document 141). This survey was based around the International Society for Technology in Education (ISTE) standards for teachers (document 077). This information was shared with the staff and used to help guide teacher learning opportunities (document 076).

Teacher leaders ran PD days throughout the year on topics identified and selected by teachers. Topics included Desire2Learn (D2L), Google Apps for Education and assessment with digital tools (Document 046). An additional professional learning day was supported by board IRTs. In August before school started, teacher 'prep' or 'just in time' sessions were also offered by a teacher-leader to support teachers getting ready for the first week (calendar events).

Teachers participated in board-facilitated (led by IRT's) collaborative inquiries (audio file 002). These collaborative inquiry sessions included teachers from a variety of schools as well as teachers from the research sites who were able to align their learning with preparing for the 1:1 BYOD program. These were called Technology Hubs. Lunch and Learn sessions were also provided by teacher leaders and teachers for any staff member interested in learning about digital tools and assessment ideas (document 003, 122, 147).

The principal worked with the school board to allow teachers to take iPads home for the summer to practice and learn with - "they were encouraged to use them at home over the summer" (audio file 001). The practice of taking home school devices had never been done before. Principals also organized and brought in guest speakers on PD days specific to collaborative learning using technology to support students making connections with other students around the globe (audio file 005). Both principals indicated that they allocated funds to support teachers in attending conferences around educational technology (audio files 001 and 005). One principal described it as:

> I definitely hand-picked teachers who I thought could carry forward and that was new to them. New to that school, conferences have never been funded and money is money so there's a limit - I used school basic budget and worked with the OSSTF rep and got money there and got some money from the superintendent so that people could go without any financial hardship to themselves. (audio file 001)

Some teachers from both secondary schools visited a school in another board that had implemented a similar 1:1 BYOD program. These teachers observed classes and had opportunities to share and learn with the teachers already implementing a similar program. (audio files 002, 003, 004, 005, calendar events).

The Simcoe County District School Board provided a 0.5 IRT position to support teachers in these two schools throughout the year leading into the program. One-on-one support, coaching, co-planning and co-teaching with the IRT occurred throughout this year (audio file 001, 005). Co-planning and co-teaching also occurred with the teacher leaders and teachers (calendar events).

One school principal modelled different digital tools at staff meetings while encouraging teachers to share what they tried in class at subsequent staff meetings (audio files 001, 004). Professional development days were organized to empower teachers to share - teachers ran small break-out sessions and teachers chose which to attend (audio file 001, document 184).

4.2.3.2 Teacher Choice

The *teacher choice* code was attached to tasks where participants or artefacts indicated teacher choice specific to professional learning experiences. It was used 19 times. This code overlapped with "teacher learning" and was used to indicate the teacher learning actions that specifically included teacher choice. Artefacts such as document 184 included surveys where teachers choose their sessions for PD days. In addition to PD days, teachers were also encouraged to suggest and request various types of support. One principal described it as "very dependent on what the teacher wanted regarding the amount of time as well as their direction" (audio file 001). The principal asked departments to propose learning plans for themselves and worked with them and the necessary supports to accommodate these learning plans (document 010).

4.2.4 Leadership

The codes *school culture, board planning, school planning, leadership development, advocate, proposal, gather information, present at conference and student voice* were grouped under the larger theme of leadership. The code *school culture* was used to identify tasks that were done with the intention of creating or shifting the culture within the school. This same code was used to identify comments made by participants that highlighted a part of the culture that shifted (as identified by participants) due to the program. Board and school planning tasks connected the BYOD blended learning program with the broader school or board planning processes. *Advocating* refers to tasks that required advocating for the program to a particular group or decision maker. *Proposal* tasks refer to the specific tasks related to presenting the idea of this project to stakeholders. *Gathering information* applies to the research or information gathering necessary to make the program successful. *Leadership development* refers to when an individual supported developing leadership skills in another individual. The action of *presenting at conferences* was mentioned a few times and while not directly related to implementing the program, warrants mentioning.

4.2.4.1 School Culture

The code *school culture* was used 27 times and describes actions intended to create or sustain a specific school culture of learning. One principal describes her intentional use of staff meetings and PD days to support the school culture:

> I asked people who are already using technology in the classroom to demonstrate to the rest of the staff. For professional development days, I had to get permission from my superintendent and their counterparts to bring professional development sessions that

were different from other schools in the board and so there was lots of talking about that at the board level as well because sometimes boards like everybody to be on the same path and we were going at things a little differently. The approach was different, but the intent was the same. (audio file 001)

The same principal described setting the culture by inviting others to share at staff meetings;

How I promoted that in staff meetings was through demonstrations. I definitely did not have the technology part, so I worked and fumbled through in front of the staff as I tried to demonstrate. Some of it worked. Some of it didn't, but we always did try and had a good laugh. Usually at my expense. But I think that was pretty key because I tried to present with, "I don't know, I'm going to try and I'm going to make mistakes too. And it's okay". At the end of the staff meeting we learned something and you move on from there. (audio file 001)

One principal ran annual learning plan (ALP) meetings to spend a few minutes with each teacher to determine their focus for learning for the year. The ALP meeting helped teachers write their ALP and the principal to collect information on general themes and directions for teacher learning as a whole (calendar event). The principal and teacher leader intentionally supported and fostered the building of a relationship between the IRT assigned to the school and teachers on staff. The intentional support of the relationship between IRT and staff included involving the IRT on meetings, planning, projects and modelling sharing and trust with the IRT (document 081). Principals supported staff when they expressed interest in things such as becoming a certified Google Apps for Education Trainer (calendar event). The school area superintendents made a concerted effort to be in schools often to show support and

encouragement (audio file 006). The teacher leader sent email messages of encouragement to teachers and copied administrators to build confidence. One email reads "I just wanted to say that you are amazing. Your dedication and willingness to take risk, try new things and awesome ideas are great. Not to even mention wicked artistic talent :) Thanks for all you do!" (document 161).

The vice-principal had tough conversations with families and students around appropriate use of technology and social media. This vice-principal also communicated with parents who were concerned about increased use of technology (audio file 004).

Some of the interview transcripts coded with *school culture* referred to observations made by a participant regarding school culture as opposed to describing deliberate actions to build or sustain a specific school culture of learning. Both principals and vice-principals commented that computer use had spread to Grades 11 and 12 by the second year. This program impacted other years beyond Grade 9 and 10 where the older students started bringing laptops as well (audio files 004 and 005). Comments were also made that there was increased access to computers in the school b/c Grade 9 and 10's were bringing their own devices. The complement of school devices could be used by other Grades more often. One principal described this:

> And you saw, even though it wasn't blended learning in the senior Grades, you saw an increased using of technology by some teachers because they were using Grade 9, the kids were taught in Grade 9. Well, I'm going to use it in my Grade 11, Grade 12, so increased use of computer labs, increased use of allowing kids to bring in their computers, the Grade 12, Grade 11 kids. (audio file 005)

One principal described the change in culture around teacher learning;

First, I would say that there would be somewhere between 10 and 15 teachers who had

never before done professional development, that engaged in professional development.

That was a big change - and quite happily. Every teacher was involved in some type of

professional development, whether that be half a day, a full day, 5 days or 10 days - it

was very dependent on what the teacher wanted in terms of the amount of time as well as

their direction. (audio file 001)

4.2.4.2 School Board Planning

The code *board planning* was used 25 times to describe actions where board staff invited

school staff to support planning at the school board level - bridging technology initiatives

between the school and the school board. From the inception of the program, principals from

both schools sat on an educational technology committee at the school board (audio file 007).

ITS invited the teacher leader (researcher) to preview and test new technologies and discuss

rollout or implementation (calendar event). The superintendent also invited the teacher leader to

provide input on implementation or projects within the Program and Innovation Department. For

example, document 126 shows an email thread inviting the teacher leader to join a central team

in meeting with Apple Education Canada in Toronto. Document 127 is an email thread asking

the teacher leader to provide input on a plan to create a digital hub for the board. Document 103

shows an email thread in follow-up to a verbal conversation where the teacher-leader had been

asked for input and support on a board-wide iPad rollout.

4.2.4.3 School Planning

The code *school planning* was used 33 times to identify actions relating to school

planning that pertained to the 1:1 BYOD blended learning program. Principals staffed the

library with teachers who could support students and teachers with technology (audio files 002, 003). Principals strategically scheduled teacher-leaders in the school timetable to support coaching in class. These teachers were provided with roles that were flexible and allowed some co-planning and co-teaching (audio file 002 and calendar events). Lastly, principals invited teachers and teacher leaders to join in the creation of the school improvement plan. Inviting teacher input was done strategically to align professional development with school goals, and the blended learning initiative (document 135, 092).

4.2.4.4 Leadership Development

The code *leadership development* was used 19 times to describe actions that were intended to build leadership skills in another educator. Throughout the year, the teacher leader strategically supported teachers to share their experiences regarding how they used technology, via a blog post, at staff meetings, during school PD days, or in lunch and learn activities (document 176, 116). In the same way, the principal strategically supported teachers to share their activities and learning at staff meetings and PD days (audio file 001). One principal strategically tried to promote the teachers in the school beyond the school by connecting them with board-level opportunities: "if there were opportunities for teachers to demonstrate at board level what they knew we definitely put forward a teacher's name" (audio file 001). This same principal focused on general leadership development: "tapping into the strength of individuals was another key component. Some people are really good at certain things other people are good at other things and tapping in was key and promoting those strengths within our staff" (audio file 001).

In one school, the blended learning committee in conjunction with the leadership course teacher ran leadership training with Grades 10-12 students to support Grade 9 transition days.

They encouraged students to design and lead the days (with teacher help). Student training was outlined in the agenda for the leadership training day (document 023) and the agenda for the Grade 9 orientation day (document 021). At the end of the second year, before the schools were amalgamating, school staff brought student leaders from each school together to run transition activities for students from both schools (audio file 004).

4.2.4.5 Advocate

The code *advocate* was used 10 times to indicate actions where someone was advocating for the program to another group. Superintendents and principals both described advocating to ITS about getting teacher notebooks refreshed early and extra Wi-Fi or network drops (audio files 001, 005, 007). One superintendent continued to bring up the topic of the 1:1 BYOD blended learning program at senior administration meetings with other superintendents and the director to ensure the program was well-supported. It was described as "the major role was a provocateur or a leader of the notion of trying to do something a little bit differently. So, take it to the AC table, explain what could be possible" (audio file 006).

Principals explained the technical issues and barriers to a board committee regularly. One teacher described this as "yes. <principal name> advocated for what we needed as part of the implementation of the program and they would pilot it at our school before implementing it across the board" (audio file 002). Also, "again, I think it happened through <principal name> where he advocated to the committee and to the board to say we have these and they have run their course (the HP's). We were within one year of being on the renewal, but we got renewed right away" (audio file 002). One principal described this work as;

> As a principal, I had to do a bit of cheerleading in terms of with my superintendent and superintendent of facilities and IT people and program people to get the physical support

that we needed. So, we needed to have our Wi-Fi increased or the range or whatever

that's called - we were able to access older computers for kids who are not able to provide

their own, and that took a little bit of convincing. (audio file 001)

As explained earlier, the principal also asked the superintendent to let teachers take home iPads

for the summer to learn. Prior to this shift, "the board philosophy before that was that equipment

was to be used at school and not take it home" (audio file 001). Lastly, both the principal and

teacher leader invited the superintendent to the school to discuss issues and share updates

(document 140, 129 and calendar event).

4.2.4.6 Proposal

The code *proposal* was used 15 times to indicate actions that were part of proposing the

idea or concept of the program to decision makers. The principal of Penetanguishene Secondary

School took the lead in working with the other principal to create a program proposal for school

board senior administrators (audio file 005, document 179). Superintendents continued to share

and push the idea of accepting the proposal to run this as a proof of concept project (audio file

006). Principals, superintendents and ITS had regular meetings about this project (audio files

001, 005, 006, 007).

4.2.4.7 Gathering Information

The code *gathering information* was used 15 times to describe actions where information

was collected through surveys or research to support development of the project. The principal

of Penetanguishene Secondary School surveyed teachers regarding the digital tools being used

(document 185), their opinions and ideas about the program (document 180), and their skills

using tech (document 077). At Midland Secondary School the teacher leader surveyed teachers pre-and post 'prep year' about their own learning (document 076).

The superintendent overseeing the ITS conducted research by talking to other school boards: "we had to try to find out what other boards were doing in terms of 1:1" (audio file 007). As previously mentioned, principals and teachers from both schools visited schools that had implemented a similar program (audio file 002, 003) to learn more about their experiences.

The blended learning committees at both schools surveyed parents on parent nights about their ability to provide devices for students (audio files 003, 004, 005). The blended learning committee (in one school) with help from front office staff (both schools) also made a phone call to each incoming Grade 9 in June to confirm their ability to bring a device, or requirement of a loaner (audio file 005, calendar events, document 032).

4.2.4.8 Student Voice

The code *student voice* was only used once. The principal at PSS ran a student forum and collected their thoughts on the project before implementing it; "so I actually took it to a group of the students, said, "What do you guys think about this idea?" (audio file 005).

4.2.4.9 Present at Conference

The code *present at conference* was used 31 times to describe presenting the learning or expertise gathered from the development of this project, to others in Ontario. The superintendent asked a teacher leader to present at a conference on her learning around social media and collaborative tools. Document 155 is an email thread where the superintendent connects the teacher leader with the conference organizers. The teacher leader presented with other IRTs at conferences on building capacity around blended learning (document 108). Lastly, the teacher

leader coordinated a team of principals, superintendents and ITS staff to present about this specific 1:1 BYOD project at an educational technology conference (documents 105, 104).

4.3   Funding a 1:1 BYOD Program

Very few funding sources were identified in documents/emails/calendar events or interviews. In total, the code *budget* was only used 13 times. Three major areas emerged: school basic budget (identified six times), ITS budget (identified three times) and special grants and funds (identified twice). Other, specific sources were identified three times.

4.3.1 School Basic Budget

Most teacher supply costs or release time for PD was covered through the school basic budget. One principal stated that 20% of this budget was allocated for PD (audio file 001). Transition days for Grade 8 students (bus and pizza lunch) were also covered through school basic budget (audio file 001). Lastly, releasing teachers and covering costs of conferences was described to be covered through a combination of school basic budget and union-provided PD funds (audio file 001).

4.3.2 ITS Budget

The ITS budget was mostly related to time CNTs spent imaging loaner devices and creating the image for those devices (audio file 008). No additional CNTs were hired. ITS identified extra funding for this project specifically to purchase batteries for loaners devices (the old refurbished laptops) (audio file 008). The superintendent of ITS and the ITS manager both stated that the increased Wi-Fi/network drops and refurbishing the teacher notebooks was

already previously budgeted and would have happened regardless of this specific project (audio files 007, 008).

4.3.3 Special Grants and Funds

Teachers at the schools applied for various grants to support teacher learning. Both the Ministry of Education Teacher Learning and Leadership Program (TLLP) and Ontario Teacher's Federation (OTF) Teacher Learning Co-op (TLC) grants were used to support teacher learning around 1:1 BYOD blended learning (document 138, calendar events). These are both teacher-directed grants where teachers direct and share their learning. One school had parent council money left over in an old school account, and this money was used to buy connectors and adapters for classrooms in addition to covering release time for PD (audio file 001).

4.3.4 Other

Collaborative inquiry funds from the board (centrally held) supported teacher learning through technology hub inquiries. These funds were not specifically for the 1:1 BYOD program, but the collaborative inquiry learning aligned with goals of the project (audio file 002). Superintendent discretionary funds were also used to bus Grade 7 and 8 students in for an additional transition day focused on digital citizenship (audio file 001). Lastly, the board budgeted 0.5 of an IRT position support for two schools during the 'prep year' before students came with laptops (audio file 001, 006, 007).

4.4 Other Findings

These other findings are related to two questions asked of participants. They were asked to share any challenges they encountered related to the implementation of the 1:1 BYOD program, lessons learned, and/or what they might change.

4.4.1 Challenges

Participants were asked about the challenges related to implementing the program separately from describing the actions they took to do so. The code *challenges* was used eleven times. This code was only used in interviews. No documents, emails or calendar events were coded with *challenges*. If participants referred to technical issues, the issues were coded as *troubleshooting*. The challenges referred to bigger picture implementation issues as identified in the interviews when participants were asked directly.

One challenge identified by a teacher was encouraging students to bring devices every single day. Another teacher identified the need for teachers to integrate student devices in class so that students saw the purpose of bringing them daily. The teacher described it as "sort of twofold - getting them to bring their devices daily and partner to that was getting teachers to make them use them daily or regularly enough so that the students would bring them regularly" (audio file 003). One principal responded that challenges were less than anticipated:

> Actually, the challenges were less than I anticipated. So, challenges would be teacher belief system in terms of 'Would it work? Is it worth the work to work? Should I do this?' It is absolutely a change for that school teaching population. (audio file 001)

A teacher echoed these thoughts;

The challenges are a little bit, getting staff…. not getting them on board…. but, everybody is at a different place of comfort, and I still... we are not all of the same place. And, so that was a challenge, still is to this day. (audio file 003)

One principal stated that the challenges would be different for a second round of implementing this program because many of the main challenges within this case involved getting all the stakeholders on the school board to understand the program and benefits (audio file 005). Challenges with the actual building such as not having enough electrical outlets or the internet going doing in areas were also highlighted (audio file 001).

Lastly, one teacher identified two challenges of getting parents on board and the big clunky refurbished computers used as loaner devices. When describing getting parents on board, the teacher said "parents was a big one. Just to get them on board. Because they see what students use devices at home for. Texting." (audio file 002). The big clunky computers resulted in some students being hesitant to carry them around and use them (audio file 002).

4.4.2 Lessons Learned

The code *lessons learned* was only used in interviews and occurred 13 times. One principal commented on differentiated support for teachers and leadership:

You take those leadership skills, and you apply them to the people that you are working with and the goal that you want. And, it's not textbook, because it all depends on who you're working with. So, it needs to be different, and it needs to be individualized and so that idea of what works with one teacher is different than what I would give to another teacher. (audio file 001)

This same principal commented on change in general:

I think the other lesson is that change is good, but that change is scary to people as well. So that support is very, very necessary, and it is not just financial, and it's not just professional development. Sometimes, it's just saying "hey that's a great idea, try it!". (audio file 001)

The other principal interviewed confirmed this:

I think in all cases there always has to be a push/pull factor. You have to push people along. Sometimes you have to pull them along. But you also have to realize they have to be at their own degree of comfort. You can't push too hard. You can't pull. But you need to provide a place safe of landing and say, "If you do something, if it doesn't work, don't worry about it. You tried it." But make sure that they're trying. (audio file 005)

Strategic staffing was a way identified to support staff. Putting teachers with strong technical background into the library was one way to support teachers (audio file 005).

In terms of planning one principal said:

I probably would have spent more energy at the board level. Maybe there may have been other funding sources or there may have been other initiatives that I could have tapped into. But, I was pretty focused on the school, and there was only so much time, and so maybe that's what I would have done differently. (audio file 001)

From the superintendents, a couple of different ideas emerged, including the idea that a project like this could use a project manager; "this could have just been a project for one person to manage with resources, instead of trying to get pieces of people to work on it" (audio file 007). Both superintendents interviewed also mentioned that following up on the program from a central board perspective was something to do next time (audio file 006, 007). Part of this explanation was that as roles change, programs and projects get put into different portfolios:

I am feeling this huge sense of responsibility for not closing the loop. So, what happened

at the end of the first year? What needed to change in order to improve it the second

year? What steps did we need to take to see if another school might want to evolve?

Like, I can think of some schools in our board that are involved in New Pedagogies,

where they would be prime candidates for a similar rollout. (audio file 006)

Then following-up;

And I think that's sort of a secret story that needs to be told. Maybe as part of what you

are doing, that will resurface it again, point our toes at it again, make us take another look

at it. To say, "what do we need to do now?". (audio file 006)

Both superintendents indicated that the project was grassroots and organic, it was felt that

more follow-up and research could be done if doing a project like this again:

That is probably something - an area of growth. So, if we were to move to another site or

couple of sites - I think we should be working with research making use of research to

fully document it. (audio file 007)

5 Discussion

The purpose of this study was to describe how secondary schools implement 1:1 BYOD

blended learning programs. Specifically, this research explored: how do secondary school and

board staff prepare for a 1:1 BYOD blended learning program? The findings are now discussed

within the context of the related literature.

5.1 How do Staff Prepare for a 1:1 BYOD Program?

How staff prepare for a 1:1 BYOD program was documented by analyzing researcher documents, emails and calendar events. The staff of the board and schools were also interviewed to determine actions they had completed to implement the program. Two superintendents, two principals, one vice-principal, two teachers and one ITS manager were interviewed. Four major themes emerged. These were: (1) technology and infrastructure, (2) professional learning, (3) leadership, and (4) adapted school tasks.

5.1.1 Technology and Infrastructure

A key finding regarding how two secondary schools transitioned to a 1:1 BYOD blended learning program revealed that actions and roles related to technology and infrastructure featured prominently in the planning and implementation processes. The focus on technology and infrastructure aligns with the findings of previous research of technology integration projects. For example, McKnight et al. (2016) state that technology infrastructure is one of the areas needing attention in a technology initiative in K-12 schools. Keane and Keane (2016) identified stable infrastructure as one of the four factors for success in 1:1 programs in secondary schools. Stable infrastructure was evident in this case study's findings. Many of the actions and roles identified in the document analysis and the interviews (within the context of technology and infrastructure) reflected the strong need for technology and solid infrastructure. The 1:1 BYOD program relied on strong networks, access to robust teacher laptops, troubleshooting help from many sources and creating, distributing and maintaining loaner devices.

The school board prioritized the two participant schools to receive updated Wi-Fi access points to ensure the networks could handle the increase in devices. The update occurred in all

secondary schools across the board, however, because of this new 1:1 BYOD program, ITS

ensured these two schools were chosen to go first due to this program. The implications of these

findings for other schools will depend greatly on their current state of technological

infrastructure. Focusing energy on ensuring the networks and access to Wi-Fi was robust

confirms the findings of Schrum and Levin (2016) who found that "based on our experiences, we

know that teachers who spend time to prepare lessons that incorporate technology will likely not

continue to do so if the network is not available when they need it" (p. 24). If a school interested

in implementing a 1:1 BYOD program does not have a robust, strong Wi-Fi network with

enough access points, this may potentially be financially challenging and potentially prohibitive.

This would require further research.

When it was time for the school board to conduct teacher notebook updates (or refresh),

concerted efforts were made to "bump up" the refresh process in the cycle for the two schools in

this study. The notebook refresh provided teachers with more reliable notebook computers that

could handle the increase in technology use that accompanied this program. For schools

considering a 1:1 BYOD blended learning program, teachers not having notebooks or computers

could possibly be a financial barrier. More research into the provision of teaching devices and

the effect on student learning is needed.

Getting loaner laptops into the hands of students and then managing any related problems

emerged as a large job for school educators (vice-principals and teacher leaders) in this case

study. One school addressed this problem by transitioning to a Chromebook model which

resulted in much less maintenance. An evolution of technology and an increase of cloud-based

technology use since the inception of this program allowed for this switch, reflecting the

adoption of cloud computing in K-12 schools predicted in the 2014 *Horizon Report* (Johnson et

al., 2014). The requirements for loaner devices appeared to lessen in the second year. Creative methods of obtaining enough devices for the first few years of the program implementation may need to be sought. It may be necessary for schools to purchase new devices as loaner devices if they do not have access to refurbished laptops like the schools in this case study did. Since the implementation of the program documented in this case study, additional options for refurbished laptops have since emerged. For example, operating systems that are based on the Chromium OS are now available and may be worth investigating. "Chromium OS is an open-source project that aims to build an operating system that provides a fast, simple, and more secure computing experience for people who spend most of their time on the web" (The Chromium Projects, n.d).

Strategic use of existing school devices to support both students in the grades for which the program was not yet running (as it rolled into the school grade by grade) and for those in the program was necessary for success. The collaboration between ITS and the school staff identified in this study is reflected in the need for leadership to ensure such collaborations are fostered and developed. Collaboration between ITS and school staff will be further elaborated upon in the leadership discussion section.

The sustainability of a program like the one described in this research depends greatly on a school's existing infrastructure. In this case study, both schools had excellent technological infrastructure and were amidst plans for upgrading. The student loaners must be considered carefully if the issue of equity is to be seriously tackled. The provision of functioning devices is essential to address what Dolan (2016) calls the first digital divide where there are "haves" and "have-nots". Once this is addressed, educators can begin addressing the more complex divide described as "who can and cannot use the technology they have" (Dolan, 2016, p. 31). Additional factors such as how the devices will be used, current options, limitation of devices

and availability of old machines, must be considered. It is important to note that in this school board, no new positions were created to support the technology and infrastructure requirements of this program. Once again, leadership regarding staff buy-in will be addressed in a subsequent section. The only additional expenses in this particular case study included new batteries for loaner devices, additional Chromebooks for one school, peripheral adapters for projectors and power bars. Schools without existing infrastructure capable of supporting a program like this would have other increased costs required.

5.1.2 Professional Learning

The professional learning theme emerged as the most frequently occurring within the documents/emails/calendar events and interview transcripts. This result may be partially explained by because documents, emails and calendar events analyzed belonging to the researcher. This teacher-leader had multiple teacher learning grants to support teacher learning and a passion for supporting teachers change their practice. However, teacher professional learning continued as a theme within the data outside of the researcher's involvement. For example, school staff engaged in professional learning throughout the 'prep year' before the program started and throughout the first year of implementation. Another theme that repeatedly emerged within professional learning was the notion of teacher choice. Principals gave teachers choice regarding their learning activities during professional development days. Teacher choice is consistent with findings from the recent Learning Forward report which found that there needs to be a balance between teacher-directed and selected learning opportunities and those directed by the school or system (Campbell et al., 2017). Departments were asked to submit proposals for their learning to be supported by the principal. Teachers were invited to attend educational technology conferences with financial assistance from the schools and the superintendent. All

professional learning sessions related to the 1:1 BYOD blended learning program that were not on PD days were optional for teachers to attend. Their work with the IRT and teacher leader to co-plan and co-teach was driven by the teachers themselves.

The idea of providing choice in professional learning is supported by the American Psychological Association when they state that motivation to learn is "stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control" (APA, 1997, p.5). Having an IRT allocated to support these schools during the prep year while preparing for the project aligned with the findings of Levin and Schrum (2013) who state that teachers in secondary schools integrating technology preferred to have a support or technology facilitators in the school to personalize their learning when they need or want it.

The studies looking at implementing technology initiatives also mention teacher learning. Levin and Schrum (2013) describe professional learning as one of the eight factors of successful secondary technology initiatives. The study looking at K-12 technology initiatives also stressed the importance of ongoing teacher-driven PD (McKnight et al., 2016). Lastly, when looking at 1:1 secondary programs, Keane and Keane (2016) indicated collaborative professional learning as one of the four factors for a successful implementation. At the time of this study, no literature specific to a 1:1 BYOD program similar to this study was found. However, these results support previous findings that teacher learning is one of the key factors to consider when implementing a technology integration program.

5.1.3 Leadership

The importance of leadership in this 1:1 BYOD blended learning program implementation aligns with previous research. Studies that examined technology integration programs identified leadership as being an important factor for the success of technology

integration or 1:1 secondary programs (Levin & Schrum, 2013; McKnight et al., 2016; Keane & Keane, 2016), and is clearly reflected in this case study.

Levin and Schrum (2013) identified vision, leadership, and school culture as three of eight distinct factors important in secondary technology integration programs. This research on 1:1 BYOD blended learning incorporated these concepts into one larger theme of leadership. Leadership has been defined in many ways (Leithwood, 2007), Leithwood states that leadership is "all about organizational improvement; more specifically, it is all about establishing widely agreed upon and worthwhile directions for the organization and doing whatever it takes to prod and support people to move in those directions" (Leithwood, 2007, p. 44).

In this case study, leadership was integral to the successful transition to a 1:1 BYOD program as seen in the actions and roles identified throughout the planning and implementation of this new program. First, leadership roles were demonstrated by teachers, principals and superintendents at both secondary schools and the school board level. Actions such as establishing the school culture conducive to trying new things was identified by both principals and teacher-leaders as a critical action in transitioning to a 1:1 BYOD program. Principals demonstrated a collaborative and shared leadership approach as seen in their modelling of risk-taking, involving staff in decisions, and meeting with all teachers to ensure each teacher's yearly personal learning plan aligned with the school learning plan related to the transition.

Working towards distributed leadership, both principals and teacher leaders encouraged teachers to share and take on leadership roles. The Ontario Leadership Frameworks states that "one means of fostering collaboration is to distribute leadership to others in the school and to support their efforts to enact that leadership" (Leithwood, 2012, p. 21). Distributed leadership was pursued by inviting teachers to share their learning, experiences, and resources at staff

meetings or by putting their names forward for appropriate leadership opportunities within the

board. Distributed leadership also spread to students as student leaders were invited and

provided training to support their younger peers on Grade 9 orientation day with a focus on

blended learning. Distributed leadership was one way that leaders got staff on-board or to 'buy-

in" to the initiative. Previous studies of successful technology initiatives stress the importance of

"getting staff 100% on board" (Levin & Schrum, 2013, p. 38).

Other potentially empowering, leadership-related initiatives were also documented in this

case study. Examples included: invitations to school staff to participate in planning related

board-wide initiatives and to participate on board technology steering committees; strategic

timetabling to support co-planning and co-teaching; flexible roles for teachers and invitations by

the principals to join in school improvement planning. These actions of empowering others

reflect Leithwood's (2007) thoughts that "leadership serves as a catalyst for unleashing the

potential capacities that already exist in the organization" (p.46).

Principals and superintendents in this case study identified the need to advocate for the

program to the school board's senior administrative team or the ITS department as a necessary

component for successful implementation of a 1:1 BYOD program.   Also, teachers recognized

that principals had advocated for the school, staff and program to board staff as well.

A few superintendents, principals and ITS representatives also met on a regular basis

throughout the first year of the program to plan. Throughout this time there was some gathering

of information involved. Principals surveyed teachers about their use of technology, beliefs

about the program, and comfort level using technology. Superintendents networked with other

school boards to see what type of 1:1 programs they were doing and blended learning

committees surveyed parents to see if they could provide devices for their students. One

principal met with students to gain their input and thoughts about the concept of the program.

Despite the best leadership attempts, participants identified getting all staff on board,

ensuring students brought devices to school every day and getting parents on board as challenges

while transitioning to the new program. Supportive teachers in the implementation of 1:1

programs are crucial to the success of such programs (Keane & Keane, 2016). As noted by

participants in this case study, through the process of transitioning to the 1:1 BYOD program,

they learned a good deal about a variety of technology-related topics. However, their learning

focused on the importance of change in education and how to support this change through

differentiated teacher support. Both principals reflected on the importance of supportive

leadership and modelling risk-taking in learning new things. Modelling risk-taking aligns with

Levin and Schrum's (2013) findings where school leaders from schools with successful

technology programs identified leading by example as a necessary component of leadership

(Levin & Schrum, 2013)

Superintendents also noted that an increase in deliberate planning for this project and a

proper research structure would have been beneficial. This project was a grassroots project

initiated by the schools, rather than a top-down, school board initiative and long-range planning

and research by the board were not considered when perhaps they should have been.

5.1.4 Adapted School Tasks

An entirely new theme that was not found in the literature emerged from the data.

Adapted school tasks are normally done in the school but were adapted or altered in some way to

support the 1:1 BYOD blended learning program. Examples of such tasks included: student

transition activities for Grade 8 students entering Grade 9, communication frequency and strategies, digital citizenship, teaching resources, and organizing supply teacher coverage.

Student transition activities were essential in this program because the implementation began as students entered Grade 9 from different feeder elementary schools. The student transition activities normally implemented by the two secondary schools in this case study were adapted to include a focus on the 1:1 BYOD program. Parents were offered an extra information evening solely focused on the program and students entering Grade 9 were provided with an additional opportunity to visit the secondary schools while still in Grade 8 to engage in activities centred around digital citizenship. During parent nights, schools had students demonstrating activities they'd done in class using technology and parents were surveyed about their ability to provide a device for their student. These schools both ended up calling parents of all incoming Grade 9 students in June. These phone calls were done to ensure they knew about the initiative and to assess how many loaner devices would be needed. Schools with low parent engagement could consider this. In the smaller of the two schools, the front office made all of the phone calls. In the larger of the two schools, the blended learning committee divided up the calls amongst the committee members. Even in large secondary schools, there are many opportunities for connecting personally with incoming Grade 9's prior to September. Each school interested in implementing a 1:1 BYOD program will need to consider their population, look at what current student success, special education, registration and transition opportunities already exist to build on and create a plan specifically for their community. Schools could ask for information on registration forms as well. In this plan to reach out to families, there should be a consideration for any students from families where English is not spoken at home. It can be predicted that the

need to call home to each family will decrease as the program becomes established and the community and feeder schools become aware.

Building on the importance of digital citizenship, school teams created lessons for teachers to implement during the first week of classes. Topics school staff include in digital citizenship activities for students will vary depending on a school's population. There are other ways of addressing digital citizenship that could be considered such as inviting guest speakers.

Communication happened between all stakeholders. Schools invited superintendents to visit, created brochures and pamphlets for parents and invited the local media to school transition events. School councils were kept up to date about the program by principals on a regular basis.

Due to the increase in teacher learning, vice-principals had more supply coverage to manage and monitor, which impacted supervision schedules as well. While there was a significant increase in the use of supply teachers in these schools, booking supply teachers and managing the logistics was only mentioned once. The lack of mentioning booking supply teachers is likely because only one participant was a vice-principal. Vice-principals are usually responsible for this task. Schools will need to consider the impact of increased teacher learning on scheduling and booking appropriate supply teacher coverage.

While previous research did not address *adapted school tasks* directly, parts of what was included in the adapted school tasks theme of this study were covered in other areas. Levin and Schrum (2013) included communicating with parents and families under "partnerships". They also discussed the expectation of students being good digital citizens under "school culture" (Levin & Schrum, 2013). There are three reasons that this new theme may have emerged. The nature of data collection in this study, through an open, semi-structured interview, instead of surveys may have resulted in participants explaining the actions in a bit more detail. The ability

to explain their actions in detail could have caused them to make connections between the actions and previous actions done historically while explaining the tasks. Secondly, because the researcher was asking about funding to complete these tasks, this often resulted in an initial comparison to how they normally fund these activities and if it had changed now that this program was implemented. Lastly, this was an organic program desired by the schools, not a top-down board-driven project. As explained by a superintendent, "the impetus came out of grassroots" (audio file 007, paragraph 38). This grass roots push may have resulted in more adapting current practices to support this program.

5.1.5 Funding 1:1 BYOD Programs

If BYOD is seen as the solution to making 1:1 device programs sustainable (Levin & Schrum, 2013), how should schools budget or fund these additional tasks, professional learning, technology and infrastructure needs and leadership initiatives?

Lack of participant response to this question was surprising. Generally, the basic school budget supported the implementation of the program. The ITS department did support the program heavily through time spent by ITS staff and yet did not state that this level of support was unsustainable. It would be interesting to determine if this model would be sustainable if all secondary schools in the board were to implement 1:1 BYOD programs. Workload and consideration of additional staff might be necessary as, in this case, no new staff were hired. However, the participants in this study indicated the ITS department researched and created an image for the loaner devices and wiped and re-imaged all 100 loaner devices with this new image the first year. The second year of this program, fewer devices were used although implications for workload must still be considered in future planning. New options for refurbished devices such as operating systems built on Google's Chromium OS may assist in

reducing the workload. Student technology teams is also an area that schools could investigate to help with both troubleshooting and managing loaner devices.

Some money from the ITS budget was used (the exact amount was not available) to purchase new batteries for these loaner devices. ITS also expedited the schools for improved Wi-Fi network access points and teacher notebook refreshes. They made it clear that these upgrades was not part of a special budget but simply a shift in priorities. These upgrades have now been made in all secondary schools in the board. Schools without this robust infrastructure may find increased barriers to program implementation.

Professional learning, or more accurately the supply teacher costs required to release classroom teachers were covered by an assortment of sources. Both schools allocated a large part of their budget to support this. Allocating at least ten percent of a school's basic budget is a required practice in this school board. However, these schools aligned all their professional learning to support the 1:1 BYOD program. Depending on school and system priorities, it may not be attainable for all schools to align all professional learning in such a manner. These two schools also requested, and received superintendent discretionary funds to support specific learning days. A program such as this requires the support of senior administration and superintendents.

Special grants were accessed by teacher-leaders such as the Ministry of Education Teacher Learning and Leadership Program (TLLP) and the Ontario Teachers Federation Teacher Learning Co-op (TLC) program. These grants helped fund supply teacher costs because the learning involved for the grants was aligned with school priorities and the 1:1 BYOD program. Schools also made use of central, board professional learning opportunities that aligned with the

program, such as participating in their technology hubs. Release time for these occasions was covered through central, school board professional learning funds.

Lastly, likely the largest single source of funding used to support the program was the allocation of 0.5 time of a central Itinerant Resource Teacher (IRT) to be shared among the two schools to support teacher learning during the prep year, or year leading into the start of the program. The provision of an IRT was funded through school board allocation of central staff.

Levin and Schrum (2013) found that successful school leaders were creative in redirecting or finding sources of funding for technology integration programs. Schools will have to investigate as many sources of funding as possible. Previous literature that identified sources of financing for 1:1 programs were not available in Ontario, nor for BYOD programs and so gives little to compare these results to. One study by Keane and Keane (2016) explains how 1:1 programs were funded through Australian government programs. The outline of funding sources provided by this study can enhance the current body of knowledge for those in Ontario considering implementing a program such as this one.

5.2   Conclusions

It is important to note that conclusions from this research are based on only one case study of two independent school sites within one school board. As previously mentioned, a case study design allows the researcher to develop an in-depth analysis of a unique case (Creswell, 2014), which in this study refers to the exploration of how two secondary schools implemented 1:1 BYOD programs in their respective schools. This study does not measure the effectiveness of its implementation on teaching and learning, and so the conclusions drawn from this study provide schools considering the implementation of a 1:1 BYOD program, with suggestions to

consider within the context of this case study. The research presented here provides no insight into the impact of this program on student learning, but only in documenting the processes completed by two small schools who have implemented this program.

This study explored how staff prepare for and fund a 1:1 BYOD blended learning program in two Ontario secondary schools. This research revealed that the schools focused on the following four key areas when planning and implementing a 1:1 BYOD blended learning program: (1) technology and infrastructure, (2) professional learning, (3) leadership, and (4) adapting school tasks to support the program. Technology and infrastructure, professional learning and leadership are supported by previous studies and established factors for successful technology implementation programs (Keane & Keane, 2016; Levin & Schrum, 2013; McKnight et. al, 2016). As previously mentioned, adapting school tasks are not directly cited in the literature. However, components such as communication and digital citizenship were addressed in other contexts or themes related to the implementation of technology programs (Levin & Schrum, 2013). This finding is interesting in that it builds upon tasks schools already implement, and demonstrates how such a program can be fully aligned with other school initiatives. This finding may be helpful to other schools considering a shift to this type of program but unaware of the tasks required to move in this direction. Additional research to explore other adapted school tasks and new implications for other schools might be beneficial.

Funding came from a variety of sources including the school's basic budget, ITS department budget, superintendent discretionary funds, special grants to support teacher-directed learning and central school board funds which support additional support staff. More research should be done on a larger scale to determine sources of funding for supporting 1:1 initiatives in

Ontario. Schools will need to be creative when looking for additional sources of funding, in addition to aligning priorities to make use of existing funds in the most efficient manner.

The full realization of the benefits of technology happens when there are pedagogical changes in teacher practice to accompany the addition of digital devices (Levin & Schrum, 2013). It has also been stated that these benefits will not be fully realized until the technology is ubiquitous (Bull et al., 2002, Papert, 1996; Papert, 1992). Ubiquitous access means that technology use is no longer an 'event' or add-on to traditional classroom learning. Blended learning results in students having the ability to personalize learning (Green & Hale, 2017). Recognizing that many schools cannot afford to sustain 1:1 laptop programs, BYOD is the sensible alternative (Levin & Schrum, 2013). BYOD allows schools to spend their money on providing devices to students who cannot afford their own. It is also an important factor in addressing the issues of digital equity (Starkey et al., 2017). A program such as the one described in this study reflects one first step in exploring how to ensure that the hardware and access are in place. This case study reflects how two schools addressed the "first" digital divide (Starkey et al., 2017) so that teachers can then begin supporting students in developing the digital skills to close the divide.

Another conclusion drawn from this case study is that appropriate planning, and strong leadership are required for the organization and implementation of a 1:1 BYOD program. More importantly, looking at the mind map in Figure 1, it is evident that the leadership tasks were shared among the principal, superintendents, teacher leaders and a committee of teachers called the blended learning committee. Robust and shared leadership is required to support the collaboration necessary among all stakeholders in a 1:1 BYOD program. Incorporating student voice was identified by one school and building student leadership by another. Student voice is

an area for potential future development. Incorporating student voice in the planning stages, and then continuing to develop student leadership in the transition activities while expanding this to support student leadership in technological areas. Students with technology expertise could support other students and teachers. Aligning school improvement plans with this initiative and with teachers' learning plans was a key strategy used in this program, demonstrating the importance of "establishing widely agreed upon and worthwhile directions for the organization and doing whatever it takes to prod and support people to move in those directions" (Leithwood, 2007, p. 44). A leadership team that is collaborative and nurturing (Schrum & Levin, 2016) was a critical factor for the successful implementation of the program described in this study. The implication here is that school boards need to foster this type of leadership within their schools.

It is interesting to reflect back and see how often collaboration among different departments or groups was required in the implementation of this program. Collaboration as an isolated theme did not emerge when coding the data, most likely because the researcher was thinking of identifying actions or tasks. However, based on Levin and Schrum's (2016) work describing the importance of a leadership team attending to "collaboration and nurturing partnerships" (p. 36), the concept of creating collaborative cultures fits within the broader leadership theme. Collaboration occurred amongst the school board senior administration and school principals, principals and teachers, ITS and school staff, and teachers and students. In fact, collaborating with teachers from another school in a different school board also occurred to support teacher learning. An area for potential future research identified by this research includes identifying how leaders develop a culture supporting collaboration among stakeholders and if this collaboration impacts the success of the program in terms of impact on student learning.

Principals and superintendents also reflected on the importance of focusing on changing practice for all stakeholders including the senior administration team, teachers, principals and ITS. Embracing change can be difficult but to strategically do so was a lesson identified by participants. A main challenge noted by participants in this study included stakeholder buy-in. Teachers, students, and parents must be provided with opportunities to learn about the program, to voice concerns, and to have a voice in the implementation of the program. Demonstrating student potential (i.e., what students can do and create) when they have ubiquitous access to technology at parent information sessions was one strategy of providing parents with information. A strong vision is required to enable leaders to articulate the benefits of a 1:1 BYOD program. Superintendents or system leaders identified that more strategic planning and research around the program would have been helpful. Leadership tasks such as pulling together the ideas of collaboration, supporting a change in practice and having a strong vision align with a recent study where Schrum and Levin (2016) found that:

> the award-winning leaders of technology-rich schools and districts we studied were successful at improving their schools or districts because they attended to change factors (nearly) simultaneously including collaboration and nurturing partnerships, visioning together with all stakeholders, managing technology planning and infrastructure, providing professional development, improving instructional strategies and curriculum, implementation issues, attending to school climate and culture and keeping abreast of school and society trends. (p. 36)

When considering technology and infrastructure, schools must also take into account where they will acquire their loaner devices. In this study, Chromebooks worked best because they required less management than old, end-of-life laptops refurbished with a basic image.

However, it is important to note that these schools both had computer labs and pods of iPads available as well as students' own devices. Schools must carefully examine the benefits and challenges of different types of devices before resourcing their schools. Some mobile devices such as Chromebooks do not allow for software installation and work best when students are working entirely in web-based environments. Whereas, the refurbished laptops allowed for software installation as needed. It was the slow speed, large size and consistent technical difficulties of the loaner laptops that convinced one school to transition to Chromebooks after the first year. Implications for schools and boards are that they must work with teachers and students to understand how they will be using the devices to support learning and weigh the benefits and challenges of different device options. Technology evolved so fast that in this project the best option for providing loaner devices shifted between the first and second years of implementation.

Other technology and infrastructure issues to consider include ensuring a stable network with internet access as well as teacher access to devices. In this study, teachers had access to teacher laptops. The process of upgrading these was already in place, and one school was prioritized to be done before the program was implemented. New teacher laptops allowed teachers to have quicker, more robust devices to support their work in class. Implications for schools and board would be the necessary task of ensuring teachers have access to appropriate devices to run a blended learning program. Like the teacher notebooks, in this study, the schools were already in cue to have network access points improved and increased, and they were prioritized. The ITS department had already studied the use of devices and network traffic and understood what was required to support the additional connections. Schools and boards considering a 1:1 BYOD program will need to assess their network access and ensure it is

capable of supporting the required connections and usage. These recommendations align with the findings of multiple technology implementation studies where technology and infrastructure are found to be important factors in the success of the programs (Keane & Kean, 2016; Levin & Schrum, 2013; McKnight et al., 2016; Schrum & Levin 2016).

Administrators must find ways to support teacher choice within learning rather than mandating specific professional development activities. As seen in this study, teachers had varying levels of technological skills and practices for integrating technology varied depending on subject area, course and teacher. Multiple entry points to teacher learning were provided, and teachers wanted to choose the opportunities that worked for them. Teacher choice is supported by the findings of the Learning Forward report which states that teacher learning needs to be a "balance of teacher choice and system coherence" (Campbell et al., 2017). Successful strategies within this case study included providing a broad spectrum of learning opportunities including tool or technology support, collaborative inquiries, lunch and learns, conferences, one-on-one support, co-planning, and co-teaching.

5.2.1 Limitations and Future Research

The results from this very small and exploratory case study cannot be generalized to other situations. In addition to the limitations imposed by such a small study, it is important to consider the overarching purpose of this research, which was to explore deeply how two schools implemented 1:1 BYOD programs in their respective schools. At the time of this study, there existed little research regarding the benefits, challenges or implementation processes for secondary schools seeking guidance in beginning a 1:1 BYOD program. This study did not address the effectiveness of 1:1 BYOD program implementation but rather focused on the implementation process. Future research regarding the outcomes related to the implementation of

such a program is warranted. All conclusions are simply considerations for other schools moving forward with a similar program, not recommendations leading to a direct increase in student learning. Schools must research and consider if such a program is effective and its impact on student learning.

This case study research was done historically, requiring participants to reflect back and describe what they did to support this program. The process of reflecting back limited the study to only identifying what was done to implement the program. Relying on participants' memories also proved troublesome at times, resulting in less detail than hoped for by the researcher. Suggested strategies for data collection for those considering documenting planning and implementation processes at the onset of the 1:1 BYOD program might include participant journal entries regarding their experiences and surveys or focus groups throughout the process to gather more detailed data regarding participants' skills, needs, attitudes, and questions.

Ideally, future research should be done on the implementation of a program such as this one from start to finish by a researcher who perhaps is not as deeply entrenched within the implementation of the program. A researcher removed from the program could potentially allow a deeper look at some of the why, how and impact of a 1:1 BYOD blended learning program from an outside perspective.

A study looking at program implementation from the start could focus on teaching practices and learning. What are the pedagogical shifts in teacher practice associated with a program like this one and how can this be supported by professional learning? Another area that this case study did not address is the impact of a 1:1 BYOD blended learning program on student learning and achievement. As some studies in the literature demonstrate, 1:1 technology programs require considerable focus on and support for pedagogical changes along with the

increase in access to technology to be effective (Levin & Schrum, 2013; Warschauer et al., 2014). In fact, Warschauer et al. (2014) state that for at-risk students implementing a technology program without strong pedagogical support may be "detrimental to students" (p. 60). Research into the pedagogical changes and teacher learning associated with that in 1:1 BYOD programs and how it relates to student learning is needed.

Another area of research within the 1:1 BYOD program context is the notion of student equity. What are the implications of providing students with devices, who until this point did not have their own? Does it impact student learning? Do their digital skills develop? Do they start with a difference in digital skills? Alternatively, could providing these students with obvious school-loaned devices make them feel centred out?

It would also be imperative to understand the implications of every student having access to a device for students with individual education plans (IEPs). While some students with IEPs have special education assistive (SEA) equipment, many do not. Studying the implications of everyone having devices on those with SEA equipment and those without would add to the body of knowledge around the importance (or unimportance) of 1:1 BYOD blended learning programs for students with special education needs.

The teacher learning required in the implementation and sustainability of a program like this is a necessary area of future study. Does the increase in technology use over time, begin to diminish the need for ongoing professional learning? Alternatively, like found in Levin and Schrum (2013) suggested, is ongoing professional learning required? Focusing research on the types of professional learning would be important. Differentiating between formal professional development and self-directed or independent learning as well as to learning about digital tools

compared to pedagogical practices incorporating digital tools will be important. It may be that a shift in types of professional learning happens over time.

5.2.2 Considerations for School Boards and Schools

The findings of this case study only apply to these two schools. The effectiveness of this 1:1 BYOD program was not investigated due to the historical nature of the case study. The implications are only considerations for schools and boards who have decided to implement a program such as the program explored in this study. When implementing a 1:1 BYOD blended learning project schools might consider the following.

Firstly, schools implementing a 1:1 BYOD program should consider researching the impact of such a program on student learning. How does providing devices to students impact their development of digital skills? With teacher support and learning, can the second digital divide (between those who can and cannot effectively use technology for learning) begin to be diminished? What about the impact of every student having a device on those with special education needs? Does this impact when and how students with special education assistive equipment use their tools? How does a program such as this impact students who have special education needs, but do not have specific assistive technology assigned to them? What percentage of students require loaner devices? Does this change as the program grows over multiple years? Does the need for teacher learning change over time? What pedagogies or changes in teacher practice and belief systems support increased student achievement in a 1:1 BYOD environment?

Schools might also consider engaging a project manager to oversee the details of the project. Having a project manager was suggested by one of the superintendents upon reflection

on the project. Another suggestion was to engage in research around the project to assess impact.

In this study, the need for communication was found to be prominent when running a 1:1 BYOD program. Coordinating multiple forms of communication between all stakeholders might benefit from being planned out and intentionally supported. Schools might consider finding ways to engage parents and families, school board senior administration and ITS.

Student voice and leadership development is an area that was only touched upon in this study, and would be an excellent area for further research. School staff might contemplate how they can provide venues for student voice in the planning of a 1:1 BYOD program. Student leadership development can be done through engaging older students in supporting student transition activities, as described in this study. Another area to explore would be the use of student technology teams where technologically savvy students support other students and teachers.

Principals worked hard to ensure teacher buy-in. Encouraging teachers to share at staff meetings, to facilitate workshops and join committees was done to help to ensure many different perspectives were involved and were stated to help with buy-in, culture and teacher learning.

Developing a culture of learning that is pervasive and school-wide could potentially support teachers in recognizing the importance of their learning. Principals might also model risk-taking by trying new technologies and pedagogies at staff meetings, and modelling that it is okay to fail and struggle, while also modelling problem-solving techniques. As seen in the case study, intentionally supporting a culture that encourages teachers to share resources they find useful in preparing for the 1:1 BYOD program may be helpful. These shared resources may

include articles, digital tools or classroom samples. Culture was also stated to be impacted by the act of advocating for the program on behalf of the principal.

Principals timetabled teachers strategically to support the program. Strategic timetabling may include placing teachers who have strong technical skills working in the library, or in other roles that allow them to collaborate with colleagues and students.

From the results of this study, teacher-directed professional learning provided before students bring laptops to class may have been an important first step. It may help for principals to meet with each teacher individually to identify their areas of interest and need for professional learning. This information from teachers can be used to create a school improvement plan and personalize teacher learning throughout the year. Aligning school goals with the system goals could help in creating a strong vision to support the program. Based on the literature review, technology initiatives should focus on the pedagogical shifts, not just the technology (Levin & Schrum, 2013). In this case study, the emphasis of teacher learning was on pedagogical change and improvement, not only on mastering digital tools. Schools could provide or support a variety of professional learning opportunities to allow for teacher choice and varying entry points including collaborative inquiries, attending conferences, department work and informal opportunities led by teachers. It may be helpful to connect with schools who have implemented a similar program and arrange for visits and collaboration.

From the literature review, it is reasonable to assume that technology and infrastructure work well to minimize the stress on teachers and students (Schrum & Levin, 2016). If principals do not feel that they have the technical skills to understand and support this area fully, it may be important for them to identify teacher-leaders who can assist and guide them. Schools or boards may need to research current device options for loaner devices or perhaps consider refurbished

machines or mobile cloud-based options such as the Chromebook. It is likely important for decision-makers to understand how the devices will be used to support learning and to anticipate the level of maintenance the devices will require to choose the best option for the school. Acquiring devices to be loaned out to students could be a large job depending on the school, population and type of device. These will have to be tracked, and a plan for distribution will be necessary. Vice-principals carried out this job at both schools by the end of the first year. The entire blended learning committee helped distribute devices on orientation days, and then the vice-principal or principal would do this throughout the year as needed. As noted in this case study, schools might also include planning for how loaners will be provided to students whose devices break throughout the year. During the first few years a plan may be needed for students in older grades where the program is not yet implemented, yet who are taking grade 9 or 10 courses where the program is in effect. Schools in this study placed pods of devices in these classes for student use.

Leading into the program, principals may find it useful to problem solve with teachers how they will provide opportunities for students to charge devices in learning spaces with few outlets. Principals can also arrange for support during the first week to help students connecting to networks and school accounts. Lastly, leaders can ensure that networks are strong throughout the building, able to handle the extra devices and that teachers have access to suitable hardware (laptops, projectors and adapters for projectors as needed) to plan and use in class.

Both schools in this project had blended learning committees. The first thing they did was to send information about the program home early on in the year to current Grade 8 families. Schools could consider letters home, social media and website postings as communication strategies. Coordinating a parent information night in the fall allowed for parents and guardians

to plan for potential future spending (e.g., purchasing devices for their children as holiday gifts). Both schools in this program had students and teachers highlighting blended learning activities at these parent nights.

Throughout the year, these schools continued to include information about the program in all transition activities for Grade 8 students. The goal was to ensure the message was clear to all incoming students that devices will be provided if families cannot provide their own. To ensure this message was understood, both schools called home to all incoming Grade 9 students in June. The phone call achieved two things. First, it ensured the messages were received by all students so they could prepare for the fall. Second, it let the school know how many loaner devices to have ready for the fall. The blended learning committee also created a plan for the first day or orientation day, with consideration to what students needed to access the network and any required accounts. Login and password information may need to be distributed or created. The orientation day could be a time to address some digital citizenship issues as well. Regardless of when or how, schools could consider a plan for developing skills for digital citizenship. Both schools in this project worked together to create short lessons that could be done during the first week of classes in September. The blended learning committee or principal may need to create or revise the current school technology distribution plan (computer labs, carts, mobile devices) to best support teacher learning throughout the year before implementation and to best support all students in the school once the program has started.

This research has provided an initial step in addressing issues of access and understanding how two secondary schools implemented a 1:1 BYOD program. This research has also established groundwork for the two schools to consider questions regarding impact and learning.

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Appendix A – Consent Form

Title of Research Study: Analyzing How Secondary School Staff Prepare for a 1:1 BYOD

Blended Learning Program

Researcher(s):
Jaclyn Calder
Email: jaclyn.calder@uoit.net
Contact number: (705) 896-0649

Principal Investigator; Diana Petrarca, Supervisor Faculty of Education
University of Ontario Institute of Technology

If you have any questions about the study, please contact Jaclyn Calder at jaclyn.calder@uoit.net

You are invited to participate in a research study through the University of Ontario Institute of Technology in the Faculty of Education. This study (REB File #15-123) has been reviewed by the University of Ontario Research Ethics Board and has been approved as of June 9th, 2016.

Before agreeing to participate in this study, it is important that you read and understand the following explanation of the proposed study procedures. The following information describes the purpose, procedures, benefits, and risks associated with this study. It also describes your right to refuse to participate or withdraw from the study at any time. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. Please listen and follow along with this consent form carefully, and feel free to ask any questions you might have before consenting to this study to ensure informed consent. You are under no obligation to participate in this study. Participation is voluntary, and your decision to participate has no impact on your standing with the SCDSB.

Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Board through the Ethics and Compliance Officer – researchethics@uoit.ca or 905.721.8668 x. 3693.

If you have questions about research being conducted in the SCDSB, please contact Deborah Scharf, PhD, Manager of Research and Evaluation Services, 705-734-6363 x11731, dscharf@scdsb.on.ca

Purpose and Procedure:

Secondary schools worldwide are beginning to implement Bring Your Own Device (BYOD) programs as a way to reach a 1:1 device to student ratio. Midland Secondary School and Penetanguishene Secondary School have both implemented programs such as these and support students who do not have their own devices by loaning older refurbished devices. You were a part of developing, implementing or supporting this program.

The overarching research question looks how two schools and one school board developed and implemented a 1:1 BYOD program. There are specific questions that are part of the full study; about your role in developing and implementing the program. More specifically, the questions will ask about what tasks you completed, the timeline and if you know where the funding came from to support those tasks, as appropriate.

You are asked to completely in an unstructured interview to explain your role. Your total time commitment to this phase is approximately 45 minutes depending how much information you share on the open-ended questions.

Potential Benefits:

You will be providing a description of the tasks you completed to develop and implement this program so that we can document and describe the process. Other schools and school boards will benefit from this information if they are interested in considering a program such as this themselves.

Potential Risk or Discomforts:

When asking individuals about a program in which they're involved, there may be a thought that, as the participant in the research, you may think that you need to say all 'positive' or all 'negative' comments; this is not the case with this study. The researchers want a description of the tasks you completed, with a time line and any information about sources of funding you may have. It is not a judgment of the program, but documenting what was involved in implementing it. All responses are confidential. Your name and identifying information will not be recorded in the recording or transcript. There will be one file that contains personal information connecting the codes to individuals. This file will be kept separate and password protected. Only the Investigator and supervisor will have access to this file. However, due to the small number of participants in the study, there is the possibility that participants may be identifiable by inference.

There is no pressure to participate in the study and you should not if you feel like you do not want to.

Storage of Data:

All data will be kept on a secure password protected UOIT network Google Drive account with which the UOIT IT Department has assisted. Any data that will be taken from the Google Drive account will be stored on password protected laptop or on an encrypted USB key or on an external drive all with password protected file(s) of data, that is double password protected files. The supervisor and investigator will have sole access to the data.

Confidentiality:

The recordings and transcripts of the interview will be maintained in confidence in a secure environment without personal identifiers. There will be one file that contains personal information connecting the codes to individuals. This file will be destroyed at the end of the study (January 2017). Your employers will not be informed if you have participated in this study (or not) and it will not have an impact on your standing within SCDSB in any way.

Anonymity:

The data is de-identified when transcripts are created from interview recordings. Each recording and transcript will be coded without personal information. There will be one file that contains personal information connecting the codes to individuals. This file will be destroyed at the end of the study (January 2017)

Right to Withdraw:

Your participation in this study is completely voluntary. You are free to withdraw at any point during this study. If you do not wish to take part in the study, you can leave this interview now. If you wish to withdraw after giving informed consent but before completing the interview, you may do so by telling me and no data will be stored, any information collected will be destroyed on the spot. After the interview recordings have been transcribed, you will again be provided an opportunity to withdraw from the study. If you choose to withdraw after the transcript has been created, the principal investigator will use the coded file to remove and destroy all of your responses and data. Please contact the investigator at jaclyn.calder@uoit.net or 705 896-0649. After the study has been completed and the coded file destroyed, it will be impossible to remove your responses because we will not be able to figure out which responses are yours without the codes.

Secondary Use of Data

The information collected from this research may be used for secondary analysis in the future. No personal information will be attached to your responses.

Debriefing and Dissemination of Results:

If you desire to receive information regarding the results of this study, please contact the researchers at (705) 896-0649 or by email at jaclyn.calder@uoit.net.

Results from the study are expected by January 2017. Results of the study will be shared with faculty members and others interested in the study but only in aggregated form and again, with no personal identification or personal data.

Participant Concerns and Reporting:

This research study has been approved by the University of Ontario Institute of Technology Research Ethics Board on June 9th, 2016. If you have any questions concerning the research study, or experience any discomfort related to the study please contact the researcher(s) at jaclyn.calder@uoit.net. Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Board through the Compliance Office (905) 721 8668 ext. 3693.

For you records, you may keep this copy of this consent form. If you agree, you are consenting to take part in all aspects the study with the understanding you may withdraw at any time. You are also consenting that you have asked any questions you have and received answers to your satisfaction related to this study.

I have read and understand the purpose of this study and my role as a participant. I understand that I can withdraw from the study at any time, and all my questions have been answered to my satisfaction. I consent to participate in this study. I understand that I will receive a copy of this consent form for my records.

Name:
Signature: Date:

Appendix B – Interview Guide

Interview Guide

Introduction:

Hello. I'm Jaclyn Calder. I am conducting the interviews for this study about MSS and PSS's 1:1 BYOD Blended Learning program. This interview will take about 45 minutes. I will ask you questions about your role in implementing the 1:1 BYOD Blended Learning project such as what you did, when you did it and if you know where the funding came for any costs involved. I will record our conversation (point to recording device). I will now read the consent form. Please follow along using the provided copy of the consent form (appendix B). You may keep that copy for your own records.

After Consent Form signing - "I will now begin the interview"

Interview Questions:

1. What was your role from September 2013 to July 2016?

2. In your role, what things did you do to develop for the 1:1 BYOD Blended Learning program? For each thing, you did please provide a date or timeline and any funding sources, if required.
       Possible questions to dig further;
       a. How did you complete that task?
       b. Why did you complete that task?
       c. What steps were involved in completing that task?
       d. Was there any cost involved in completing that task?
       e. When did you complete that task?
       f. Do you know where did the funding come from to complete that task?

3. Can you identify any challenges in the development of the program? How did you deal with them?

4. Can you identify any lessons learned in the development of the program?

5. What might you have done differently during the development of the program? Why?

6. Was there any background knowledge or preparation that you had to complete in order to be ready to support the program? If so, please explain.

7. Was there anything else you did to support the program that you have not described yet? If so, please describe.

Wrap-Up:

Thank you very much for participating in this study. I will take this recording, store it in a password protected file until it is destroyed. You will receive a hard copy of the transcript from this interview soon. You will have the opportunity to withdraw from the study or make any corrections as needed at that point. Please remember that you can withdraw from this study at any time.

Thank you very much for your time today.

Appendix C – Thank You Letter

Dear   ;

Thank you for completing an interview about your role in implementing the 1:1 BYOD program at MSS and PSS. The time taken from your busy schedule you spent answering questions is greatly appreciated. The recording from your interview has been transcribed and is attached to this message. Please review the transcript. As described, you may withdraw from the study at any time. If you choose to withdraw at this point, your recording and transcript can be destroyed and not included in the study.

Information you provided will be kept confidential. Information collected that could identify you will not be published or shared beyond the research team. Any data from this research which will be shared or published will be the aggregated data of all participants. That means it will be reported for the whole group not for individual persons.

You may withdraw from this study at any time. If you choose to withdraw now, after the transcript has been created, the principal investigator will use the coded file to remove and destroy all of your responses and data. After the study has been completed and the coded file destroyed (January 2017), it will be impossible to remove your specific responses because it will be impossible to figure out which responses are yours without the codes.

This study has been reviewed and cleared by the UOIT and SCDSB Ethics Boards. Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Board through the Ethics and Compliance Officer – researchethics@uoit.ca or 905.721.8668 x. 3693.

When results are compiled, the team would be pleased to send you a copy. Please request results by email or phone if you would like a summary sent to you.

Thank you again for participating in the study. Please review the transcript and contact me if you have any corrections, questions, problems or would like to withdraw from the study.

Thank you

Jaclyn Calder
jaclyn.calder@uoit.net
705 896 0649

Appendix D – Summary of Actions Completed by Schools and School Board

Leadership:
- ☐ Identify a project manager
- ☐ Assign someone to ensure that the board senior admin team understand and support program
- ☐ Collect, analyze and consider student, parent and staff voice prior to implementing program
- ☐ Intentionally support ensuring staff/teacher buy-in
- ☐ Identify a dedicated teacher-leader to support staff
- ☐ Connect with information technology services to ensure two-way communication and collaboration
- ☐ Intentionally support leadership development in teachers - ask them to share at staff meetings, facilitate workshops, join committees, etc.
- ☐ Look for ways to develop student leadership - student-led transition days, webinars, tech teams, etc.
- ☐ Develop a culture of sharing where staff share resources and materials they find helpful
- ☐ Advocate for the program by seeking additional resources to support it
- ☐ Model risk taking by trying new technologies and practices at staff meetings
- ☐ Timetable teachers strategically to support the program
- ☐ Engage in research around the program from the start to assess impact and monitor

Teacher Learning:
- ☐ Support ongoing, teacher-directed professional learning
- ☐ Meet with each teacher to determine what they need to learn before program starts
- ☐ Ensure the emphasis is on pedagogical changes and improvement, not only mastering the digital tools
- ☐ Connect with and visit other schools who have 1:1 BYOD blended learning programs
- ☐ Align the school improvement plan and other professional learning in the school with the program
- ☐ Support teachers in providing informal learning opportunities for their colleagues
- ☐ Support departments working together to learn, plan and prepare
- ☐ Support targeted teachers in attending conferences and then sharing their learning upon return
- ☐ Provide opportunities for teacher collaborative inquiries
- ☐ Look for board-provided (or other) learning opportunities that align and make use of them

Technology:
- ☐ Research current device options for loaner devices and make a decision
- ☐ Acquire enough loaner devices
- ☐ Have a distribution plan for loaner devices - orientation day or first day of school
- ☐ Have support available during the first week for help connecting to networks and school accounts
- ☐ For the first few years, develop a plan for students who are in older grades taking grade 9 courses to access devices
- ☐ Develop a plan for signing out loaners - to supplement lost or broken devices
- ☐ Ensure networks are strong throughout building and can handle the extra devices
- ☐ Ensure teachers have access to laptops, projectors and adapters for projectors as needed
- ☐ Problem solve with teachers - ways to allow student access to outlets for charging

School Tasks:
- ☐ Send information home early to current Grade 8's in family of schools (letters, social media, etc.)
- ☐ Coordinate parent information evening in the fall
- ☐ Include information about the program in all transition activities throughout the year for Grade 8's.
- ☐ Ensure families and feeder schools understand that devices will be provided as needed
- ☐ Call all parents/families of incoming Grade 9's to remind them of the program and answer questions
- ☐ Find out via survey or phone call if students will need loaner devices
- ☐ Create a blended learning committee to support initiatives and provide guidance for program implementation
- ☐ Develop a plan for addressing digital citizenship proactively
- ☐ Create a plan for the first day, or orientation day. Consider what do students need to access the network and any required accounts? Login and Passwords?
- ☐ Create or revise current school technology distribution plan (computer labs, carts, mobile devices) to best support all students