Enhancing Instruction in a Changing World: Kindergarten Educators Implementing Technology to Support Student Reading Development

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Submitted in partial fulfillment

of the requirements for the degree of

Master of Education

Faculty of Education, Brock University

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Abstract

With the rapid integration of technology into classrooms, educators are experiencing challenges in implementing technology into their Kindergarten programs. This study sought to identify ways to help Kindergarten educators enhance reading instruction with technology-infused lessons. This research drew on Dewey's theory of progressivism, as well as Mishra and Koehler's Technological Pedagogical Content Knowledge (TPACK) conceptual model. The study employed qualitative methods through a design-based research approach that included 2 teacher and 2 ECE participants who engaged in 3 training and reflective meetings with the researcher and created and implemented technology-enhanced reading lessons over 12 sessions. Data collection included fieldnotes, interviews, and surveys. Data analysis techniques involved open-ended and axial coding to derive themes that illustrated the data set. Results indicated that support can be provided to educators by recognizing and anticipating their needs, using differentiation, researcher problem solving, iterative professional learning cycles, and liaising with administration. Additionally, findings show that participants changed over the course of the study with attitudinal shifts, increased skills and knowledge of SMART Boards, and technology-enhanced practices. Lastly, findings show that the participants experienced numerous external and internal barriers, but were also able to identify ways to mitigate the barriers. Overall, this research provides implications for practice, research, and theory that can be used to implement effective pedagogy and programming for Kindergarten educators to support students' reading development through technology-enhanced practices.

Acknowledgements

First and foremost, I would like to thank my supervisor, Dr. Tiffany Gallagher. Your guidance, patience, support, and unwavering confidence in me made this possible; I would not have been able to complete this without you. The opportunities you have provided me with, and the skills and knowledge I have learned from you are irreplaceable; I am forever grateful for your mentorship.

I would like to thank my committee members, Dr. Debra Harwood and Dr. Mary-Louise Vanderlee. Your support and advice helped me refine my thesis and push my thinking to a deeper level. I am grateful for the time and effort you contributed.

I would also like to thank the donors (Dr. Mary-Jane Miller and Mr. Byron Bellows) of scholarships I received, and the Ontario Graduate Scholarship program for providing grants for emerging researchers like myself. Without this recognition and financial support, I would not have been able to complete my MEd.

Last, but definitely not least, I would like to thank my boyfriend, parents, sister, and friends for their unwavering support and belief in me. In the trying times, you were there for me, and lifted me up. I would not have been able to get through this without each and every one of you.

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CHAPTER ONE: INTRODUCTION

Recently, there has been a heightened focus on understanding learners in the early years, and working towards enhancing the instructional practices of Early Childhood Educators (ECEs) and Kindergarten teachers; this is especially the case in Ontario (McCuaig & Akbari, 2017). Professional development for educators is the impetus to enhancing their practices (Kennedy, 2016) with the goal of enriching student learning; however, limited research exists on the effects of professional development on ECEs, Kindergarten teachers, and early learner outcomes. With the burgeoning use of technology, a notable shift has taken place in educators' practices (McGlynn-Stewart, Hobman, et al., 2017), but there are still a vast number of enactment barriers (Finger & Houguet, 2009; Flewitt, Messer, & Kucirkova, 2015). McGlynn-Stewart, Hobman, et al. (2017) explain that current and future generations of students require educators who are competent with digital practices and who implement these practices into their early literacy programs. Overall, "early learning provides necessary building blocks for later reading and math abilities" (Davies, Janus, Duku, & Gaskin, 2016, p. 72). Therefore, supporting educators in implementing technology to improve their pedagogy and in turn, support student development is a timely inquiry. A potential strategy to address this problem is the impetus for the current research.

A single definition of literacy has been difficult to propose in the past; this is especially the case in the 21st century. For the purpose of this research, the definition of early literacy is derived from the seminal work of Catherine E. Snow (2008), who states that "everyone agrees that literacy is a complex and multifaceted skill which changes enormously as it is acquired" (p. 275). Snow explores different views of literacy; one dichotomous set of views is the componential versus holistic literacy. It can be argued that both views are essential in creating a complete definition of literacy. The componential view regards literacy as a product of smaller components; for example, phonological awareness, letter recognition, automaticity, and lexical access (Snow, 2008). Snow (2008) explains the holistic view with the goal of literacy as meaning-making, and that children engage with "authentic literacy activities" (p. 280).

As Snow (2008) demonstrates, there is evidence to support both the componential and holistic views. However, neither one of the views should be adopted in totality. When considering implications of the views, Snow (2008) posits that if a child knows how to use components of literacy, the child would not be considered literate; the child would be considered literate when the child uses the components to construct meaning. Snow (2008) concludes by stating:

> both componential and holistic thinkers would strongly support the use of activities in early childhood classrooms that promote active involvement with meaningful literacy, such as reading books aloud and then talking about them, embedding reading and writing activities in language-rich play, and encouraging children to use mixtures of drawing and unconventional writing to express themselves. … In particular, there are insights from both views that offer guidance for the design of optimally supportive environments for young children's literacy development. (p. 288)

For the purpose of this research, the adopted definition of early literacy includes the purposeful integration of both the componential and holistic views of literacy, as it relates to reading development and pedagogy. Accordingly, this study sought to identify ways to support Kindergarten educators in enhancing their reading instruction with technology-infused lessons. The remainder of this chapter will outline the background of the problem, statement of the problem, background of the study, purpose of the study, rationale for the study, identify the research questions, provide definitions of important terms, and provide an overview of the document.

Background of Problem

In Ontario, the Full Day Kindergarten (FDK) program has been in the spotlight since its integration (Ontario Ministry of Education [OME], 2016). Ontario FDK is recognized by educators, researchers, and other worldwide institutions as unique, and a front-runner of its kind (Darling-Hammond & Rothman, 2011; Rushowy, 2019). Full day programming, play- and inquiry-based focus, one certified ECE, and one Ontario certified teacher are the main components that make Ontario's program distinctive. However, a sophisticated Kindergarten program comes with a high price tag; provincial funding of educational programs in Ontario is in question, which includes the FDK program (Rushowy, 2019). Experts support FDK, as research demonstrates its successes, and any change from a successful program would be detrimental to students, families, and educators (Little, 2019; Rushowy, 2019). With the uncertainty regarding the future of FDK in Ontario (Rushowy, 2019), research in the field is pertinent to inform future decisions, especially related to the preparedness of Kindergarten educators.

Statement of Problem

Two current issues contribute to the problem investigated in this research. The first issue is related to the number of Kindergarten students who are deemed as vulnerable in language and cognitive development, and communication and general knowledge (Early Development Instrument [EDI], n.d.). Secondly, with the rapid development of technology and its integration into classrooms, ECEs and Kindergarten teachers are experiencing challenges in how to strategically implement technology into their Kindergarten programs (Lynch, 2014).

Literacy skills are imperative to educational attainment and a high quality of life (Canadian Index of Wellbeing [CIW], 2016; Organisation for Economic Co-operation and Development [OECD], 2012). Accordingly, providing for the literacy learning needs of all learners is a priority, making it crucial to predict which students might be developmentally at-risk. The EDI (n.d.) measures five domains of Senior Kindergarten students' abilities to meet developmental expectations and their outcomes. Two domains pertain to literacy learning: Language and Cognitive Development (L&CD) and Communication Skills and General Knowledge (CS&GK). The following EDI results for these two domains are from Cycle 4 (2014/15 school year) in Ontario. In the L&CD domain, 6.7% of children scored as vulnerable (below the 10th percentile) and 11.2% of children scored as at-risk (between 10th and 25th percentiles). In the CS&GK domain, 10.2% of children scored as vulnerable, and 15.7% of children scored as at-risk. Students who score as vulnerable or at-risk in these two domains of the EDI are more likely to remain in this standing on standardized Grade 3 reading and writing tests and are more likely to be labelled with an exceptionality by Grade 9 (EDI, n.d.). However, it is important to note that not all students who score as vulnerable remain in that category (Calman & Crawford, 2013). Moreover, Davies et al. (2016) found that "all five readiness domains were significantly related to Grade 3 outcomes…[but] the language–cognitive and communication-general knowledge domains had the strongest associations" (p. 71). As well, Physical Health and Well-Being was found to have strong associations to both math and reading (Davies et al., 2016). This demonstrates that multiple domains of the EDI have associations to reading skills and literacy. Accordingly, it is imperative to investigate ways that technology might support the learning of students that score as vulnerable or at-risk on the EDI through providing educator professional development.

Technology has ample benefits when integrated into a classroom, especially for young learners (Clements & Sarama, 2002; Flewitt et al., 2015), therefore, it is important that Kindergarten educators are competent in infusing technology into their practices to enhance the learning of their students. Technology, literacy, and play structures are interrelated, with research documenting successes integrating among them (McGlynn-Stewart, Hobman, et al., 2017). Yet, there are challenges with infusing literacy and numeracy into play-based learning (Pyle & Danniels, 2017) and with integrating technology (Finger & Houguet, 2009; Flewitt et al., 2015; Lynch, 2014; Turnbill, 2001). Why is this? Arnott (2017) alludes to the fact that there is no shared definition of technology, yet, and the definition affects how educators view and integrate technology into the classroom. It might not be possible to have a "static definition" (Arnott, 2017, p. 10) for a fluid concept. Further, implementation challenges are posed by some teachers who enact more traditional pedagogies and might resist the use of technology in their classrooms (Parette, Quesenberry, & Blum, 2010).

In general, technology use is urged and implemented in schools across the world (Gallagher et al., 2015), but the saturation of technology in society has not yet permeated into early childhood contexts (Parette et al., 2010). Parette and colleagues (2010) advocate for ECEs and Kindergarten teachers to understand the value of technology and integrate it into their practices, so as to not "miss the boat" on relevant instruction for younger generations.

Background of Study

Children as young as 3 years old are using technology in their everyday lives (Hsin, Li & Tsai, 2014), making technology ubiquitous in today's society. Recently, researchers have documented that the use of technology can be beneficial for young children (Hsin, Li, & Tsai, 2014; McGlynn-Stewart, Hobman, et al., 2017; Northrop & Killeen, 2013). In addition to being beneficial for academics, many researchers have found that the use of technology in the classroom increases student motivation, engagement, and collaboration (Beschorner & Hutchison, 2013; Flewitt et al., 2015; Harwood et al., 2015; Levy & Sinclair, 2017). In literacy learning, there are numerous examples of how technology has contributed to skill development. For example, McGlynn-Stewart, Hobman, et al. (2017) found that children who used open-ended apps to create slideshows demonstrated a higher competency in literacy compared to traditional tools, like pencil and paper, and were empowered by their abilities to create. Overall, technology integration into early literacy practices can enhance student learning, however an effective method must be sought to assist educators with this integration.

Design-based research (DBR) is situated to address the needs of Kindergarten educators as they strive to enhance their practices and implement technology into their reading instruction, as it is a collaborative, iterative, and a solution-based theory and method (Design Based Research Collective [DBRC], 2003; Wang & Hannafin, 2005). DBR allows for iterative cycles of designing in collaboration, implementing, and reflecting and redesigning practices within the scope of research (Wang & Hannafin, 2005). This process is often supported by a researcher and allows educators to self-determine how to enhance their practices. In Chapter 2, DBR will be described at length as both a research method and professional learning model in this research.

Purpose of Study

In addition to the difficulties when implementing play into the curriculum (Lynch, 2014; Pyle, Poliszczuk, & Danniels, 2018; Pyle, Prioletta, & Poliszczuk, 2018), Finger and Houguet (2009) cite many intrinsic and extrinsic barriers facing educators who try to implement technology. Intrinsic barriers included professional knowledge, understanding, and adequacy, and their teaching approach. Extrinsic barriers included resources, time, professional development, and support. These barriers have been corroborated by many other researchers (e.g., Flewitt et al., 2015; Hsu, 2016; Nikolopoulou & Gialamas, 2015; Shanley, Cary, Clarke, Guerreiro & Thier, 2017). During the process of DBR, this research attempted to identify and mitigate barriers that ECEs and Kindergarten teachers faced in the implementation of technology and provide them with technology-driven interventions to support student reading development. The purpose of the current study was to conduct research on this process in order to provide educators, researchers, practitioners, and stakeholders with the information needed to offer effective early years programming and close the gap between research and practice.

Rationale of Study

One of the greatest preventative measures that can be taken against developing reading difficulties is high-quality reading instruction in the early years (Snow, Burns, & Griffin, 1998). Kindergarten educators are uniquely positioned to identify and support at-risk students (McCuaig & Akbari, 2017), making early interventions and effective pedagogies in Kindergarten imperative. This study provided educators with technology-enhanced reading lessons that might be used to support all students' reading development. Additionally, since many educators experience difficulties with technology integration (Finger & Houguet, 2009; Flewitt et al., 2015; Lynch, 2014; Turnbill, 2001), this study documented how educators might work together to manage feasible ways to integrate technology into their instruction to support students' reading development.

Research Questions

The following questions were addressed in the current research:

1. How can Kindergarten educators be supported through DBR to implement technology-enhanced reading instruction to support student reading development?
2. What are Kindergarten educators perceptions of their attitudes, skills, and practices of technology-enhanced reading instruction at the beginning of a DBR professional learning project? Did the attitudes, skills, and practices change, and if so, how?
3. What barriers do Kindergarten educators face in the delivery of technology-enhanced reading instruction? How can these barriers be mitigated by using the instructional resources and strategies available to them?

Definition of Terms

For the purpose of the current study, *Kindergarten teacher* refers to a teacher who is certified and licensed by the Ontario College of Teachers (OCT), is in good standing with the college (OCT, 2019b), who has a full-time position in a publicly funded Kindergarten classroom. An *Early Childhood Educator (ECE)* refers to a person who is certified and licensed by the College of Early Childhood Educators (CECE), is in good standing as denoted by "current member" on the Public Register of Members, and who has a full-time position in a publicly funded Kindergarten classroom (CECE, 2018). *Kindergarten teaching team* denotes a Kindergarten teacher and the ECE who are assigned to work in the same Kindergarten classroom, as regulated by the OME (2018a). Additionally, for the purpose of the current study, *Kindergarten educators* will be used as an inclusive term for both Kindergarten teachers and ECEs within the Ontario education context. *Full-day Kindergarten (FDK)* program refers to the new program in place in which children ages 4 to 6 attend full-day Kindergarten classes accompanied by the new curriculum (OME, 2016). Kindergarten students within the FDK program are either *Junior Kindergarten* (JK) or *Senior Kindergarten* (SK) students, determined by their age upon entering the FDK program. *At-risk students* in JK or SK are identified by their Kindergarten teacher and ECE as scoring below what is expected for their age on screening tests, or as identified by the Kindergarten educators. *Technology-enhanced reading lessons* refer to the integration of iPads, Chromebooks, tablets, Interactive Whiteboards, or other technology into reading lessons where the delivery of the lesson will be enhanced as a result.

Overview of Document

The remainder of this document will provide detailed information to communicate the background, implementation, outcomes, and implications of the current research. Chapter 2 offers a review of literature that will provide the context and focus of the current research. Chapter 3 outlines the methodology of the current research. Chapter 4 presents the findings of the research and finally, Chapter 5 discusses findings, and implications for practice, theory, and research.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

This chapter reviews literature to situate the study within relevant research findings. Five main sections will be covered: theoretical framework and conceptual model, literacy and early learners, literacy and technology considerations in Kindergarten, Kindergarten educators, and professional development.

Theoretical Framework and Conceptual Model

This research is situated in the theoretical framework of John Dewey's (1923) progressivism. Dewey's theory is the constructivist foundation of Mishra and Koehler's (2006) conceptual model of Technological Pedagogical and Content Knowledge (TPACK).

Theoretical Framework

Educational philosophies are plentiful and views regarding what should be taught and how it should be taught have been long debated and opinionized by educators and society alike (Hall, Quinn, & Gollnick, 2017). John Dewey dominated the educational landscape in the 1900s with his rich, forward-thinking, and pragmatic ideas regarding learners and education (Hall et al., 2017). Dewey's work came to fruition in the 1920s and 1930s (Sadker & Sadker, 2005), when at this point in time, his progressive ideals and notions were ubiquitous. Despite the fact that progressivism was both the source of educational reform and controversy (Sadker & Sadker, 2005), the ideas are still relevant today, with many current models of education rooted in Deweyan progressivism.

According to Dewey, the main components of progressive education are that it is learner-centred (i.e., elicited from learners' interests) rather than teacher-centred; active learning and experience takes precedence over passivity (Dewey, 1934). Another component of progressive education is that social interactions and relations are pertinent to the learning process, as learning does not occur in isolation (Dewey, 1938). Overall, “the learner’s interests serve as a springboard to understanding and mastering contemporary issues” (Sadker & Sadker, 2005, p. 315).

Change is a constant variable, therefore, the notions of progressivism state that one of the duties of schooling is to educate students in ways in which they are able to adapt to any change that occurs (Hall et al., 2017; Johnson, Musial, Hall, & Gollnick, 2014). Learners have to be adaptable; this is accomplished through enabling students to “[learn] how to think rather than what to think” (Johnson et al., 2014, p. 111).

Given the integral role of the learner in progressivism, the educator also has an instrumental role. It is contested in Deweyan progressivism that teachers should consider multiple variables regarding a learner, such as the learner’s needs or interests as well as the learning environment, and use this knowledge to provide an education that considers these variables (Sadker & Sadker, 2005). Additionally, in progressivism, “flexibility is important in curriculum design” (Johnson et al., 2014, p. 111). Further, educators should view their practice as a variable that is always being tested and enhanced, rather than a finite entity (Edmunds & Edmunds, 2015); this helps educators adapt to their learners and environment. Overall, Dewey (1923) explains that “teachers to be successful nowadays have to be informed about individual capacities, abilities, and weaknesses and their out-of-school environment in order that they may adapt teaching to these varying conditions” (p. 192). Although Dewey’s seminal writing is almost 100 years old, its validity endures, and reiterates the role of the educator in a progressivist classroom.

The learner and the educator are only two pieces to the puzzle; the environment, as alluded to previously, also plays a role in progressive education. Dewey viewed the classroom as "the perfect research laboratory for educational exploration" (Edmunds & Edmunds, 2015, p. 13) and saw progressivism as a way to apply theory and research to practice (Sadker & Sadker, 2005). Overall, educators should continuously re-evaluate their practices and learners to create an environment in which the learners can actively and socially think, grow, and learn. Overall, Dewey's prolific and influential notions about progressive education have shaped today's educational landscape and provided modern educators with methods to foster student learning in a rapidly changing world.

In this study, Kindergarten educators engaged in evaluating, enhancing, and re-evaluating their technology-infused literacy practices, with the goal of responding to their students in a constantly changing technological context. This directly aligns with Deweyan theory, as the theory asserts that change is constant (Hall et al., 2017), the learning environment is important (Edmunds & Edmunds, 2015), and educators must be able to adapt their instruction to the needs of students (Johnson et al., 2014).

Conceptual Model

Mishra and Koehler's (2006) TPCK (Technological Pedagogical Content Knowledge)—now known as TPACK (Technological Pedagogical and Content Knowledge; Thompson & Mishra, 2007)—conceptual model frames this study (see Figure 1). TPACK is an extension of the seminal PCK (Pedagogical Content Knowledge; Shulman, 1986) model that aims to capture the nuanced, complex, and unique ways of how technology is used in education. In essence, both PCK (Shulman, 1986) and TPACK (Mishra & Koehler, 2006) view the domains (pedagogical, content, or technological) as interrelated and interconnected pieces, rather than in isolation. This framework requires vast knowledge of multiple structures, including TK, PK, CK, and TPACK (Mishra & Koehler, 2006).

Belo, McKenney, Voogt, and Bradley (2016) assert that TPACK is an important model to inform educator decisions about the use of technology in early literacy. However, Voogt and McKenney (2017) found that in teacher education programs, teacher candidates were not always provided with the accurate information or adequate skills on using technology to support early literacy. Additionally, Boschman, McKenney, and Voogt (2015) found that in discussions about how teachers design lessons that integrate technology into early literacy, the use of TPACK was related to practical concerns. Teacher candidates and teachers alike need assistance implementing TPACK. Further, McKenney, Boschman, Pieters, and Voogt (2016) found that “non-supported design team engagement is unlikely to yield professional development” (p. 385); however, with both basic and content facilitator support, design talk was enhanced. This demonstrates the difficult nature in which TPACK is integrated into educational contexts, as some educators may require additional support in enacting TPACK. Despite the use of TPACK in practice and research, Graham (2011) highlights the lack of development and support that TPACK has as a theoretical framework. In keeping with this, for the purpose of this study, TPACK will be used as a conceptual model to help understand and garner insights into educators’ technology-integrated practices rather than a theoretical framework.

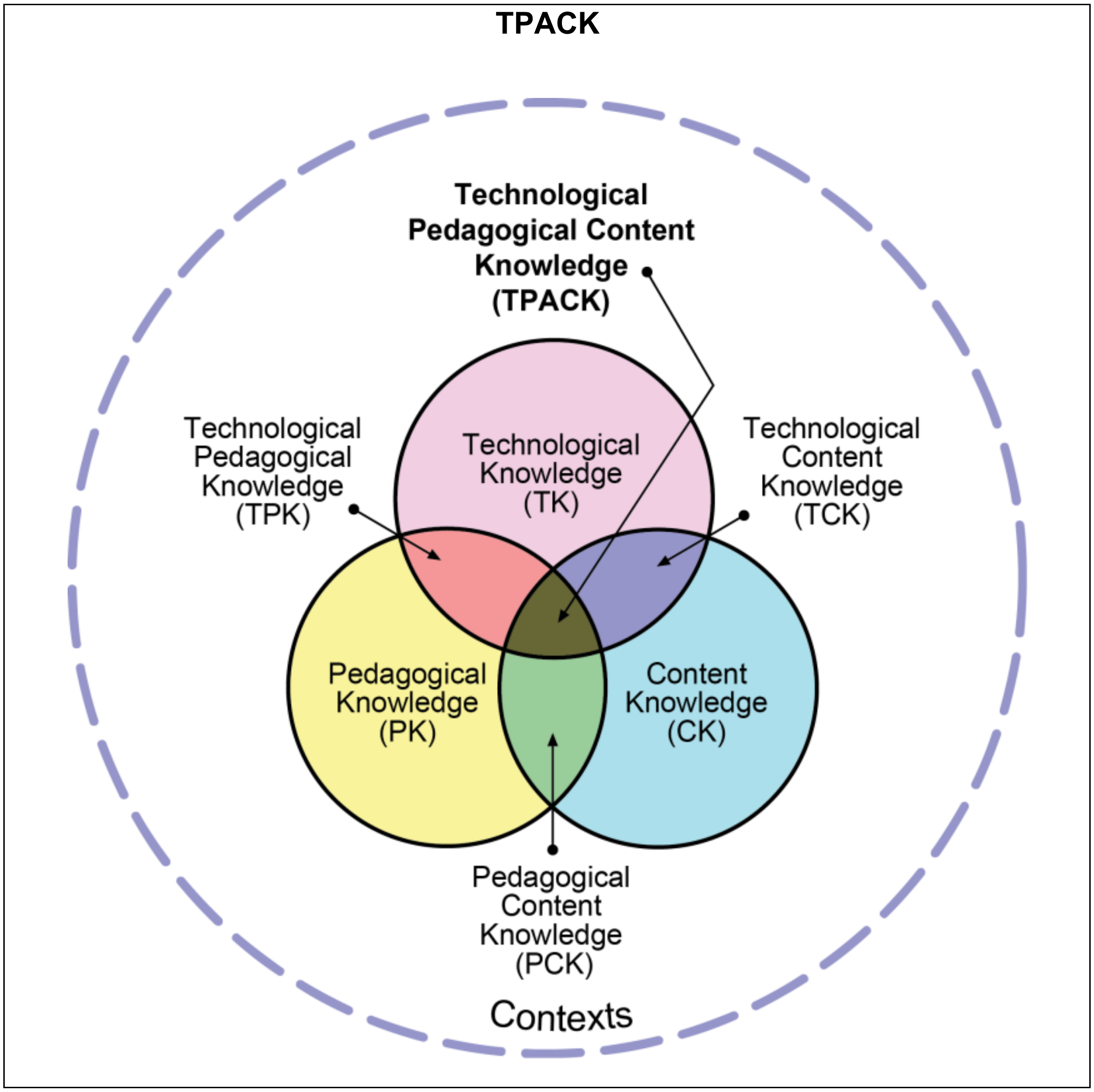

Figure 1. TPACK Model (Koehler & Mishra, 2012)[1]

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Literacy and Early Learners

It is widely accepted that rapid growth and development occur in the early years of a child's life, and that experiences during this time have profound and long-lasting impacts on a child's future (Gerhardt, 2015). This section will review the literature on the literacy skills of early learners and early digital literacy learners.

Who Are Early Learners?

Early learners are a unique set of children transitioning from home or child-care to an educational setting. Specifically, early learners encompass children from birth to 4 and 5 years old when they enter FDK in Ontario. Early learners are "competent, capable of complex thinking, curious, and rich in potential" (OME, 2014, p. 6). Early learners require a program that is tailored to their strengths, and helps them develop the skills they need to succeed. "Early years programs play an important role in supporting children's learning, development, health, and well-being. Evidence from diverse fields of study tells us that children grow in programs where adults are caring and responsive" (OME, 2014, p. 4). Early year programs help children competently develop in all domains.

Early Literacy Skills

Conceptualizations of early literacy and what it means to be literate vary. Marie Clay (1966) posited the concept of emergent literacy to understand the development of children's literacy. It is now understood that literacy development is ongoing and the level of development that children have attained when entering school varies greatly (Doyle, 2013; Slegers, 1996). Clay found that before young children could read, they engaged in behaviours relating to literacy (as cited in Doyle, 2013). Although these behaviours were not reading, it was found that they contributed to reading development.

Additionally, Clay (1982) found that each child pursues a different path during literacy development, and some children skip steps that other children may have experienced. This supports the notion that there is no single way that children develop literacy. Overall, Doyle (2013) states that:

> Beginning, novice readers/writers apply low-level strategies in their earliest attempts to read and write as they approach literacy tasks with vague, rudimentary understandings. They gain proficiency as a result of opportunities to engage in reading and writing continuous texts with supportive instruction. They acquire more knowledge to support their processing, and over time their behaviors indicate acquisition of a more efficient and effective inner processing system, a complex network of working systems for processing text. (p. 646)

As demonstrated by Clay's (1966, 1982) work, children engage in a complex and unique course of literacy development. The interplay between genetics and the home literacy environment contribute to differences in emergent literacy when children enter school (Carroll, Holliman, Weir, & Baroody, 2019). Children can also influence their own literacy-learning environment through their inherent interest in literacy or literacy-related activities (Carroll et al., 2019). Recent researchers have corroborated that the home-literacy environment contributes to children's development of literacy (Anderson, Atkinson, Swaggerty, & O'Brien, 2018; Harrison & McTavish, 2018; Puglisi, Hulme, Hamilton, & Snowling, 2017). With regards to emergent literacy and technology, the use of tablets helped develop emergent literacy skills (alphabet knowledge, print concepts, name writing) in young children (Harrison & McTavish, 2018; Neumann, 2018).

Decades of research findings suggest that early detriments to literacy skills have a lifelong, negative impact on future literacy and academic success (Haughbrook, Hart, Schatschneider, & Taylor, 2017; Nathan, Stackhouse, Goulandris, & Snowling, 2004; Snow et al., 1998). Therefore, effective early literacy instruction, early identification, and intervention are paramount (Clay, 1982, 2001; Snow et al., 1998).

Literacy predictors. Literacy is a construct that changes with time. Harrison and McTavish (2018) explain that since children's lives are now saturated with technology, literacy is no longer "confined to printed text" (p. 164) and includes multimodal ways of meaning making. Early literacy skills predict a child's success in multiple other realms such as literacy and other academic areas (Whitehurst & Lonigan, 2001; National Early Literacy Panel [NELP], 2008). In particular, phonological processing is one of the most fundamental and strongest predictors of literacy (Wagner & Torgesen, 1987). Along with phonological processing, specifically, phonological awareness (PA; Phillips & Piasta, 2013; Pullen & Justice, 2003), key predictors include alphabet knowledge (AK; Phillips & Piasta, 2013), and oral language (Pullen & Justice, 2003; Whitehurst & Lonigan, 2001). Multiple researchers have found that these key emergent literacy predictors are interconnected and intercorrelated during the early years (Clay, 1982, 2001; Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003).

Phonological awareness. "PA is considered to represent an umbrella term that includes children's sensitivity to, and capacity to manipulate, sounds within spoken language at varying levels of linguistic complexity, from the whole world to the phoneme" (Phillips & Piasta, 2013, p. 96). According to Wyse and Goswami (2013), during the development of PA, syllables are one of the first skills that children develop.

Within PA, phoneme segmentation has been found to have the strongest predictive relationship to a child's future reading success (Hayward et al., 2017). Given that PA is a strong predictor of future literacy and academic success, children who experience difficulties with PA might experience potential difficulties with future literacy tasks (Pullen & Justice, 2003). Overall, PA is a very important skill for children to develop, however, it is not the only skill that is relevant in predicting future literacy success.

Alphabet knowledge. In addition to PA, AK is another early literacy skill that can predict literacy success and provide a strong foundation for children moving forward. AK can be defined as the "recognition and production of the names and sounds of letters" (Phillips & Piasta, 2013, p. 96). Whitehurst and Lonigan (2001) note that a strong predictor of later literacy success is full AK when entering Kindergarten. AK has been found to predict phonological sensitivity, because children who have high AK are better able to "detect and manipulate phonemes" (Whitehurst & Lonigan, 2001, p. 17). Despite the strong correlations with high AK, support should not focus solely on AK but also on phonological sensitivity along with AK, which has been found to yield significant results (Whitehurst & Lonigan, 2001).

Oral language. Oral language can be defined as the "system through which we use spoken words to express knowledge, ideas, and feelings" (Lesaux & Harris, n.d., p. 1). The NELP (2008) reported that Kindergarten or preschool programs had little effect (preschool had slightly higher effects than Kindergarten) on a child's oral language development; however, home and parent programs had much higher effects. This suggests that oral language development occurs before the start of formal schooling.

Despite the abundance of evidence for the instruction of specific literacy skills, all children benefit from a rich and integrated literacy environment in which literacy skills develop concurrently (Burke, Hagan-Burke, Kwok, & Parker, 2009). Given the interrelationship of children's emergent literacy abilities, there is no exact combination of instructional approaches or skills to support literacy learners (Dickinson et al., 2003). Regardless, these skills are integral, and when considering today's educational landscape, they can be developed and supported through student use of technology (Harrison & McTavish, 2018; Neumann, 2018).

Early Digital Literacy Learners

Technology for early learners has received a substantial amount of recent attention. Harwood (2017) succinctly captures the role of technology for today's early learners, stating that "despite the cautions, digital mediums are a part of the sociocultural context of young children's lives" (p. 2). Technology in the early years is now a mainstream occurrence, because young children are spending significant amounts of time on technology, and it is a part of their daily reality (Hsin et al., 2014). Accordingly, one goal of this study is to support teachers to find ways to make children's time with technology beneficial to their cognitive development, specifically, the development of reading skills including letter identification, letter sounds, and sight words.

In the abundance of research related to learning through technology in the recent years, there have been some contradictions (Hsin et al., 2014). For example, research from the early 2000s indicated that spending time on technology decreases children's social skills, however more current research demonstrates that when children are engaged with technology, they are utilizing collaborative skills and increasing their social competence (Hsin et al., 2014). There have also been studies demonstrating that technology might negatively impact student achievement (Bus, Takacs, & Kegel, 2015; Northrop & Killeen, 2013). For example, during e-book reading, students may become too distracted by extra features, which were found to effect their reading comprehension (Northrop & Killeen, 2013). Other issues include applications (apps) that are not created with children's cognitive development in mind (Bus et al., 2015). These are apps that have too many features (e.g., too many buttons, pop-ups, animations, music, et cetera), and if those features are not directly related to the content, or if there are too many features, they can trigger cognitive overload and compromise learning (Bus et al., 2015). More specifically, "animated pictures, sometimes enriched with music and sound, that match the simultaneously presented story text, can help integrate nonverbal information and language and thus promote storage of those in memory" (Bus et al., 2015, p. 79). Overall, apps for the purpose of instruction need to be specifically designed with children, their development, and curricular contexts in mind (Hutchison, Beschorner, & Schmidt-Crawford, 2012). For example, Shamir and Korat (2015) conducted research using e-books they created and found that children with at-risk literacy skills who were in the e-book intervention group experienced increased vocabulary and phonological awareness skills. As aforementioned, these literacy predictors are pertinent to a child's linguistic development; therefore, an e-book's ability to increase these skills provides a feasible way for educators to incorporate technology for this purpose.

Technology has the ability to play a unique role in learning, because many studies have found that the integration of technology has actually created an increase in student interest and motivation to learn (Northrop & Killeen, 2013). As Chiong, Ree, Takeuchi, and Erickson (2012) found, children who were co-reading on e-books with their parent were more engaged in the story compared to the dyads reading a traditional book. Flewitt et al. (2015) also found that when using iPads, motivation, concentration, and independence increased for students ages 3 to 13. Further, children's engagement with iPads and other technologies gives them the power to be their own 'meaning makers' and act as both inventors and producers of this meaning (Rowsell & Harwood, 2015); this process is one of the hallmarks of the Kindergarten program. In the executive summary of *Take a Giant Step: A Blueprint for Teaching Young Children in a Digital Age*, Barron et al. (2011) state that:

> Enhanced, modernized early learning will improve their long-term prospects for school success. Technology is most productive in young children's lives when it enhances their engagement in the rich activities of childhood—talking, interacting, manipulating, pretending, reading, constructing, exploring—as well as in children's reflections on their actions and experiences. (p. 3)

This quote exemplifies the need for technology to be a program enrichment rather than a replacement; this is important to both understand and apply when educators are considering the use of technology in the early learning classroom.

Technologies other than iPads or tablets have also been common in education. Lovell (2014) found that teachers who integrated Interactive Whiteboards (i.e., SMART Boards) into their practices used them in the majority of their lessons and claimed improved instruction as a result, despite the fact that their pedagogy did not undergo any changes. However, Lovell and Phillips (2012) note that the integration of technology into classrooms has been overwhelming, especially with the lack of research on its effectiveness, potential educational benefits, and challenges. There are numerous myths that exist surrounding technology and its educational use. Lovell and Phillips (2012) caution against fully accepting technology, especially when the benefits of the technology are endorsed by the manufacturers themselves. Educators should continue to seek evidence regarding effects on student learning when integrating technology.

Overall, technology has been able to offer students many options to explore, discover, create, increase their skills, and play; however, not all educators have adapted their instructional practices to incorporate technology in the early learning classroom. This shift takes knowledge, skill, and preparation to be able to integrate literacy, play, and technology while adhering to the demands of the government-mandated curriculum.

Literacy and Technology Considerations in Kindergarten

Literacy, technology, and play are interrelated and interconnected in Ontario FDK classrooms, however, implementation of these components are enacted in different ways by different educators (Pyle & Danniels, 2017). This section will outline literacy and technology considerations in the Kindergarten classrooms, as well as their integration with play-based learning.

Literacy Integration with Play-Based Curriculum

The OME (2016) expresses the importance of early literacy development in of the recent revisions to the FDK program. The OME (2016) emphasizes the role of children as producers of literacy throughout the curriculum document and curricular expectations; this is an integral consideration for when Kindergarten educators are programming for their students’ literacy needs. Rather than explicitly outlining how literacy programming fits into the play-based curriculum, the OME (2016) provides implicit examples of how to weave play and literacy together through the five stages of play (Play Learning Lab, 2018):

> negotiating during a block construction [student directed], discussing plans at a sand table, describing intentions while painting, asking questions during a conversation, giving reasons for moving an object to another table, modelling behaviour during a read-aloud, or discussing options during interactive writing with a small group [teacher directed]. (p. 71)

The Play Continuum (Play Learning Lab, 2018) begins with student-directed practices including free play, which is followed by inquiry play, collaborative play, playful learning, and learning through games that are categorized as teacher-directed (See Figure 2). These five different types of play should be used in variation as students learn differently in each type. Throughout the document, the OME (2016) implicitly references examples within each of these five types of play, suggesting that literacy is infused in each level of play.

Similar to the other Ontario curriculum documents, the OME (2016) outlines learning outcomes and expectations leaving room for educators to use their professional judgment. However, unlike other grade-level/subject-specific curriculum documents, the challenge with the Kindergarten program is incorporating multiple considerations related to curriculum and pedagogy, such as the role of play and technologies in literacy. This is a challenge that Kindergarten educators must work to master (Lynch, 2014).

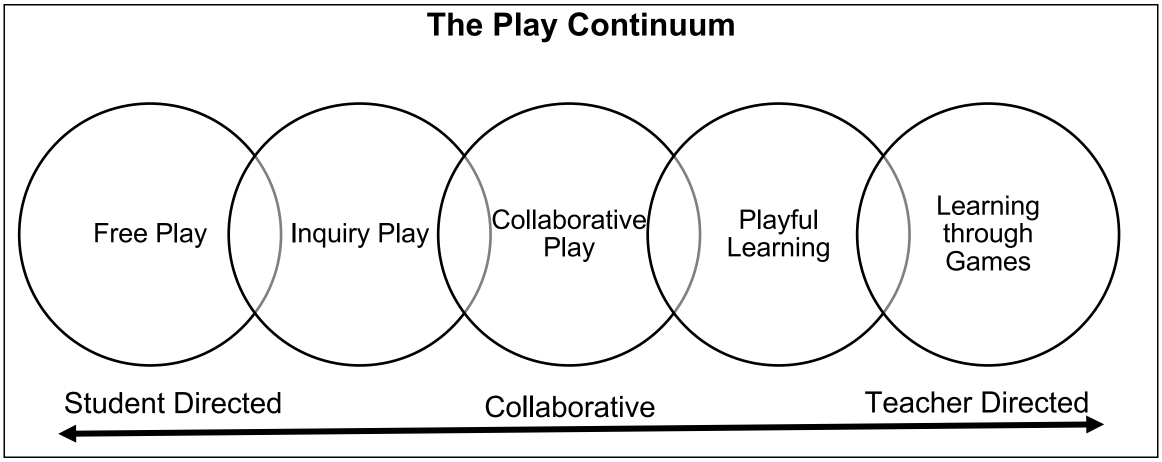

Figure 2. The Play Continuum. Adapted from Play Learning Lab (2018).

Play has been documented to have positive effects on all domains of development (Pyle, DeLuca & Danniels, 2017), especially literacy (Roskos & Christie, 2013), which is why it is positioned as the foundation of Kindergarten programs and curriculum. From the beginning of its implementation in 2010 (OME, 2016), educators in Ontario expressed concerns regarding how to implement the full day, play-based Kindergarten program (Lynch, 2014). Many educators were appeased with the return to the play- and inquiry-based model; however, others were concerned about the lack of emphasis on academics (Lynch, 2014). The professional discussion about the affordances and challenges of a play- and inquiry-based Kindergarten programming is not only occurring in Ontario, but also internationally (Pyle, Prioletta, et al., 2018). In multiple research studies, Kindergarten educators demonstrated differences in their enactment of play, inquiry, and literacy learning integration in their classrooms based on their beliefs (Lynch, 2014; Pyle & Bigelow, 2015; Pyle & Danniels, 2017; Pyle, Prioletta, et al., 2018).

The constructs of play and academics are believed to be dichotomous by some educators, who then enact this belief in their practices (Pyle & Danniels, 2017). Pyle et al. (2017) state that some educators believe that the academic pressure is too strong, and they sacrifice play to focus on literacy and numeracy, or they believe that literacy and numeracy can be promoted through play. Educators' beliefs shape their practices, as demonstrated as in Pyle and Danniels (2017) research, which found that within the educators they studied, two different profiles emerged regarding play and learning. The first profile consisted of Kindergarten educators who believed that play and learning were not synonymous, meaning that they believed that play and learning were separate constructs. These educators experienced difficulty when trying to program for separate times for play and learning. The second profile that emerged were Kindergarten educators who believed that play can enhance learning, and enacted this in their practice. This study demonstrates the gaps and implications between practice and research.

Pyle, Prioletta, et al. (2018) have labelled Kindergarten educators, based on their findings, as focused on “play and development” or “integrated play and learning ” (p. 117). Educators in the play and development group emphasize free play, and lack value in the role of play in literacy learning. In contrast, educators in the integrated play and learning group allow multiple types of play into their classroom and believe that literacy skills can be attained through play-based learning (Pyle & Danniels, 2017; Pyle, Prioletta, et al., 2018). Further, in a study focused on Kindergarten educators, Lynch (2014) interviewed one teacher who stated that with the focus on play and inquiry, there is not enough time to learn letters or printing. Many other teachers in this research also expressed their concerns about the lack of time to academically prepare students for literacy and numeracy in grade one (Lynch, 2014).

Specific challenges that educators experienced when attempting to implement play were elucidated by Pyle, Poliszczuk, et al. (2018), who found “three common challenges with integrating play and literacy learning: direct instruction plays a key instructional role, play is less structured and difficult to plan, and feeling uncertain how to implement guided play” (p. 219). These challenges may stem from teachers’ educational understanding of play and its relation to learning: “previous research has found that Ontario FDK teachers have the misconception that play-based learning involves no explicit teaching” (Tozer, as cited in Lynch, 2014, p. 330).

Overall, most educators believe that play is an integral part of childhood; however, some are not able to integrate it with academic curriculum and learning due to their beliefs or perceived practical barriers (Pyle & Danniels, 2017). It is recommended that future research on how educators achieve a balance between academics and play be conducted (Pyle et al., 2017). Overall, the paradoxical relationship between academics and play has created tensions and challenges for Kindergarten educators because they struggle to find balance in their classrooms (Pyle & Danniels, 2017), let alone attempt to balance their challenges with the influx of technology.

Implementing Technology in the Kindergarten Classroom

In today's society, technological knowledge and understanding is pertinent, because technology is now a widespread and dominant construct (Gallagher et al., 2015). The FDK curriculum (OME, 2016) highlights the importance of the implementation of technology, noting that educators can, and should, use technology to enhance their practices within the classroom "whenever appropriate" (p. 105). Yet, some Kindergarten educators are faced with balancing their concerns regarding literacy and play-based learning integration and the implementation of technology to help foster the skills and values that 21st century learners require. McGlynn-Stewart, Brathwaite, Hobman, Maguire, and Mogyorodi (2018) note that most research has emphasized technology as a tool to help students learn skills, however recent research is highlighting the use of technology, such as iPads, for open-ended use. Based on these two schools of thought, technology use in Kindergarten can be framed two ways: technology as a tool to support the learning of students or technology as an entity of play or inquiry. Both schools of thought have their place in Kindergarten classrooms, as demonstrated below.

Technology as an entity of play. Marsh, Plowman, Yamada-Rice, Bishop, and Scott (2016) introduce digital play as "a new classification" (p. 242). Edwards (2016) argued that converged play (also known as digital play) and traditional play are not dichotomous and cannot be separated in today's landscape. These views align with many other researchers, such as Harwood (2017) who elicits that technology can be used as a provocation in Kindergarten. This view of digital play (Marsh et al., 2016) uses technology in the Kindergarten classroom as a means to enhance literacy because it can be meaningfully and easily integrated into play-based learning. McGlynn-Stewart, Hobman, et al. (2017) studied open-ended app use in Kindergarten and found that educators were empowered by assisting students in their exploration. Students were also empowered, and autonomous because they were able to create their own identity though open-ended app use.

Technology as a tool. In addition to those who view technology as an entity of play, there are also researchers and educators who view technology as a means to learn a specific skill. For example, McGlynn-Stewart et al. (2018) explain that an abundance of research has focused on the use of technology to enhance discrete skills within literacy development. As such, these researchers believe that technology is a tool in education.

Northrop and Killeen (2013) emphasize that the integration of iPads and other technologies as learning tools should not be haphazard; iPad and technology integration should be purposeful and organized. Northrop and Killeen (2013) also suggest using four steps that emphasize the Gradual Release of Responsibility model with the implementation of apps on tablets or iPads into early years classrooms: "(1) teach the targeted literacy skill without the app; (2) explain and model the app; (3) guided practice with the app and with the targeted literacy skill; (4) independent practice with the app" (p. 533). This framework for implementing apps into the classroom emphasizes the need for teacher professional learning, as Northrop and Killeen (2013) believe that iPads should not be a replacement, but enhancement of instruction.

When teachers are considering implementing technology into their classrooms, it is important that they "select appropriate activity types and assessment strategies before making a final selection about which technology tool will be most useful" (Hutchison et al., 2012, p. 22). Again, this emphasizes the notion that implementation of technology as a tool needs to be deliberate and when integrated properly, benefits can be gleaned.

For the purpose of this research, technology as a tool to support the learning of students was the adopted viewpoint, because this aligned with what the participants were currently enacting in their practices. However, it can be argued that both schools of thought can be embodied in a Kindergarten classroom. For example, when considering Play Learning Lab's (2018) continuum of play, technology as an entity of play would be situated on the left side of the continuum, under free play (student-directed), where children engage in digital play (Marsh et al., 2016) or converged play (Edwards, 2016); whereas technology as a learning tool would be situated on the right side of the continuum of learning through games (teacher-directed). Utilizing technology during different types of play and making it freely available to students during all types of play allows technology to be used in different ways, for different purposes and outcomes.

Benefits of technology implementation. The benefits of implementing iPads or other tablet technology into the classroom are outlined by many researchers (Beschorner & Hutchison, 2013; Flewitt et al., 2015; Harwood et al., 2015; Levy & Sinclair, 2017). Students demonstrate high levels of motivation (Flewitt et al., 2015; Levy & Sinclair, 2017) when interacting with iPads, and in turn this increases their independence, concentration, (Flewitt et al., 2015) and confidence (Levy & Sinclair, 2017). Further, "enriched communication and creative collaboration" (Flewitt et al., 2015, p. 301) were demonstrated across multiple age groups when iPads were integrated into student learning. Furthering this finding, Milman, Carlson-Bancroft, and Boogart (2012) note that the use of iPads in pre-Kindergarten to 4th grade classrooms enhanced collaboration not only between students, but also between students and teachers. The impetus for this increased collaboration and interaction may be due to the physical environment (Clements & Sarama, 2002), because the position of the iPads in different parts of the room may allow for different levels of interaction with them (Daniels, 2017). Multiple researchers have found that iPads can promote student collaboration and communication (Beschorner & Hutchison, 2013; Flewitt et al., 2015; Harwood et al., 2015).

McGlynn-Stewart, Hobman, et al. (2017) also found that children who used open-ended apps to create slideshows demonstrated higher literacy competency compared to using traditional tools. More specifically, McGlynn-Stewart, Hobman, et al. (2017) found that Kindergarten students were empowered by the ability to be their own meaning-makers through open-ended apps. McGlynn-Stewart et al. (2018) also found that Kindergarten students who created multimodal slideshows within an open-ended app demonstrated more competent use of literacy skills compared to using pencil and paper. Additionally, McGlynn-Stewart, Brathwaite et al. (2017) found that open-ended iPad use in Kindergarten classrooms supported English language learners and students with exceptionalities in multiple areas, including communication, social, and discrete skill development. The benefits of using technology in the classroom to enhance teacher instruction and student learning are vast and plentiful, however there are barriers to overcome to achieve productive implementation.

Barriers of technology implementation. Several practitioners and researchers have cited challenges when implementing technology into the classroom (Cviko, McKenney, & Voogt, 2012; Finger & Houguet, 2009; Flewitt et al., 2015; Hsu, 2016; Shanley et al., 2017; Voogt & McKenney, 2017). The challenges that educators face regarding technology implementation are vast and cover a wide variety of issues. Researchers have categorized the challenges that educators encounter into extrinsic and intrinsic challenges, as documented next.

Extrinsically, lack of time to implement technology into the classroom was marked as a major barrier for many educators (Finger & Houguet, 2009; Flewitt et al., 2015; Hsu, 2016; Shanley et al., 2017). Finding appropriate apps and considering implementation and assessment is a time-consuming process that can take hours of an educator's planning and preparation time (Flewitt et al., 2015). Finger and Houguet (2009) report that often, educators found that a lack of resources is another major barrier; sharing technology with other educators, or even the school, makes it difficult for educators to be able to use the technology when they require it. In addition to lack of availability (Nikolopoulou & Gailamas, 2015), another barrier is when technology is unreliable and does not work (Finger & Houguet, 2009). Radano (2018) also found that the physical set-up of an interactive whiteboard in the classroom can be a barrier; it was installed too high and Kindergarten students could not interact properly with it. Moreover, Flewitt et al. (2015) reported that "technical difficulties...sometimes disrupted the flow of learning-teaching episodes" (p. 302), which can create frustration for both educators and students. In addition to extrinsic barriers, some educators also face a myriad of intrinsic barriers.

Intrinsic barriers to technology implementation reside within the educator. These barriers include a lack of professional knowledge or understanding on how to implement technology, lack of professional development or training opportunities (Finger & Houguet, 2009; Hsu, 2016; Shanley et al., 2017), or lack of confidence in one's ability to implement technology (Nikolopoulou & Gailamas, 2015). Further, as Cviko et al. (2012) explain, educator beliefs can affect how teachers perceive and implement technology. This may begin early in their practice, as Voogt and McKenney (2017) found that pre-service teachers are not adequately prepared on how to implement technology into early literacy practices, and that this is a primary barrier to issues encountered in practice. When extrinsic and intrinsic barriers are compared, Shanley et al. (2017) found that external (first-order) barriers were less likely to impact implementation of technology compared to intrinsic (second-order) barriers. Despite the type of barriers or challenges that educators experience, it is necessary that they "receive appropriate, timely, and effective support to develop effective technology-based classroom systems" (Shanley et al., 2017, p. 826).

The implementation of technology into the classroom to both enhance instruction and learning can be tedious and difficult at times, but there are numerous obtainable benefits. The ways in which teachers perceive implementation of technology into their pedagogies and classrooms is variable, because educators use technology in different ways (Gallagher et al., 2015). Technology-infused literacy programs in Kindergarten have gained momentum in the recent years as the rise of technology in education has increased and research uncovering the benefits of such implementation becomes more prevalent. This current study will add to this literature on how to support educators to offer effective early years reading programs with technology.

Kindergarten Educators

It is well established that "the early years are a period of intense learning and development, when tremendous changes occur in the brain over a short period of time" (OME, 2013, p. 4). Kindergarten educators have the important role of helping students learn and develop in cognitive, physical, social, and emotional domains. Additionally, it has been found that educators have a positive impact on academic achievement and psychosocial adjustment, especially in preschool and Kindergarten (Fredriksen & Rhodes, 2004; Hamre & Pianta, 2005; Pianta & Stuhlman, 2004).

Ontario's New Early Year Program: Full Day Kindergarten

An innovative overhaul to the early years programming in Ontario began in 2010 (Lynch, 2014; OME, 2013). This change was monumental, as it was the largest educational restructuring in Ontario history to this program (OME, 2018a). The enhancement of the early years program included the introduction of ECEs and the play-based curriculum (OME, 2013). Although the roll-out of the new program began in 2010, full implementation of FDK across Ontario was not accomplished until 2014. The OME (2016) states that:

> the introduction of a full day of learning for four- and five-year-olds in Ontario called for transformational changes in the pedagogical approaches used in Kindergarten, moving from a traditional pedagogy to one centred on the child and informed by evidence from research and practice about how young children learn. (p. 4)

In 2010, the FDK program began and initially included about 15% of Ontario's Kindergarten students (OME, 2013). In 2013, approximately 75% of Kindergarten students in Ontario were taking part in the FDK program, and by September 2014, all Kindergarten students were in the FDK program (OME, 2013). In 2016, the official curriculum document for the FDK program, *The Kindergarten Program* (OME, 2016) was published and in effect.

Unequivocally, Kindergarten educators have important jobs as they are often the first educators that children experience in the education system. "The importance [of] a successful transition to Kindergarten cannot be overstated. Kindergarten marks a child's entry into formal schooling, and performance in Kindergarten paves the way for future academic success" (Schulting, Malone, & Dodge, 2005, p. 860). This places a heavy reliance on Kindergarten educators to be effective in their roles, nurturing children to grow, develop, gain independency, and begin their formal education (Schulting et al., 2005). In some cases, prior to Kindergarten, some children will have spent time in daycare or preschool (Schulting et al., 2005), so they may be more adept at spending time away from their parents, but the social, emotional, and cognitive demands of Kindergarten are different than in daycare or preschool. Kindergarten educators are responsible for preparing students for grade one, which in the changing educational system is more difficult than ever (Katz & Dack, 2011).

A feature of the FDK program is that Kindergarten teachers and ECEs work as a team of educators and complement each other's skills to provide a well-rounded and rich environment for Kindergarten students (OME, 2018a). It is apparent that there are a few pertinent issues with the ECE and teacher dynamic. Mainly, teachers and ECEs experience differences with regards to PD opportunities (Hoffman, 2013; McGlynn-Stewart & Bezaire, 2014). Additionally, both teachers and ECEs note that lack of planning time together is a very difficult barrier to navigate (Lynch, 2014); teachers receive paid planning time every day but this does not coincide with ECE planning time which occurs only once per week (Hoffman, 2013; McGlynn-Stewart & Bezaire, 2014). This makes it difficult to work together and collaborate on instruction and assessment practices. McGlynn-Stewart and Bezaire (2014) note both teachers and ECEs express an understanding that relationships are the key to successful partnerships and collaboration.

Indeed, the OME (2017) notes that Kindergarten teachers and ECEs need to "collaborate in observing, monitoring, and assessing the progress and development of the children in Kindergarten and in communicating with families" (p. 2). Further, research surrounding the addition of ECEs in the Kindergarten classroom notes that quality education stems from well educated professionals who work well and collaborate together (Bas, 2017; Gananathan, 2011). More research is required as presently there are a limited number of studies that explore the Kindergarten teacher and ECE partnership. The current study aims to provide educators, researchers, practitioners, and stakeholders with the information needed to offer effective early years programming and close the gap between research and practice.

Role of Kindergarten Teachers

The OME (2018a) explains the background for the roles within the early learning team, describing Kindergarten teachers as those who "have a knowledge of the broader elementary curriculum, assessment, evaluation and reporting, and child development. They are responsible for student learning, effective instruction and evaluation and formal reporting to parents, based on the teacher-ECE team's assessments of children's progress" (para. 6). The role of the Kindergarten teacher is extensive in nature and encompasses a range of responsibilities from supporting students' social development to identifying learning difficulties early on. Given the significant responsibilities that Kindergarten teachers have, it is advantageous that in Ontario there is another educational professional in the classroom. In Ontario classrooms, ECEs share some responsibilities with Kindergarten teachers, but they also have their own role based on their education.

Role of the ECE

The OME (2018a) explains that "early childhood educators have knowledge of early childhood development, observation and assessment. They bring a focus on age-appropriate program planning that promotes each child's physical, cognitive, language, emotional, social and creative development and well-being" (para. 5). Since the educational background of ECEs is predominated by knowledge in early childhood development, they bring a unique perspective to the Kindergarten classroom, especially in identifying and supporting at-risk students. Similar to Kindergarten teachers being responsive to learners who are at-risk, ECEs also share this role. ECEs have a great breadth of knowledge of the overall development of children (OME, 2018a), and therefore are able to recognize disparities or difficulties that students in their classrooms are experiencing.

Educator Perceptions of Digital Pedagogies

Studies that measure educator perceptions of technology are limited. For example, Jeong and Kim (2017) state that "two perceptions, namely, perceived usefulness and perceived ease of use, are the central operating variables that determine an individual's attitudes toward using a particular technology, which in turn, influences the behavioral intentions to use the technology" (p. 498). The complex interactions between educators' attitudes and perceptions make it difficult to isolate perceptions, especially in a field of research that is still emerging.

Another variable that challenges this field of research is that educators' perceptions of digital technology and pedagogy vary greatly. McKnight et al. (2016) found that teachers across seven different schools perceived and used technology differently in their classrooms and practices. Further, Cviko et al. (2012) found that the way that teachers used a certain technology (e.g., PictoPal) could be related to their perceptions about learning with technology. In this study, the enactment of technology was different for each educator even though the same intervention was used, indicating that there is a level of interplay between perceptions and behaviours of educators when implementing technology (Cviko et al., 2012). Jeong and Kim (2017) measured perceived usefulness, computer self-efficacy (belief/confidence in computer skills), subjective norm (perceptions or pressures of others in adopting technology or not) and personal innovativeness in educational technology (comfortable in taking risks with technology before others). It was found that perceived usefulness and subjective norm both had significant effects on intentions to use technology. Additionally, personal innovativeness in educational technology had significant effects on both computer self-efficacy and subjective norm (Jeong & Kim, 2017). Lastly, Mundy, Kupczynski, and Kee (2012) state that one of the most significant ways to increase attitudes towards technology use is to provide training. Understanding educator perceptions on technology is still an emerging field of study within early childhood education, with most research focusing on attitudes.

Teaching With Technology

Teaching with technology in the Kindergarten context is a relatively new practice. McKnight et al. (2016) argue that “a successful digital conversation for classrooms … is not determined by the technology, but how technology enables teaching and learning” (p. 194). Simply having technology in the classroom does not assure effective teaching and learning with technology; it must be carefully integrated by educators to enhance practice and effect learning (McKnight et al., 2016). Further, Clark and Mayer (2011) state that sound pedagogy is still very important despite the tools or materials used to facilitate instruction, aligning with TPACK (Mishra & Koehler, 2006). McKnight et al. (2016) state that teaching with technology has been documented to improve teacher access to new and more relevant resources, “restructure teacher time” (p. 204), and potentially alter traditional teacher and student roles. Yet, many scholars have cited the difficulties of integrating technology into classrooms (McKenney et al., 2016).

With regards to literacy, Cviko, McKenney, and Voogt (2014) identified three different teacher roles (executer, re-designer, and co-designer) based on different enactments of technology integration into early literacy activities. Although there were positive effects on students for all three types of teacher roles, the greatest effectiveness of integration came from the teacher as a co-designer role. In this role, educators were involved and collaboratively designed literacy activities with technology-rich integration. Further, Lafton (2015) considers the integration of different agents into an educator’s pedagogy when teaching with technology in the early years. Lafton (2015) argues that:

> Learning rather relates to how non-humans make the participants act and engage in the processes, and what forces are evoked in the event. When tools, both digital

> and non-digital, appear as actors, they participate in creating pedagogical moments and lead to understanding agency as fluid. (p. 150)

Further, Lafton (2015) argues that the relationship between digital tools (non-human) and human actors is an interrelationship that should be considered, and that they cannot be separated from one another; these must be accounted for when seeking to enhance an educator's pedagogy with technology. Overall, understanding educators as designers of technology integration in the early years is a complex, still emerging field of study that requires more support and research to sustain its continued development.

Professional Development in Education

Professional development (PD) or professional learning (PL) in education is a multifaceted concept that covers a wide range of professionals, ideals, and forms (Buysse, Winton, & Rous, 2009). Further, many aspects must be considered to effectively implement PD or PL to produce thorough results for students, educators, parents, principals, and stakeholders (Kennedy, 2010). Effective PD is particularly pertinent in today's educational and societal landscapes given that the world is changing rapidly, and educators are required to keep up in order to prepare students (Caena, 2011). PD can help teachers adapt and improve their practices to educate the students of today's world (Darling-Hammond, Hyler, & Gardner, 2017), therefore, it is essential that to optimize educators' PD for student achievement and teacher longevity. Caena (2011) argues that PL, different from PD, is integrated into the lives and experiences of teachers as a more fluid and effectual construct. Cherrington and Thornton (2013) support this notion as they state that PL is a more constructivist view compared to PD and Trevitt and Stocks (2012) state that the use of the term "development" has a negative connotation. Further, Caena

(2011) found through a literature review that teacher efficacy is influenced by professional learning and student achievement is influenced by teacher efficacy; the interrelationship here is key, and although both relationships are indirect, research has identified them as affecting each other.

DeMonte (2013) postulates that in the past, PD has been irregular, short in nature, and devoid of direction and attention to quality. To ameliorate this, in Ontario, a Continuous Professional Learning (CPL) framework for ECEs has been implemented, generating a new direction for PL in early childhood education. Jensen and Iannone (2018) emphasize that CPL extends the antiquated view of PD from knowledge and skills to include the vital components of critical reflection and communities of practice. CPL is enacted differently in different organizations and districts (Jensen & Iannone, 2018), meaning that a definition of CPL is not in place. A lack of definition for CPL contributes to its versatile application across contexts. The CPL framework helps close gaps between research and practice and implement effective PL (Jensen & Iannone, 2018).

When it comes to creating and implementing PL for educators, authentic engagement over participation must be prioritized; solely the act of participation does not lead to change or growth in practice (Hill, 2009). CPL addresses this by interweaving self-assessment, self-reflection, and self-directed learning, where educators are engaged in multiple levels of professional learning that best suits their needs (CECE, 2017). Jensen and Iannone (2018) state that in Europe, it is widely accepted that progress beyond discrete skills and knowledge in the early childhood practice must occur. Overall, there is a lack of research regarding PD in education, let alone CPL; more research is required as a result of the emergence of new PD and PL frameworks in Ontario education.

Professional Development in Ontario

In Ontario, PD is required as per licensure, meaning that when a teacher or an ECE obtains their license, they then have to carry out the standards that are required under their respective licences. For both ECEs and Ontario College of Teacher (OCT) certified teachers, there is a requirement for ongoing professional learning, but these requirements are carried out differently. ECEs have a portfolio requirement to help them with CPL; however, teachers just have a framework that recognizes the different ways that PD or PL can occur in the profession. According to a comparative study by Darling-Hammond and Rothman (2011), Ontario, along with Finland and Singapore, have comprehensive systems for teacher development which support highly effective educators and principals, compared to other jurisdictions.

Professional learning for teachers. Professional development for teachers in Ontario is dictated by licensure (OCT) as well as through various levels of the OME (1990). The OCT mandates that teachers must engage in ongoing professional learning or professional development that is varied, collaborative, self-directed, and reflective (OCT, 2016). *The Standards of Practice* indicate that "members recognize that a commitment to ongoing professional learning is integral to effective practice and to student learning. Professional practice and self-directed learning are informed by experience, research, collaboration and knowledge" (OCT, 2019a, para. 7). The OCT (2019a) places an emphasis on PD, noting that it is the impetus to student achievement.

The *Education Act* (OME, 1990) mandates that the Minister of Education provide PD for both teachers and ECEs; that school boards provide employees with PD programs on bullying and positive school climates; and lastly that teachers have the duty to "organize themselves for the purpose of conducting PD conferences and seminars" (sec. 264, 3). For teachers in their first year, the *Education Act* mandates a New Teacher Induction Program (NTIP; OME, 1990, sec. 268, 2.3) in which confidence, efficacy, instructional practice, and commitment to continuous learning are focused on (OME, 2018b). For experienced teachers, Ontario Regulation 98/02 under the *Education Act* (OME, 1990) mandates Teacher Learning Plans where each year, a plan and timeline is created for professional growth objectives, which is then reviewed by the principal. Additionally, principals complete performance appraisals of teachers every five years (OME, 1990, Reg. 99.02). Lastly, the OME (2019) provides each school board with three professional learning days each year, with pre-determined foci (PPM No. 51). It is clear that ongoing PL and PD for teachers is espoused by policies, frameworks, and licensure.

Professional learning for ECEs. The CECE mandates that its members participate in CPL. The CECE (2017) defines CPL as "the systematic and intentional maintenance, enhancement and expansion of the knowledge, skills and ethical values and behaviours necessary to ensure ongoing quality professional practice throughout a member's career" (p. 4). CPL is a program for ECEs that aims to create formalized, ongoing professional learning and consists of a 2-year cycle where ECEs self-assess, create a Professional Learning Plan, engage in professional learning, and track their progress (CECE, 2017). Rather than just mandating that members must engage with ongoing professional learning, the CECE (2017) has provided a framework to guide them in their enactment of CPL. Reflection, as well as intention are emphasized in this framework alongside enhancing one's practice through professional learning. The *Education Act* (OME, 1990) also states that induction programs for new ECEs are required (sec. 277.47) that include orientation, mentoring, and professional development and training.

Although CPL has been adopted by the CECE, limited research exists, because it is a new construct with the majority of the research that does exist from contexts other than North America (e.g., Cherrington & Thornton, 2013; Hadley, Waniganayake, & Shepherd, 2015; Jensen & Iannone, 2018). This emphasizes the need for more relevant research to take place in Ontario regarding CPL.

Challenges Surrounding Professional Development

For decades, PD approaches in education were outdated and required amelioration (DeMonte, 2013; Hill, 2009; Learning First Alliance, 2000; OME, 2004). Hill (2009) advocated for a revamped PD model that better utilizes resources and produces tangible results. Subsequently, in the last decade, much attention has been drawn to emerging frameworks of PL that recognize changing knowledge and the increase of complex educational practices (Fenwick, Nerland, & Jensen, 2012). CPL or CPD is one of the emerging frameworks for professional learning and development, as adopted by the CECE (2017). CPL addresses some of the previous issues with PD such as critical reflection (CECE, 2017), learning in practice (CECE, 2017; Reich, Rooney, & Boud, 2015), and self-directed PL (CECE, 2017).

However, the new CPL framework does not come without some implementation issues. Jensen and Iannone (2018) found that collaborative and reflective practices within communities and networks of educators enhance CPL, however this is not mandated to occur. Specifically, the CECE (2017) asks that members consider engaging in collaboration, and educators who seek out these opportunities will garner the additional benefits. The majority of the CPL portfolio is completed individually: a self-assessment, a self-directed learning plan, and a record of one's own learning (CECE, 2017). Perhaps more emphasis should be placed on collaboration in CPL frameworks given the benefits of communities of practice and networks that Jensen and Iannone (2018) highlight.

Trevitt, Stocks, and Quinlan (2012) also bring attention to some challenges with portfolio use for CPL. They note that sometimes there is ambiguity in the role of the portfolio: is it a purpose or an outcome? Reich et al. (2015) note that professional organizations often have difficulties in determining portfolio requirements and when trying to evaluate personal and reflective components such as journals or self-assessments. Additionally, a portfolio is a large time commitment, and the benefits must be considered relative to how much time it takes to complete a portfolio (Trevitt et al., 2012). Lastly, the self-reflection skills required in a portfolio are not always innate to all members as reflection is difficult and may make some uncomfortable (Trevitt et al., 2012). Although there are some challenges, the CPL framework enacts many components of effective professional development.

Components of Effective Professional Development

Given that each educator's needs regarding PD and growth are individualized, a one-size-fits-all model is not optimal (Learning First Alliance, 2000). Birman, Desimone, Porter, and Garet (2000) state that there is an inverse relationship between the number of teachers and quality of PD: the more teachers that are included in PD, the lower the quality of the PD. Perhaps this is because individuality is not honoured (Kennedy, 2010), or the more generic the PD is, the less teachers gain from it (Birman et al., 2000).

Overall, many educational researchers have outlined effective elements of PD, however, there is no single formula for operative PD. After researching 10,000 teachers across three districts in the USA, The New Teachers Project (TNTP, 2015) found that among the 30% of teachers who demonstrated growth in their teaching practices, their growth could not be linked to any one particular variable or set of variables. This suggests that even though educational research has identified effective components of PD, there is still no definitive connection between the components and change or growth in teachers' practice. The components of effective PD should be used as guidelines with a strong focus on teacher engagement, and this is beginning to be the focus in frameworks such as CPL. Current models such as the CPL framework advocate for learning in multiple realms from journaling to taking courses or programs (CECE, 2017).

Many well-distinguished researchers in the field of PD have outlined key elements that contribute to effective and quality professional development (e.g., Bates & Morgan, 2018; Birman et al., 2000; Darling-Hammond et al., 2017; Kennedy, 2010; TNTP, 2015). "The research on effective PD has begun to create a consensus about key principles in the design of learning experiences that can impact teachers' knowledge and practices" (Darling-Hammond et al., 2017, p. 4). It has been demonstrated that the inclusion of the following key components has the ability to produce growth (Birman et al., 2000); however, these features are not quintessential elements of PD because the field is still inconclusive. Seminal work by Birman et al. (2000) outlines nine structural and core features that should be at the foundation of PD; many other educational researchers have validated this work (e.g., Bates & Morgan, 2018; Darling-Hammond et al., 2017; Kennedy, 2010).

Form. Birman et al. (2000) note that taking into consideration the form of PD is very important. Traditional, plenary session forms of PD are ineffective, outdated, and were in need of replacement by approaches that match the current educational landscape, educator learning, and subsequent achievement of students (Birman et al., 2000). For example, the CECE (2017) promotes multiple different forms of CPL, allowing educators to tailor their PL experiences to their needs. By contrast, the PD days mandated by the OME are still largely traditional in their form, bringing attention to a paradox that exists in the PD/PL landscape in Ontario. Despite the importance of form in PD, Birman et al. state that if many other elements are present, then form is one element that can remain somewhat traditional.

Duration. One of the most discussed elements of PD is duration. Current literature has highlighted many concerns of the one-time, single workshop PD. Although researchers have not determined the optimal duration of PD, it is recognized that the longer in duration, in combination with other elements, the greater impact it will have on teacher and student growth (Darling-Hammond et al., 2017; Kennedy, 2010). This might be due to increased time to implement other key components (Birman et al., 2000). More specifically, Cordingley and Bell (2012) state that weeks or months of sustained PD are more effective than short-term PD in impacting educator growth and student learning.

Collective participation and collaboration. Collaboration in professional learning can take different forms from one-on-one collaboration to a complex whole-school approach (Darling-Hammond et al., 2017). When teachers of the same grades or subjects collaborate, it enhances their growth because there is coherence between the experiences they share, discuss, and problem solve about (Birman et al., 2000). Collective participation can lead to a "shared professional culture … [from] common understanding" (Birman et al., 2000, p. 30); this is an important factor to foster because trust is a key aspect of collaboration (Bates & Morgan, 2018). Trust in the process of professional learning is important, as Bates and Morgan (2018) cite Vygotsky, who posited that those who work and learn together form relationships from a foundation of trust. As DeMonte (2013) illuminates, the collaboration should, in part, be about improving teaching to enhance student learning; if only one person has the drive to improve his/her teaching, collaboration will not be as beneficial because there is a lack of shared goals. Researchers have documented the positive impact of collaboration and shared goals on student and school achievement (Darling-Hammond et al., 2017). Collaboration, collaborative inquiry, networks, communities of practice, and communication are important components of PD and CPL (Cordingley & Bell, 2012; Darling-Hammond et al., 2017; Jensen & Iannone, 2018).

Content focus. Birman et al. (2000) state that there must be a clear and specific focus of the PD, as generic PD is viewed as less effective by classroom teachers. Given that curriculum and more complex methods of thinking and learning are professionally demanding, it is essential that teachers have a strong knowledge and understanding of the PD content (Birman et al., 2000). PD models that integrate a strong content focus have greater outcomes on teacher growth and student achievement (Birman et al., 2000; Darling-Hammond et al., 2017). PD with strong content focus that is job embedded creates even higher quality PD (Darling-Hammond et al., 2017; DeMonte, 2013). Further, it has been found that teachers are more likely to engage in PD when what they are learning about is meaningful and relevant to them (Bates & Morgan, 2018). However, it is argued that changing times require educators to be more adaptable than ever (Caena, 2011), therefore a PD focus on discrete skills and knowledge should be considered carefully (Jensen & Iannone, 2018). This points to a need for more research on the focus of content within flexible frameworks such as CPL.

Active learning. Active learning is tied closely to form as PD models that are less traditional integrate active learning similar to a contemporary method of teaching and learning (Bates & Morgan, 2018; DeMonte, 2013). PD sessions that integrate active learning are more likely to lead to a change in teacher practices through increased knowledge and skills (Birman et al., 2000), which in turn supports student learning and growth (Darling-Hammond et al., 2017). Like many other key elements, active learning encompasses multiple components including collaboration, feedback and modelling (Darling-Hammond et al., 2017). When multiple components are integrated together purposefully, there are benefits for teacher growth and student learning. The CPL framework helps foster this because educators are engaged in self-directed, self-reflective learning (CECE, 2017).

Coherence. Coherence with regards to PD refers to connectedness and alignment (Birman et al., 2000; DeMonte, 2013). “A coherent professional development activity is linked to standards and assessments, consistent with individual teachers’ needs and goals, or designed to build on previous professional learning” (Birman et al., 2000, p. 77). In some cases, PD is not connected to teachers’ everyday practices (DeMonte, 2013), and teachers noted that there was little connection to content from previous professional learning or development activities (Birman et al., 2000). However, the CPL framework addresses this issue, because it is rooted in learning from one's daily practice, and PL can be completed through daily reflection, journaling, or even engagement with social media (CECE, 2017). Overall, formal PD and PL sessions and activities must be well-thought out, organized, logical, and build on previous experiences for optimal growth and learning to occur (Birman et al., 2000; DeMonte, 2013).

Models and modelling. Bates and Morgan (2018) argue that teachers benefit from experiencing models of effective practices, just as students benefit from their teacher modelling to demonstrate expectations and learnings. Models of how new curricula, materials, or strategies fit into existing classroom practices and pedagogies are important for teachers' understanding and successful implementation (Bates & Morgan, 2018; DeMonte, 2013). A comprehensive review by Darling-Hammond et al. (2017) noted the successful results of the use of effective modelling in PD sessions that resulted in increased teacher learning which positively affected student achievement. Examples of modelling could include observing colleagues, using samples of student work, videos of teaching, case studies, or modelling of lesson plans (Bates & Morgan, 2018; Darling-Hammond et al., 2017). The CECE (2017) supports job shadowing, mentoring, networking, and communities of practice as CPL activities, which align with modelling as an effective component of PD.

Coaching and expert support. Coaching and expert support can include informal support such as from principals or veteran teachers, to trained experts such as subject-specific coaches, instructional coaches, researchers, or faculty members (Bates & Morgan, 2018; Darling-Hammond et al., 2017). Having multiple experts support teachers in their growth creates a community of practice (Darling-Hammond et al., 2017) in which teachers are engaged in “rich learning opportunities” (Bates & Morgan, 2018, p. 624). When the coaching occurs in the teacher’s classroom, there is the greatest opportunity for personalized feedback, reflection, and debriefing discussions (Bates & Morgan, 2018). Feedback can be given right away, and reflection can occur throughout the whole process which is valuable to the teacher’s learning, especially when implementing new practices, pedagogies, or curricula (Bates & Morgan, 2018). Scaffolding (Verenikina, 2003) or the Gradual Release of Responsibility (Maynes, Julien-Schultz, & Dunn, 2010) is a key role of the coach and its effect is similar to when teachers use these practices with their students. Additionally, Cordingley and Bell (2012) note that coaching, mentoring, and the inclusion of experts are essential components of CPD. Additionally, the CECE (2017) values mentoring and job shadowing as CPL activities which can include the use of a coach or expert. Coaching and expert support coincide with effective modelling of practices such as feedback and reflection infused throughout the coaching process.

Feedback and reflection. An important aspect of Adult Learning Theory is feedback and reflection (Darling-Hammond et al., 2017); therefore, when coaching educators, it is pertinent that this element is implemented. Overall, feedback and reflection are “powerful tools” (Darling-Hammond et al., 2017, p. 14) that, if utilized correctly, can help teachers grow in their practice to foster increased student achievement. The feedback-reflection procedure for PD is a two-step process that should be continuous and purposeful throughout PD (Darling-Hammond et al., 2017). TNTP (2015) states that one-time PD workshops or sessions do not allow for this element to occur, which is a major drawback. “Professional development models associated with gains in student learning frequently provide built-in time for teachers to think about, receive input on, and make changes to their practice" (Darling-Hammond et al., 2017, p. 14). The CPL framework addresses this because it encourages educators to be continuously reflective and reflexive in their practice (Jensen & Iannone, 2018). However, TNTP (2015) argues that feedback is generally not provided to teachers during their daily practice, so they are unaware of their need for change, making it difficult to engage in PD that will strengthen areas of need.

Overall, these nine structural and core features are the foundation of effective PD, and are interconnected pieces that fit together. However, even if a model of PD includes these features, it is not a guarantee that the PD will be successful; other factors that must be accounted for include teacher individuality, a teacher's professional strengths and weaknesses, the students, and the school and classroom environment. A means for considering these additional factors when planning professional learning opportunities might be through the method of design-based research (DBR).

Design-Based Research

For the purpose of this study, DBR is situated as both a framework and a method (Fazio & Gallagher, 2018). There has been a long-standing consensus "that educational research is often alienated from daily practices and education issues" (Sari & Lim, 2012, p. 28). DBR is a methodology that is used for educational inquiry (Design Based Research Collective [DBRC], 2003) in which research and practice simultaneously take place (Wang & Hannafin, 2005) to eliminate the gap that often occurs between educational research and practice (Sari & Lim, 2012). DBR has numerous distinctive features which make it an engaging research method as well as a rigorous professional learning approach because it is practice-based, emergent, iterative, authentic, and leads to shareable theories with a wide range of applications (DBRC, 2003). An important aspect of DBR is the role of the researcher, who, in this methodology, "assumes the functions of both designer and researcher, drawing on procedures and methods from both fields, in the form of hybrid methodology" (Wang & Hannafin, 2005, p. 6). Thus, the researcher's role is multifaceted with various responsibilities, seamlessly transitioning between the roles they assume during DBR, which can also be very challenging (Fazio & Gallagher, 2018).

The essence of DBR is its iterative nature in which the researcher and participants collaboratively engage in each step of the cyclical process which involves designing, enacting, analyzing, and redesigning instructional strategies and practices (Wang & Hannafin, 2005). This process leads to an outcome in which new professional knowledge or practice-based theory is created (DBRC, 2003; Wang & Hannafin, 2005). Overall, DBR is flexible and iterative, and can be used in numerous contexts in which it "guides theory development, improves instructional design, extends the application of results and identifies new design possibilities" (Wang & Hannafin, 2003, p. 12).

DBR in technology education. Wang and Hannafin (2005) proposed that DBR and technological education learning environments (TELEs) have similar components; therefore, DBR can be used as a methodology for TELEs in researching and developing theories surrounding the use of technology in education. Amiel and Reeves (2008) argue that investment and use of technology does not equate to increased student achievement, and that DBR can "address some of the deficiencies of other research methods in investigating the role of tools and techniques in the classroom" (p. 29).

DBR in elementary classrooms. In a study conducted by Brown, Taylor, and Ponambalum (2016), DBR and lesson study were used to address issues surrounding the transition from elementary to secondary school. They found that teacher capacity was increased as a result of the integration of DBR, "[it] has been successful in helping practitioners reflect not only on pupil learning, but also what needs to change in terms of their teaching to facilitate this learning" (Brown et al., 2016, p. 17). Overall, teachers felt that they were able to plan and account for more purposeful next steps, were more aware of the challenges that existed, and experienced increased reflection that assisted them in solving the issues around transitioning. At the end of the study, teachers were confident with the prospect of using components of DBR without the researchers in order to continue to sustain growth in their practice and their students' learning.

Fazio and Gallagher (2018) used DBR as a methodological and theoretical framework to investigate how professional learning could facilitate elementary teachers' instructional practice of integrating science and literacy. It was found that the integration of DBR into professional development was successful, and that teachers valued the process where they were able to collaborate and engage in critical discussions with other teachers. Overall, "DBR, as a professional learning intervention, provided the conditions from which the teachers began to transform their views on science and literacy integration" (Fazio & Gallagher, 2018, p. 277). The opportunity to address existing views on curricular integration was a necessary condition to enhance integration.

The role of DBR in educational research has the potential to foster collaborative and harmonized relationships among educators and researchers to enhance student learning. The role of collaboration in PD for educators is extremely important because teaching cannot be carried out in isolation (Darling-Hammond et al., 2017). The opportunity to engage with DBR as a PD methodology provides educators with the opportunity to collaborate with teaching partners, grade level partners, educators from different schools, and educational facilitators or researchers.

Chapter Summary

Kindergarten educators must consider, balance, and implement a complex interplay of early childhood development and educational methods to successfully deliver *The Kindergarten Program* (OME, 2016). Kindergarten educators are required to engage in PD and implement their learning into practice, collaborate with their teaching partner, consider the development and growth of early learners, and integrate assessment and programming. Educators may experience challenges when they have new pedagogies to implement (Lynch, 2014). With new pedagogical tools, it is important to provide educators with practical and specific ways to include these in their practices. Using technology to support the reading skills of Kindergarten students will assist educators will also increase their scope of practice. Overall, this chapter aimed to situate the current study in a review of past research. Subsequent chapters will now outline the research methodology, results, and discussion of the present study.

CHAPTER THREE: METHODOLOGY AND PROCEDURES

The purpose of this chapter is to describe the methodological and ethical procedures that took place for this research. The methods outlined in this chapter address the following research questions:

1. How can Kindergarten educators be supported through DBR to implement technology-enhanced reading instruction to support student reading development?
2. What are Kindergarten educators perceptions of their attitudes, skills, and practices of technology-enhanced reading instruction at the beginning of a DBR professional learning project? Did the attitudes, skills, and practices change, and if so, how?
3. What barriers do Kindergarten educators face in the delivery of technology-enhanced reading instruction? How can these barriers be mitigated by using the instructional resources and strategies available to them?

The methodology used in this study was grounded on insights from a pilot study previously conducted that informed site and participant selection, data collection and analysis, and ethical matters. Step-by-step, this chapter outlines the measures taken to ensure validity and reliability for the current research.

Research Design

This research is rooted in design-based research (DBR) as a methodology. DBR emerged as a unique and distinctive research method in the early 21st century (Anderson & Shattuck, 2012), however the basic notions of DBR are premised in the work of John Dewey (as cited in Bell, Hoadley, & Lynn, 2004). Although not regarded as DBR in the 19th century, Dewey "employed the systematic study of teaching and learning associated with the enactment of complex educational interventions" (Bell et al., 2004, p. 74). Since then, the method has evolved and many other researchers have adapted or improved upon Dewey's first iterations of the method. Most notably, Brown (1992) and Collins (1992) conducted design experiments rooted in Dewey's work, and both pieces of work are frequently described as the impetus for contemporary DBR (Anderson & Shattuck, 2012; Barab & Squire, 2004). Overall, DBR is versatile because it can be used as a theory, a method, or both; the uniqueness inherently lies within the use of DBR as multiple iterative approaches to create new knowledge structures (Barab & Squire, 2004). In an educational context, DBR is defined as a genre of research involving the iterative development of solutions; it is intervention-centred, theoretically informed, goal oriented, pragmatic, and a mixed modality design (Sandoval & Bell, 2004). Additionally, the "use of DBR as a methodological approach, unlike other approaches, posits a model for design and testing of innovations in a classroom setting" (Fazio & Gallagher, 2018, p. 270). Within the DBR framework, the present study used qualitative methods.

As a methodology, DBR is dependent on the situation and research context that the researcher and participants are engaged in. Therefore, DBR can be described as a process that involves implementing iterative cycles of research design and theory to produce results, which are then analyzed and reflected upon, iterated in the next cycle, and so forth (Fraefel, 2014). Reeves (2006) outlines four general steps to take when implementing DBR as a methodology (see Figure 3). The iterative steps within the current study followed the steps explained by Reeves (2006), beginning with a needs and contextual analysis, co-constructing technology-based reading lessons with the participants, testing the design through implementation, co-evaluating and reflecting upon the success and challenges during in the implementation, changing the lessons accordingly, and re-implementing the lesson(s).

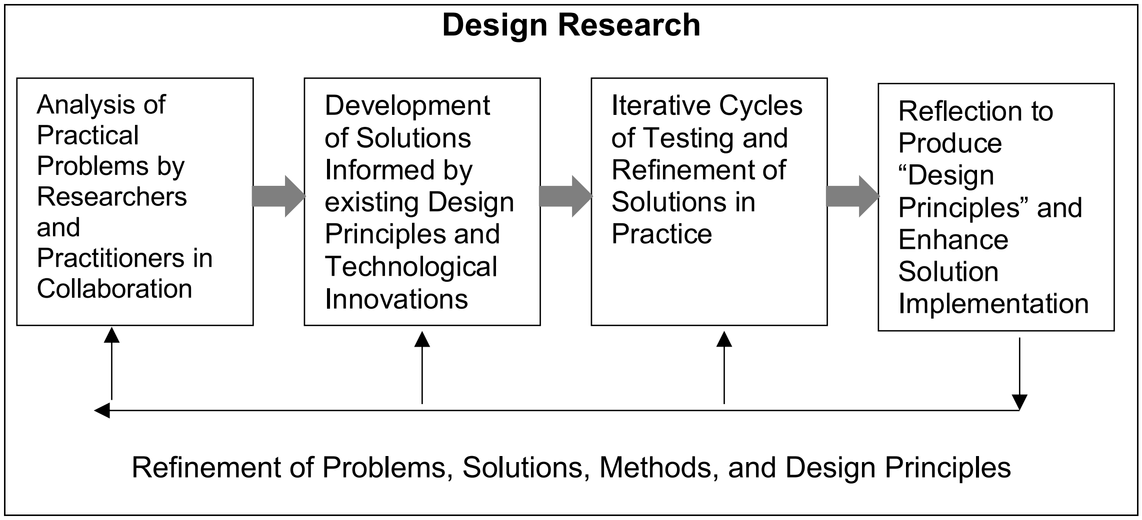

Figure 3. Design-based research as a methodology (Reeves, 2006).

Pilot Study

A small-scale pilot study was conducted in the Spring of 2018 to test the DBR research methodology. The pilot study was granted Ethics Clearance by both Brock University's Research Ethics Board and the participating school board's Research Ethics Committee. The goal of the pilot study was to test the methodology with one Kindergarten teacher and ECE to determine feasibility for the larger-scale study.

The pilot study was 6 weeks long, beginning with teacher and ECE surveys, interviews, and student reading assessments. In accordance with DBR, a co-planning meeting took place to collaboratively plan the technology-enhanced reading lessons and discuss lesson implementation. During the co-planning meeting, the researcher demonstrated options for the teacher and ECE; they selected those that they wished to use to implement technology. These options included SMART Board lessons and the use of iPads. SMART Board lesson examples were pre-made by the researcher and were demonstrated to the teacher and ECE. With regards to literacy, the school board only had two apps on the iPads: *Word Wizard* (L'Escapadou, 2018), and a letter tracing app. The *Word Wizard* app was chosen because it focused on phonics and sight words and this was aligned with the support that the students needed. The teacher and ECE then used their professional knowledge and understanding of their students to assist in customizing the SMART Board lessons and use of the iPad app to better match their classroom and students' learning needs. The teacher and ECE provided the researcher with new concepts and ideas that they wanted the SMART Board lessons to focus on. Through dialogue, the teacher, ECE, and researcher came to a consensus about the content and order of the lessons.

The teacher and ECE then implemented three lessons that were observed by the researcher sitting at a table behind the carpet where the students were seated for the lesson; the researcher took fieldnotes with pen and paper. The researcher also worked with two students three times during this iteration. These students were selected by the Kindergarten teacher and ECE, and consent was given by both parents and students. During the student interactions, the researcher worked one-on-one with each student for approximately 10 to 15 minutes on the *Word Wizard* app. This app was pre-approved and downloaded by the school board on all iPads. For the one student participant who was in JK, the researcher worked with the *Talking Movable Alphabet* (a game in the *Word Wizard* app) where the researcher would ask the participant to identify letters, name their sound, and drag them to the top of the screen. During this time, the researcher would note which letters or sounds were challenging for the participant; these were the focus during the next interaction. With the participant in SK, the researcher first used the *Talking Movable Alphabet*, but then was able to move on to the *Scrambled Letters* feature using the Pre-Primer list of Dolch Words (i.e. a list of frequently used words in English). Here, the word letters were scrambled, the researcher said the word, and the participant used the letter sounds to drag the letters in the right order.

After the observation of the three lessons and three student interactions, a co-evaluative meeting took place where the lessons were reflected upon and altered to further enhance student learning. During this meeting, the teacher, ECE, and researcher evaluated the effectiveness of the implemented lessons. This was completed qualitatively through discussion and reflection. For example, the ECE noted that the interactive SMART Board lessons would be more effective if there were smaller groups of children, so that the others were not waiting so long for their turn. Additional SMART Board lessons were demonstrated by the researcher based on teacher and ECE provided feedback, and the new feedback was implemented prior to the next set of lessons. Three more lessons were observed, and three more student interactions took place, with the same two students, which were the same as the aforementioned interactions. Lastly, the teacher and ECE completed the post-survey and post-interview, and the students completed the post-assessments.

Based on the pilot study, several learnings were garnered that informed the current research. First, in the initial stage of establishing rapport with the teacher and ECE participants, it was noted that a very important part of the needs analysis is to simply observe a reading lesson before any planning occurs. This way, it is clear to the researcher about the inherent timing, processes, and flow of the classroom lessons that the teacher and ECE implement on a daily basis. The researcher could then find ways to infuse technology seamlessly within the classroom without changing the major structure of lessons; this is an important consideration for quality integration.

Another facet to observe prior to starting the current research project that came to light as a function of the pilot study: the researcher needs to observe to appreciate how the teacher and ECE enact their literacy and digital pedagogies. For example, after a short whole-group lesson, the teacher took the SKs (and children the educators identified as high readers in JK) to an adjacent classroom for reading instruction, while the ECE kept the JKs (or children the educators identified as low readers in SK) in the classroom. This division made it difficult to conduct observations in each of the separate classrooms where reading instruction was taking place. Given the reality that each Kindergarten educator team enacts their reading instructional methods in different ways, it is important for the researcher to be responsive to the educators. In accordance with DBR, the researcher accommodated for educators' needs based on their practice, and supported them as they enhanced lessons without creating drastic changes that were not feasible for educators to maintain after the intervention period. Therefore, it was noted that a pre-observation should take place prior to the first planning meeting with the teachers and ECEs to garner these important notions for the current study.

The pilot study was planned with four 20-minute meetings prior to the intervention. The pilot study revealed it was evident that these educators did not need this long to plan. Perhaps, during the Winter term, they already knew what their students' needs were and what resources were available. Therefore, for the current study, the researcher remained flexible with respect to the number of meetings that the educators deemed they required. Thus, co-planning must adopt a flexible, emergent design.

The interview questions for the teacher and ECE proved to be quite comprehensive; however, one identified gap from the pilot study was gaining perspectives on student assessment. Therefore, for the current research, the question, "How do you assess for students who are at-risk?" was added to the pre- and post-interview prompts.

Intervention Design

For the current study, the researcher engaged in DBR that aimed to maintain the integrity and the professional needs of the teachers and ECEs through collaboration. In accordance with DBR, this was achieved through multiple iterations in which the researcher collaborated with two separate Kindergarten teacher and ECE dyads to implement technology-enhanced reading lessons. This took place over six iterations, as described below, and depicted in Table 1.

This research took place at one school in a southern Ontario school district. The school was located in a middle- to high-socioeconomic area. Two Kindergarten classes were involved. Each Kindergarten class had one teacher and one ECE. Co-planning meetings took place before school (between 8:00 a.m. and 8:50 a.m.) in the library. At the beginning of the study, neither Kindergarten class had a SMART Board in it. For the technology-enhanced lessons, each class went separately to the library where they used the SMART Board to enact their lessons.

The research began in mid-October, 2018 with an initial meeting among the researcher, the thesis supervisor, the principal, and the two participating teachers. Although the researcher wanted the ECEs to attend the meeting, they could not because of scheduling conflicts. Five days after the initial meeting took place, the pre-interview and pre-survey (with all four educator participants), as well as the pre-observation (in each of the two classrooms) were conducted by the researcher.

After collecting the preliminary data, the researcher had an instructional meeting with the participants, followed by a co-planning meeting (as described below in Iteration Two). Six lessons took place (described in detail below), and then a co-evaluative meeting, in accordance with DBR. Following the iterative cycles of DBR, six more lessons took place, followed by the post-interview and post-survey. Overall, the research took place over 16 weeks with 17 points of interaction. Over the course of these interactions, the researcher spent 46 hours at the school engaged in various aspects of the research process. The research ended in mid-February, 2019.

Table 1

Description of Iterations

Iteration no.	Description	Date
1	Initial meeting	October 19, 2018
	Pre-Observation	October 24, 2018
	Pre-Survey	October 24, 2018
	Pre-Interview	October 24, 2018
2	Instructional meeting	November 1, 2018
	Co-Planning meeting	November 13, 2018
3	Observation of Lesson 1	November 15, 2018
	Observation of Lesson 2	November 21, 2018
	Observation of Lesson 3	November 23, 2018
	Observation of Lesson 4	December 19, 2018
	Observation of Lesson 5	January 16, 2019
	Observation of Lesson 6	January 21, 2019
4	Co-Evaluative meeting	January 22, 2019
5	Observation of Lesson 7	January 24, 2019
	Observation of Lesson 8	January 24, 2019
	Observation of Lesson 9	January 25, 2019
	Observation of Lesson 10	January 25, 2019
	Observation of Lesson 11	February 1, 2019
	Observation of Lesson 12	February 1, 2019
6	Post-Survey	February 11, 2019
	Post-Interview	February 11, 2019

For the purpose of distinguishing the two classrooms involved in this research, the first class, run by Scarlett[2] (teacher) and Christina (ECE), is referred to as K1 and the second class, run by Riley (teacher) and Jamie (ECE), is referred to as K2. Additionally, G1 denotes group 1, which consisted of students who were working on letter names and sounds. These students were mostly junior Kindergarten students with some senior Kindergarten students. G2 denotes group 2, which consisted of students who were working on sight words, word families, or sentences. These students were senior Kindergarten students with some junior Kindergarten students.

Iteration 1

The first iteration included the initial meeting, classroom pre-observation (as described in the pilot study), and the teacher and ECE pre-surveys and pre-interviews. This iteration embodies Reeves's (2006) step one: a needs analysis. The classroom pre-observation provided valuable data on how the Kindergarten educators worked together to deliver their reading lessons. The interviews and surveys revealed the perceived challenges and attitudes that the educators had in implementing technology into their reading lessons as well as their beliefs and knowledge with respect to technology. The educators also expressed during the interview how they used professional judgement to assess the reading skills of their students and what skills the lessons should address.

Iteration 2

This iteration focused on the development of solutions (Reeves, 2006). Herein, the researcher collaborated with each Kindergarten teacher and ECE dyad to implement technology in reading lessons using the expertise of all three individuals. These occurred

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[2] Pseudonyms used for all participants' names.

in two 20-30 minute meetings, per dyad. Instead of two co-planning meetings, as initially planned, one instructional meeting and one co-planning meeting took place based on the educators needs, as described in detail below.

Instructional meeting. The first meeting was an instructional lesson on the SMART Board program, *SMART Notebook 18.* The researcher realized after the initial observation and interviews that three out of the four participants had never used a SMART Board. The researcher understood that since the educators had never used this technology, they could not participate in collaboratively planning reading lessons; in accordance with DBR, researchers must accommodate the needs of the educators. During this instructional meeting, the researcher demonstrated the basic capabilities of the SMART Notebook 18 program to the participants, as well as the *SMART Lab* tool within the program. The *Smart Lab* tool consists of pre-made activity formats such as matching, sorting, or fill in the blank games, where the user inputs content and the activity is generated by the program. The researcher demonstrated the matching activity and the educators thought that the *SMART Lab* was a good place to start since the activities were quick and easy to create and use.

Co-planning meeting. The co-planning meeting took place after the instructional meeting. The purpose, in accordance with DBR, was to collaborate with the educators to create and implement technology enhanced lessons. The researcher explained that she would create the first few lessons as a model, and then the educators would begin creating them (see Table 2).

Table 2

Scaffolding Lesson Creation and Set-Up

Lesson no.	Who made the SMART Notebook 18 lesson?	Who set up the SMART Board
1	Researcher	Researcher
2	Researcher	Researcher
3	Researcher	Researcher helped educators
4	Researcher (for K2), teacher (for K1)	Researcher helped educators
5	Re-use a lesson (K2), ECE (for K1)	Educators (w/ help as needed)
6	Educators	Educators (w/ help as needed)
7	Educators	Educators (w/ help as needed)
8	Educators	Educators (w/ help as needed)
9	Educators	Educators
10	Educators	Educators
11	Educators	Educators
12	Educators	Educators

Additionally, the researcher, teachers, and ECEs decided that the teachers would create and implement lessons for their Senior Kindergarten (Year 2) students, and the ECEs would create and implement lessons for their Junior Kindergarten (Year 1) students. This decision was based on how their regular duties were split in both classrooms and so that all students could benefit from technology implementation. Additionally, it was an opportunity for the educators to learn how to differentiate using technology. During this co-planning meeting, it was agreed that a three-part lesson would meet the needs of the learners, and frame the SMART Board lesson with other technological and non-technological integration. The three-part lesson included a video (found by the educators) that highlighted the targeted skill that the SMART Board lesson would address that day, followed by the SMART Board lesson, and a follow-up activity. The foci of the lessons were discussed, as represented in Table 3.

During the second co-planning meeting, the researchers and educators discussed how it would be best to divide the time with the SMART Board in the library. Each class was split into G1 and G2, each group made up roughly half of each respective Kindergarten class. Then, within each group (G1 and G2), they were split in half again to make the group sizes using the SMART Board more manageable (a key finding from the Pilot Study). Each class therefore had four groups of 5-6 students who participated in a 15-minute SMART Board lesson. Each class had similar groupings but for K2, the sessions evolved to be larger group sessions as this is what the educators saw fit for their class, which resulted in longer lessons with more students; the researcher did not intervene in this decision. The co-planning meeting took approximately 20 minutes, per dyad. Fieldnotes were taken by the researcher during these meetings.

Table 3

Foci of Lessons

Lesson no.	Group	K1	K2
1	G1	Letter matching	Upper/lowercase matching
2	G2	Fill in the blank: put the words in a sentence	1:1 correspondence
3	G1	Letter matching	Upper/lowercase matching
4	G2	Fill in the blank: put the words in a sentence	Rhyming “AT” word families
5	G1	Upper/lowercase sorting	Matching uppercase & lowercase | Match Letter to Word Onset
6	G2	Fill in the blank: put the words in a sentence	Fill in the blank: “AT” Word Family | Matching
7	G2	Sight word memory match	“AT” word family | Sight word memory match | Label reveal
8	G1	Letter matching | “AT” word matching | memory match upper/lowercase letters	Upper and lowercase memory match
9	G2	Match word to picture	Memory match “AT” words | Memory match sight words
10	G1	Sight word matching | Picture and letter matching | Memory match upper/lower	Memory match “AT” words | Multiple choice sentences from book
11	G2	Memory match words | Writing practice	Name memory match | Sight word memory match
12	G1	Matching “AT” words | Alphabet order | Memory match	Matching sight words | Picture to word matching

Iteration 3

Iteration 3 was the intervention period in which the researcher scaffolded the teachers and ECEs implementing the technology-enhanced reading lessons. This iteration is the beginning of step three as identified by Reeves (2006) where technology is implemented, and cycles of testing and refinement occur. Fieldnotes were taken during the observation of lessons.

The first lesson was created and conducted by the researcher so that the teacher and ECE of each class could see how it worked. See Table 2 for more details on how the researcher scaffolded the teachers and ECEs in Iteration 3. In accordance with DBR, it is imperative that the teachers and ECEs learn to create and teach these lessons themselves, because the long-term goal of completing this research is that educators will be able to implement technology-enhanced instruction autonomously after the intervention period.

The researcher had to intervene many times during the SMART Board lessons, especially during the first three to four lessons, to assist the educator with issues that arose that they did not yet know how to fix. When the researcher intervened, she made sure to explain what happened and how to fix it so that next time, they could navigate it independently. The researcher was quick to intervene, so as to not disrupt the flow of the lesson (i.e. usually less than 1 minute).

Each lesson took place as follows: the researcher arrived at the school at 9:00 a.m. and let the educators know that she was there. For the first three or four lessons (as depicted in Table 2), the researcher then set up the lesson on the library SMART Board between 9:00 a.m. and 9:30 a.m. At 9:30 a.m., after announcements and attendance, the researcher went down to the K2 classroom and brought them down to the library. The educators set up the tools and materials for the group that was not working with the SMART Board that day, while the students watched a video for the lesson. The teacher or ECE (depending on the lesson) then proceeded to enact the lesson. The follow-up activity was often the use of the iPads. It also included letter bingo, fiddlesticks (reading sight words off popsicle sticks), or writing sight words or letters on mini whiteboards. Each lesson targeted either JK students or SK students. For lessons 4 (for K1), 5, and 6, the educator who was in charge of that lesson set up the SMART Board when they came into the library. The first student group of K2 participated in the lesson from 9:30 a.m.-9:45 a.m., and the second K2 group participated in the lesson from 9:45 a.m.-10:00 a.m.. At 10:00 a.m., K2 packed up and went back to class, while the researcher went to get K1. K1 then set up in the library and the first group from K1 had their lesson from 10:00 a.m.-10:15 a.m., and then the second group from K1 had their lesson from 10:15 a.m.-10:30 a.m.; at 10:30 a.m., K1 packed up and went back to class. It is important to note that the membership in the student groupings was fluid, not prescribed. The purpose of the fluid groups was so that students could be moved to a particular group that would benefit them given the topic and time of that lesson. The groups were created by the educator participants. After these lesson rotations, the researcher often debriefed with the educators and provided feedback and support. This was during the school's break time and the two teachers were on break (occasionally had duty) and the two ECEs had recess duty. During this debriefing, the teachers often had questions for the researcher, the researcher needed to confirm times and/or dates, or the researcher reviewed what the educators had learned or were working on. Although there was not time to debrief with the ECEs at the same time, the researcher made other options available for them.

Iteration 4

This iteration was the same as Iteration 2, except for the fact that the researcher collaboratively reflected with each of the teacher and ECE dyads, about the successes and challenges incurred during Iteration 3. Subsequent lessons were then changed accordingly. Maintaining flexibility, these discussions occurred in one 20-minute meeting, prior to the start of school. The educators were asked to come to the meeting prepared with what they perceived their successes and challenges to be. K1 educators had their meeting from 8:00 a.m.-8:25 a.m., and K2 educators had their meeting from 8:25 a.m.-8:50 a.m. Fieldnotes were taken by the researcher during these meetings.

The researcher and educators discussed successes and challenges in technology implementation during the first six lessons. Educators elaborated on how they felt during the first six lessons and where they wanted to go for the next six lessons. One educator (Christina) expressed interest in learning what else the SMART Notebook 18 software had to offer. The other educators were not interested in this. Each educator was different in her approach to her own learning and professional growth. It was important to honour this when working with the educators and to understand the individual needs of each participant. After the meetings, the educators and researcher determined that another meeting was not needed.

Iteration 5

This iteration was identical to Iteration 3, except that the lessons were reflected upon and enhanced based on the co-planning meetings in Iteration 4. Fieldnotes were taken during the observations of all lessons.

Iteration 6

This final iteration was the same as Iteration 1. The post-survey and post-interview were completed individually with each of the teachers and ECEs at a convenient time and in a private space. The data collected in Iteration 6 were analyzed comparatively to the data collected in Iteration 1 to glean results of any change in the teachers or ECEs.

Present Study

This section outlines the site and participant selection, description of participants, data collection, and data analysis.

Site Selection

The site and participant selection were completed by the participating school board. The researcher and thesis supervisor emailed the Research Officer of the school board explaining the research. After providing the school board with Brock University's Ethics Clearance, the Research Officer sent a request to the literacy consultants who were asked to identify two Kindergarten teaching teams, as well as their principals, who would be interested in participating in the research. Although the principals were not participants, their role is to support the teachers and students; therefore, principals' involvement at the beginning of this process was critical. The researcher provided the literacy consultants with a short list of requirements that the teacher and ECE team should fulfill, including: not currently, but willing to, integrate technology into their reading lessons; eager to learn and collaborate with each other and a researcher with the goal of enhancing their practices and the reading skills of their students; as well as have SMART Boards, iPads, tablets, or Google Chromebooks on site. The literacy consultants suggested two Kindergarten teams, and the Research Officer provided the researcher with their school board email addresses. The researcher then sent the Letter of Invitation to the teachers, ECEs, and principal for their review of potential participation in the research. After they expressed interest in participating in the research, the researcher sent the Consent Forms. Both teachers and both ECEs agreed to participate in all aspects of the research, with the understanding that they could opt-out at any time.

Description of Participants

Teacher participants were certified Ontario College of Teachers (OCT) who were employed by the participating school board. They had a full-time teaching assignment in a Kindergarten classroom for the full duration of the study. The ECEs were certified by the CECE and employed by the school board. They had a full-time ECE assignment in a Kindergarten classroom for the full duration of the study. The teachers and ECEs were eager, willing, and ready to learn how to enhance their practices through implementing technology into their literacy lessons to improve student reading skills. All participants were female and between the ages of 30-50 years. There were two teams of educators (K1 and K2), each comprised of one teacher and one ECE. All participants selected their own pseudonyms during the pre-interview to represent themselves in the research.

Scarlett. Scarlett is the teacher of K1. She has been in this role, at this school, for 2 years. She has been with the current school board for 14 years, the first 7 years as a supply teacher. Additional qualifications (AQs) that Scarlett had completed included Kindergarten Part 1, Reading Specialist, and Special Education Specialist. Scarlett had not participated in PD related to technology. She was apprehensive about using technology, and described it as “frightening” (Scarlett Interview 1, October 24, 2019).

Christina. Christina is the ECE of K1. Christina has been an ECE for 18 years, with her current position being her 7th year with the school board. She was also qualified to teach Montessori Education, which was how she began her career. She had only participated in one technology in-service training, but it was related to math. She was eager to learn more about technology but was quick to identify that she could use the help of a support person when it comes to technology.

Riley. Riley is the teacher of K2. Riley has been in this position for 18 years with the same school board and school. During this time, she remained at the same school. AQ courses that Riley completed included Primary Specialist, Religion Part 1, and Special Education Part 1. She had not attended any technology or literacy professional development. Riley recently implemented iPads in her classroom but felt that it could be improved. She also identified that she would require support with new technology.

Jamie. Jamie is the ECE of K2. Jamie has been an ECE for 11 years, the last 6 years with the school board. She holds her ECE qualification, and had not attended any recent technology or literacy professional development. Jamie implemented iPads in her classroom, but believed that it could be improved, and identified that she would require support with regards to technology.

Context. K1 and K2 were very similar in their classroom set-up and enactment of literacy instruction. In each classroom, during the pre-observation, it was observed that literacy consisted of directed play, or play through games. In accordance with the Play Learning Lab's (2018) Play Continuum, the educator participants in this study exhibited that they aligned with the teacher-directed end of the continuum, where their students learned through games and engaged in playful learning. Other types of play may have been enacted, however, not during the literacy block that was observed. During the literacy block (approximately 90 minutes), each table, as well as the carpet, had an activity set up on it that the students were to work on. Examples included: tracing or copying letters or words onto small white-boards, writing their names in a notebook, and games such as letter bingo. Each classroom had a small reading centre, with a small shelf of books. Additionally, during exploration time in K1, the teacher and ECE would select students who required one-on-one or small group instruction in writing or other areas.

In terms of technology, at the beginning of the study, each ECE had a Chromebook, and K1 had a desktop computer which was rarely used. Both classes had a laptop connected to an LCD projector with speakers. The speakers in K2 did not work because they were missing a cord. K2 had a radio with CD port that they used to play letter songs. The projector in K1 had to be used against the windows with the blinds rolled down; this was the only space available to use the projector. This space was not near the carpet, so if they wanted to use the projector, they had to move all the students to that area. For maps of the classroom, pre-intervention, see Appendix A (K1) and Appendix B (K2). At the end of the study, K2 had a SMART Board MX installed (see Appendix C for K2 classroom map post-intervention). This was connected to a desktop computer. Once this was installed, the projector and CD/radio player were removed from the room. Overall, both classrooms demonstrated similarities in their literacy practices, however differences in technology existed by the end of the study.

Data Collection

In accordance with the principles of data triangulation (Golafshani, 2003), multiple types of data were collected for this research. This section outlines the data that were collected, including surveys completed by the teachers and ECEs, transcribed audio-recordings of interviews with the teachers and ECEs, as well as fieldnotes from co-planning meetings and observations of lessons.

Surveys. Each educator participant completed two surveys: a pre-survey as part of Iteration One, and a post-survey as part of Iteration Six. The survey administered was the *Quick Teacher Technology Survey* (see Appendix D; PowerUp What Works, n.d.). This survey was created by PowerUp What Works, a subdivision of the American Institutes for Research (AIR, 2019) funded by a government grant from the U.S. Department of Education, Office of Special Education Programs. The survey was accessed online by the researcher and was not modified. The survey was developed as a tool for technology leads to plan professional development as it elicits responses from educators with regards to their skills, needs, and attitudes of technology (Zorfass, 2014).

The researcher administered the *Quick Teacher Technology Survey* after the initial meeting and pre-observation. This survey took approximately 20 minutes for them to complete. The survey was completed in a private environment at the time of day that was convenient for each of the participants. Prior to the survey administration, the researcher explained the sections of the survey as well as reminded the participants that if they did not feel comfortable answering any questions, they could leave them blank. After the survey was complete, the researcher collected it and had time to review the responses off-site. The survey gave the researcher an indication of the teacher and ECE participants' background knowledge as well as attitudes and views surrounding technology. At the end of the study the post-survey was completed prior to the post-interview to allow the researcher to garner ideas of potential changes in the educators' surveys and address these in the interviews.

Interviews. There were two interviews for each participant: a pre-interview and a post-interview. The purpose of the interviews was to capture the knowledge, beliefs, thoughts, and attitudes of the teachers and ECEs. The pre-interview was part of Iteration 1, and took place prior to the co-planning meetings. The post-interview was part of Iteration 6, and therefore occurred after the last lesson observation.

Both pre- and post-interviews were completed separately, and involved the researcher and each participant one-on-one. These interviews were between 15 and 25 minutes long and were conducted in a private location at the time of day that was convenient for the participant. The interview questions were open ended to ensure that the participants were able to provide information as well as elaborate on their beliefs and attitudes towards technology and literacy. Prompts were used to move the interview along in a timely manner (see Appendix E for pre-interview prompts, and Appendix F for post-interview prompts). The interview allowed the participants to expand on their answers from the survey, and the researcher used guiding questions to clarify or further prompt the participants to elaborate on answers from the survey. The pre-interview also served as an initial needs' assessment for each participant, and therefore also focused on their current skills, challenges, and intentions of implementing technology into their classroom for reading instruction. The interviews were audio recorded by the researcher. Before the interviews began, the researcher reminded the participants that the interview was being audio recorded and answered any questions that they had regarding the recordings. The audio recording was kept on a locked recording device that only the researcher could access. After the interview, the recording was transcribed by the researcher in a private environment where only the researcher could hear the recording, and then the recording was deleted.

Fieldnotes. Fieldnotes were taken by the researcher on a laptop during two instances: co-planning/evaluative meetings and observation of lessons. All fieldnotes were formatted in the same manner: a chart with one column on the left titled "Observations" and the right column titled "Researcher Interpretations." This allowed for the researcher to document both objective and subjective observations. In total, there were 18 sets of fieldnotes.

Co-planning meetings. Based on the data collected in Iteration One, the researcher collaborated with the teacher and ECE to co-plan for their students' needs and took fieldnotes. This occurred during two 20 minute meetings before school started. During the first meeting, the researcher demonstrated the SMART Board and the SMART Notebook 18 program to the participants. The second meeting was for co-planning purposes where the teacher and ECE dyads separately co-planned lessons with the researcher to effectively implement technology to support the reading skills of the targeted students. This included discussing the areas in reading that the teacher and ECE decided on as foci for JK students and SK students.

Observations of lessons. During the implementation of the technology-enhanced lessons by the teacher or ECE, the researcher took fieldnotes using a laptop to document the delivery of the lesson, challenges incurred, and the perceived learning impact on the students. The researcher was as unobtrusive as possible to ensure that the students were not distracted by the presence of the researcher however, many technical problems arose that the educators were not yet equipped to deal with, so the researcher had to step in and assist. For example, during the lesson observations, the researcher sat to the side of the SMART Board to assist with any issues that arose for the first six lessons, and then as the teachers became more autonomous, the researcher took notes from a table behind the students who sat on the carpet in front of the SMART Board.

Data Analysis

Data analysis was employed using NVivo (n.d.) qualitative software. Data were analyzed using inductive analysis. According to Thomas (2006), "the primary purpose of the inductive approach is to allow research findings to emerge from the frequent, dominant, or significant themes inherent in raw data" (p. 238). In this study, the researcher uploaded the raw data (interviews and fieldnotes) into NVivo and used open-ended coding to create nodes (Johnson & Christensen, 2004). Axial coding was then used to create themes to illustrate the data set (Johnson & Christensen, 2004).

Surveys. The surveys were analyzed for their descriptive properties to elaborate on educators' attitudes, needs, and skills with technology-enhanced instruction. The descriptive properties were also compared between the pre-survey and the post-survey to garner any changes in attitudes, beliefs, or knowledge regarding technology that may have not arose in the interviews. This was accomplished through the researcher re-printing and marking up one survey for each participant using different coloured highlighters (yellow for pre- and green for post-surveys). This made it easier for the researcher to input the data by participant into a master chart using Microsoft Word. This chart had each statement from the survey down the left-hand column, followed by each participant's name and the pre- and post-survey columns. This chart with all participants' answers mapped, allowed the researcher to compare and evaluate answers within and across participants. The researcher then went through the chart and modified the text colour of changes as follows: positive changes (in green), negative changes (in red), neutral changes (in orange), anomalies (in blue), and no changes were left as black text. The researcher then analyzed and drew conclusions horizontally (across participants) and vertically (for individual participants). During this process, the researcher wrote down findings for each section including changes in participants' responses and responses that were similar across participants.

Interviews. The audio-recorded interviews were transcribed by the researcher in a private environment to ensure confidentiality. Interview transcriptions were then returned via email to each of the participants for member-checking and their requested revisions were made prior to data analysis. The researcher used open-ended coding to create nodes (Johnson & Christensen, 2004). When reading the interview transcripts, the researcher assigned nodes to the data by reading and re-reading the documents, highlighting the corresponding text, and assigning it to a node. As coding progressed, the researcher re-named codes accordingly as more data were added to them. The researcher also took handwritten notes of preliminary findings, or important nodes that arose. Axial coding was then used to create themes used to illustrate the data (Johnson & Christensen, 2004). For these thematic findings, representative direct quotations were extracted and cited using the participants' chosen pseudonym.

Fieldnotes. Typed fieldnotes from the co-planning meetings and observations of lessons were uploaded into NVivo software. The fieldnotes were formatted with two columns: one column on the left of what was observed objectively, and one column on the right of researcher interpretations. The researcher started analyzing the fieldnotes first, chronologically. The researcher used open-ended coding to create nodes (Johnson & Christensen, 2004). When reading the fieldnotes, the researcher assigned nodes to the data by reading and re-reading the documents, highlighting the corresponding text, and assigning it to a node. As coding progressed, the researcher re-named codes accordingly as more data were added to them. The researcher also took handwritten notes of preliminary findings, or important nodes that arose. Axial coding was then used to create themes used to illustrate the data (Johnson & Christensen, 2004).

Intervention Matrix

The first step in preliminary data analysis that the researcher took was to create an intervention matrix. This was completed after all data were collected, but before any other data were analyzed. The researcher created this matrix to map any potential relationships between the participants, lesson numbers, as well as the number of interventions. Two intervention categories (L1 and L2) were created by the researcher. A level one (L1) intervention was classified as an intervention in which the researcher assisted the educator during her lesson through a verbal cue. For example, "Jamie asks how to write words. I [researcher] say 'just pick up the pen and start writing'" (November 15, 2018). A simple explanation was sufficient in guiding Jamie towards the correct answer, thus, a verbal intervention was used, and was coded as a L1. A level two (L2) intervention was when the question or issue was too complicated to explain with words, and a demonstration was needed. For example, "She tries to make it full screen but accidentally clicks to the end of the video. … I [researcher] have to get up and help her with this part" (January 16, 2018). The researcher printed the fieldnotes and used pink highlighter for L1s and blue highlighter for L2s. These were searched for in the data by reading through the fieldnotes and looking for key words associated with each intervention. L1s were differentiated by the researcher's notes dictating "I said" or "I say," and L2s were differentiated by notes dictating "I showed" or "I got up." After beginning to code the interventions, the researcher realized that she needed to add in a category called "enhancements" (E). This was for instances when an intervention was not necessary, but the researcher interjected in order to extend the learning of the educator. All interventions were mapped into chart form (see Appendix G: Intervention Matrix).

Observing the completed matrix, the researcher looked for patterns, and no patterns were evident. The researcher then realized that the numbers might elicit something in relation to the DBR iterations. The researcher then mapped the preliminary findings onto the DBR interventions and this clustering of the 12 lessons garnered a different insight. The researcher also noticed once the chart was complete that during the study, one educator was absent (Jamie), which meant that her teaching partner (Riley) completed more lessons than the other educators, and Jamie completed fewer lessons. This meant that the raw tally score of how many interventions per lesson would not be an accurate way to analyze the data. To address this, the researcher averaged the number of interventions over the number of lessons, respective to each educator, after lessons 1-6 and 7-12. This provided a more detailed and accurate number to descriptively analyze the data. After all data were uploaded into NVivo software, the researcher and thesis supervisor had a data analysis meeting where they discussed the interventions matrix, the preliminary analysis, and the mapping number of interventions to participants per lesson.

Next, a table was created to summarize the barriers that the educators experienced during the implementation. These barriers were coded to simplify how they were represented in NVivo. To simplify the first level of coding, the researcher only coded all barriers to a "barriers" node, with no further distinction as the nature of the barrier. After this coding was complete in NVivo, the researcher created a chart in Microsoft Word to further categorize the barriers into external and internal barriers. The researcher opened the "barriers" node in NVivo and read through each node individually. The node was then copied and pasted into the Microsoft Word document as an external or internal barrier and then further subcategorized based on the nature of the barrier. Subcategories were created as the researcher progressed through the nodes. The researcher also noted the percentages of the total source coded to the node, as provided in NVivo. This gave the researcher a descriptive number detailing the percentage of each field note or transcript that had barriers coded in it. Some barriers did not fit with created categories, so they were put in a separate document and integrated at the end of the process. If they still did not fit into a category, they were labelled as outliers. Another chart was made with the label of the subcategorized nodes and the frequency of the data coded within to determine which nodes were most significant. Frequencies of more than 10 were considered their own theme due to the raw number of occurrences. Frequencies of less than 10 were collapsed and merged into other categories, however if they could not be merged, they were considered low-frequency outliers and were removed from the data chart.

The researcher conducted a similar process with the "attitude" node. The researcher opened the node in NVivo and copied and pasted the data into a Microsoft Word chart to group each node. Subcategories were created as the nodes were copied and pasted, merging new nodes with existing ones or creating a new one. A frequencies chart was also created to track the significance of each node coded under "attitude." Additionally, since the researcher was interested in a change, or lack of change, in attitude, the nodes were highlighted for pre- and post-interview attitudes. The researcher then noticed that confidence was a robust node, and went into that node to differentiate between confidence and lack of confidence. A second frequencies chart was made for this node to compare pre- and post-interview confidence, or lack thereof. This same process was also competed for other significant nodes (10+ coded to the node). After consulting with her thesis supervisor, three main themes emerged. Similar nodes were grouped, which created a new theme. The researcher then compiled the interview data with the survey data for the attitude node. Survey data for attitudes were added into the existing interview themes, or new themes were added.

The final step of the data analysis process was compiling all the themes as findings that were then mapped on to the research questions. The researcher created a chart of the research questions (left column), the emerging themes (middle column), and the evidence from the data that contributed to the finding (right column). This chart ensured that the findings were corroborated by the data. It was decided that the findings would be presented in Chapter 4 in order of the research questions.

The researcher chose representative quotes from fieldnotes and interviews to illustrate the themes within the findings. This was tracked in a chart composed of columns that noted the themes as well as the evidence in the data that contributed to that theme (quotes). Quotes from all data sources were included, thus providing robust illustrations of the themes. When choosing quotes to represent the data, the researcher looked at the chart that included all the quotes for the themes and chose them based on participant representation as well as the degree to which the quote illuminated the theme.

Ethical Review

This study was granted Ethics Clearance by both Brock University's Research Ethics Board (file # 17-216) and the school board's Research Ethics Review Committee. After the pilot study, modifications were made to the existing ethics files in accordance with the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (Government of Canada, 2017) as well as policies governed by Brock University and the participating school board.

CHAPTER FOUR: RESULTS

The purpose of the study was to conduct research on supporting Kindergarten educators in implementing technology into their reading lessons, in order to provide educators, researchers, practitioners, and stakeholders with the information needed to offer effective early years programming and close the gap between research and practice. Qualitative methods were employed in this study, using DBR as both a methodology and framework. Data collection included observations, interviews, and surveys. Participants included two female Kindergarten teachers and two female Kindergarten ECEs. Inductive content analysis (Thomas, 2006) was used to analyze the data. This chapter will reveal detailed results that emerged from the study by describing themes that emerged to address the three main research questions. The results will be presented sequentially in response to the three research questions in three main sections for this chapter.

In response to the first research question, it was found that Kindergarten educators can be supported through DBR to implement technology-enhanced reading instruction to enhance student reading development by diagnosing and anticipating educators' needs, differentiating support for educators, providing researcher self-determined problem solving, iterating professional learning cycles, and liaising with administration. To answer the second research question, it was documented that Kindergarten educators' attitudes, skills, and practices of technology-enhanced reading instruction changed in different ways including, for example, higher frustration levels with unreliable technology as well as increased confidence levels, increased skills, and a change in practice. The results for the third research question illuminated the barriers that Kindergarten educators face in the delivery of technology-enhanced reading instruction include the following external barriers: unreliable technology, administrative, behaviour management, lack of time, inadvertent incidents, physical set-up, lack of training, and technology's influence on student learning. Internal barriers that educators faced included their attitudes and their lack of technology related knowledge. It was also found that these barriers can be mitigated through a coach providing ongoing professional learning and support, educators engaging in collegial collaboration, and self-determined professional learning.

Research Question 1: Supporting Educators in Technology-Enhanced Reading Instruction

The first research question was: How can Kindergarten educators be supported through DBR to implement technology-enhanced reading instruction to support student reading development? The major finding of this research question was that the researcher used the role of a coach to support the educator participants. Through this role, the researcher supported the educators in multiple ways. Several methods emerged that were effective in supporting the educators, including diagnosing and anticipating educator needs, differentiating support for educators, providing researcher self-determined problem solving, iterative professional learning cycles, and liaising with administration. Each of these results are further described below.

Anticipating and Diagnosing Educator Needs

An initial and integral part of the researcher's support to educators included anticipating their needs. In multiple instances, the researcher made decisions that would benefit the educators by considering their professional learning, their roles as educators, and their prior knowledge. For example, the researcher noted:

> I emailed and suggested that instead of a co-planning meeting, we do an introduction lesson to the SMART Board given that three out of four teachers

> have never used a SMART Board before. I explained that it would be hard for them to co-plan lessons for the SMART Board with me when they haven't used one before. They all agreed and thought this was a great idea. (Fieldnote, October 24, 2018)

Here, the researcher was able to anticipate the needs of the educators in order to best support them with their professional learning. The researcher diagnosed the needs of the educators during the survey and interview and learned that three out of the four participants had never used a SMART Board before. The co-planning meeting was supposed to come next in the DBR cycle, however the researcher realized that since the majority of the educators had not used a SMART Board, that they would not be able to engage in co-planning since they were not aware of its capabilities. The researcher realized that this lesson to familiarize them with the technology was integral, so the educators could participate in the subsequent co-planning meeting. Consequently, the researcher anticipated the needs of the participants by offering a SMART Board lesson prior to the co-planning meeting.

Another example of anticipating the educators' needs occurred when lesson 4 was enacted 3 days before Winter Break. This timing was not optimal given the pending school holiday and the fact that the previous lesson that the educators completed was approximately 1 month before lesson 4. "[Riley and Scarlett] emailed prior to me being here today and said they want me to go over [setting up and making a lesson] with them again" (Fieldnote, December 19, 2018). "I have my laptop hooked up because they are feeling overwhelmed this time of year and it has been about one month since I've been here" (Fieldnotes, December 19, 2018). Additionally, based on this information, the researcher anticipated the educators' needs and set up the SMART Board for the educators for lesson 4 and used an existing lesson for K2. The lapse in time was due to extraneous factors, and the researcher did anticipate loss of their skills during this time since the educators did not have SMART Boards in their classrooms. She anticipated that the educators might have had difficulty setting up the SMART Board, therefore, the researcher used her professional judgment and provided the solution of scaffolding for the educators. Overall, the researcher was able to anticipate and diagnose educator requirements to provide them with coaching and support that best suited their professional learning needs.

Differentiation of Support for Educators

It was found that the educators responded positively to the differentiated nature of support that the researcher provided. As educators differentiate for their students, they appreciated the same differentiation when it came to their own professional learning. In this study, the educators were working through the same technology implementation steps together, so it was important for the researcher to validate their needs and wants, and differentiate accordingly. Differentiation was achieved through the researcher helping the educators one-on-one. The educators enacted their lessons in the morning which ended at first break; this was when the teachers (not ECEs) had a break for recess. During this time, the researcher often sat down with the teachers and answered any questions they had, as well as provided them with further instruction if required. These one-on-one meetings occurred naturally, and only if the participants requested this time. In total, there were seven impromptu meetings. Three of these meetings included the two educators together. It is important to note that most of these meetings included just the teachers because ECEs did not have the same breaks. However, when the ECEs wanted to meet, the researcher created a time that worked with their schedule.

> Riley told me that after their lesson that both her and Scarlett have breaks. … I said I could stay and help them make lessons. I walked them through step-by-step how to do a pre-made matching activity with SMART Lab Activities. Riley took extensive step-by-step notes and Scarlett followed along step-by-step on her laptop, which has the trial version of SMART Notebook. Afterwards, they had 10 minutes left, so I let Riley try to follow her notes and create a matching lesson using my laptop. (Fieldnote, December 19, 2018)
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> I go and check in with Riley to see if she needs help with the new SMART Notebook program on her laptop. She wants to try making a lesson. I show her how to get to the application (through start menu). I make a shortcut on her desktop so she can find it easier next time. She opens it up, and she follows the detailed notes she took last time. She wants to do a fill-in-the-blank [activity] so I explain it to her because this was not in the notes. She does well with this. (Fieldnote, January 16, 2019)

At the end of January, after the co-evaluative meeting, Christina demonstrated an interest in furthering her learning. The researcher suggested meeting one-on-one before school with her. The other educators were notified however they did not want to take part because they felt that they had just mastered the SMART Lab activities, and they did not want to overwhelm themselves with more and risk losing their progress. The researcher respected this, and set up a date that worked for Christina. The researcher also had Christina prepare a list of what she would like to do with the SMART Notebook program so that the lesson could be targeted to her needs.

> First, I show her [how] to open SMART Notebook. I show her the basic layout and where to find basic functions such as add a page or save the file. … She starts with the first one. I show her how to do that and explain what I'm doing as I do it. I also have her do it after I show her. She is loving everything we are doing and surprised at how easy it is. We get to the end of the list and there is still 10 minutes before duty so I give her time with the laptop and program to explore on her own. (Fieldnotes, January 24, 2019)

Riley and Jamie also demonstrated an interest in furthering their learning at the end of the study. The SMART Board was installed in the last week that the researcher was at the school collecting data.

> Since the SMART Board will be in their class by then, [Riley and Jamie] want me to help them both integrate it. Using it in the library and it actually having it in their classroom are such huge differences. I told them that this is a great idea. (Fieldnote, February 1, 2019)

Differentiation of researcher support was also evident throughout the lessons that the educators enacted. The support that each educator required was different, so the researcher had to adapt her coaching and assistance to best fit the educator. For example, during the scaffolding of lesson set-up and creation, by lesson 4 the educators were supposed to be setting the SMART Board up, however, some educators were not prepared for this and required the researcher's assistance for another lesson. The researcher helped K2 set up their lesson however for K1, the teacher set it up independently.

Differentiation that the researcher provided the educators varied and was adapted to their individual professional learning needs. Differentiation from the researcher on multiple levels allowed the researcher to meet each educator where they were at in order to enhance their practice using technology in reading lessons.

Iterative Nature of Professional Learning

The researcher also supported the participants in their professional learning by engaging them in the process of DBR. It was found that the participants perceived the iterative nature of the study, a foundational principle of DBR (DBRC, 2003; Wang & Hannafin, 2005), was beneficial to their professional learning. Participants identified in their post-interviews that they believed that repetitiveness of the professional learning cycles helped them solidify the knowledge and skills they were learning.

> With your guidance, and step-by-step instructions and I think the repetitiveness too… that continuous learning, and going to the SMART Board helped. I think, you know when you keep away from it for a while, then you kind of forget, cause you're not doing it every [day] but I think that repetitiveness helped. (Christina, Interview 2)
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> I think at the beginning … again it's me not wanting to push forward on my own, but needing somebody … all my lessons were exactly the same, up until the halfway mark there. I needed that [repetition] to figure out what was happening and then seeing that you know then you could open my mind up to other areas that I could move onto. (Scarlett, Interview 2)

Allowing enough time in each iteration for participants to become comfortable and elicit their learning was an important aspect of the research. Overall, the iterative nature of the DBR framework and method (DBRC, 2003) that was used in this study was perceived as beneficial to the participants in their professional learning when integrating technology into their reading instruction.

Researcher Self-Determined Problem Solving

Intervening to solve problems that arose was self-determined by the researcher. The researcher deemed it necessary to immediately address many problems that arose during the research. “I set up and explained guided access for all the iPads in both Kindergarten classrooms. I left notes on their desk on how to set it up, enable it, and disable it” (Fieldnote, October 24, 2018). This example was an immediate response to an issue that was identified during the pre-interviews. The participants revealed that they did not like using the iPads because the students knew how to navigate out of the app and would go on YouTube when the educators were busy and often would not notice. The researcher went into the classrooms and immediately addressed this issue by enabling a setting so that the educators could use the iPads with confidence that their students were remaining in the application that they intended them to be in. “The teachers were amazed by this and very thankful” (Fieldnote, October 24, 2018).

An additional example was that the SMART Board in the library, after being installed, did not have a computer hooked up to it, and therefore did not have SMART Notebook 18 program that the researcher needed to demonstrate how to use the SMART Board. Immediately, the researcher began looking for answers to solve the problem.

> We peek our heads in and sure enough, a computer is hooked up to his [another teacher’s SMART Board]. He asked if he could help us and I explained what the problem was. He came with me to the library. He went to see if he had a cable for the monitor as that was the only thing we were missing. When he got back he helped me figure out how to change inputs and he tried logging in. It came up with an error saying that there was no server to log onto. This is an issue that must be addressed by IT, I will have to email the principal. He went back to his class

> and returned with his laptop. We hooked it up and it worked! I told him I had a laptop that I could hook up so he didn't have to leave his there. We hooked up mine and it still worked. (Fieldnote, November 1, 2018)

This immediate problem solving allowed the researcher to complete the SMART Board lesson with the educators. Without this problem solving, the educators would have had to gather around a small laptop, and this would not have been conducive to their learning of the *SMART Notebook 18* program. Overall, the self-determined problem solving by the researcher allowed the study to continue with few issues, although many other problems arose that the researcher could not solve.

Liaising With Administration

Liaising with administration was also an aspect of support carried out by the researcher to assist the educators. The researcher realized that for some of the logistical problems that could not be solved on her own, she would need the help of the principal at the school. The researcher found that liaising with administration helped in solving certain problems that arose. For example:

> She [the principal] said that the issue is the monitor…because of the high resolution of the SMART Board, the old monitor is not compatible. She picked up the phone and called IT right away. She said either someone needed to deliver the monitor today or she would go pick it up. (Fieldnote, February 7, 2019)

In this instance, the principal went to pick up the new monitor and the researcher hooked it up since IT was not able to do so. This was a very quick solution to an issue that could have taken weeks to solve if the researcher and administration had not worked together. Another example of liaising with administration included on-site coordination:

> [The principal] said we will make sure that the book fair isn't an issue. She will either make sure the librarian knows to leave space at the SMART Board or she will confirm when the SMART Board installation is taking place in Riley and Jamie's classroom so that we can do our lessons in there [if there is no space in the library]. (Fieldnote, January 16, 2019)

In this example, the principal assured the researcher that there would not be any problems in enacting the SMART Board lessons. Furthermore, "[the principal] is so active in the school and supportive of my work. She knows it is important and is always asking me … if everything is going well or if she needs to do anything. It is such a nice atmosphere" (Fieldnote, December 19, 2018). Throughout the research, the principal was a source of enablement for the researcher, however there were also administrative barriers that will be discussed later in this chapter. Regardless, it was important that the researcher liaise and coordinate with administration to provide support for the participants in enacting technology-rich reading instruction.

Summary for Research Question 1 Results

Overall, in response to research question 1, it was found that multiple types of support provided by the researcher were able to assist Kindergarten educators attempting to enhance their practice through introducing technology into their reading lessons. These types of support included diagnosing and anticipating educator needs, differentiating support for educators, providing researcher self-determined problem solving, iterating professional learning cycles, and liaising with administration.

Research Question 2: Changes in Perceived Attitudes, Skills, and Practices

Research question 2 stated: What are Kindergarten educators perceptions of their attitudes, skills, and practices of technology-enhanced reading instruction at the beginning of a DBR professional learning project? Did the attitudes, skills, and practices change, and if so, how? In accordance with this research question, the researcher was interested in the Kindergarten educators perceptions of their attitudes, skills, and practices of technology-enhanced reading instruction at the beginning of the DBR professional learning project, and if any of the aforementioned perceptions changed and how they changed. Indeed, there were many changes that occurred, and these will be explained in detail within this subsection, in order of perceived attitudes, perceived skills, and educator practices.

Educator's Perceived Attitudes

Four distinct types of participant attitudes showed related changes from pre- to post-intervention. These included the perceptions of technology use on students and educators, affective responses to technology in the classroom, perceived growth in technological competency, and perceived systemic conditions for technology professional learning.

Perception of technology on students and educators: Pre-intervention. The perceived benefits of technology on students and educators were expressed during both the pre-interview and pre-survey (i.e., Fall 2018). Educators had numerous perceived attitudes regarding the effects of technology use on both students and educators.

Technology benefits students. Educators' responses in the pre-survey (PowerUp What Works, n.d.) indicated that they believed that technology benefited students in many ways including peer collaboration (all four educators) and student motivation (three out of four educators). Further, two participants (of the three that responded to this question) agreed that technology "helps create products that show a higher level of learning." Lastly, all four educators disagreed with the statement that technology creates more discipline problems. In the pre-interview, Jamie stated, "I think a SMART Board would be nice to implement it … to get kids up and using it and touching it, I think that would probably be the best for this classroom" (Jamie, Interview 1). The other three educators also elucidated that:

> Definitely a SMART Board—I would think that would benefit [students]. I've seen great learning with literacy and math at previous schools that I was at and even just with inquiry too. I think that the learning would be extended and I think that a lot more questions would come up and a lot more interest would come up with the kids and I'm just not finding that right now, currently. (Christina, Interview 1)
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> I think that [technology] helps them because they're learning without realizing that they're learning, they're having fun, as opposed to like a flash card, and doing it that way, which seems so archaic right? … It's not only going to help them with their literacy skills but their technology skills which I think are going to be equally important for this generation. (Riley, Interview 1)
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> Yeah I know I've been in a few classes that have [a SMART Board]. … It was great, the kids were moving things over and around, and I even see in the classrooms here … the movement, and Kindergarten they need that right? To get

> up, and get touching things … I just think that we'd be able to do a lot more fun activities, whole class that would engage the kids more. (Scarlett, Interview 1)

Overall, all four of the educators perceived that technology, especially the SMART Board, would be beneficial for students and their learning, especially in Kindergarten.

Technology does not benefit students. Even though the educators perceived that technology benefited students, they also perceived that it had drawbacks. Additionally, two educators (of the three that responded to this question) agreed that students visit inappropriate sites. In the interviews, one educator stated that she had concerns about technology replacing traditional skills: "when I see [students] with the one finger, it just …I just feel like we're taking three steps back instead of three steps forward" (Christina, Interview 1). Participants also perceived concerns about students going on apps such as YouTube: "when I see them go on games, and we turn our backs, and they're trying to get on YouTube, that kind of makes me nervous" (Christina, Interview 1); "like I said the iPads, sometimes they're just, I don't even know what they're doing on it" (Jamie, Interview 1); and "you kind of have to be watching them … or they're [going to] get onto … other apps like YouTube; … if I see them on something else and they're not supposed to I just take it, and they're off it for the day" (Scarlett, Interview 1). Lastly, the educators in K2 believed that students should not be on technology during exploration time: "I think there would be certain times that it would be best not so much [to] give [iPads] to them during exploration time because there are other things they need to be doing. Just like sitting there isn't good for them" (Jamie, Interview 1) and "during exploration time we want them exploring and doing other stuff, cause sometimes they'll just go and sit on them" (Riley, Interview 1).

Overall, pre-intervention, there was a more predominant perceived attitude that technology did not significantly benefit students; this was an attitude shared by all participants. Participants perceived attitudes as to how technology benefits students and educators differed pre-intervention.

Technology benefits educators. On the pre-intervention survey, it was also perceived that technology was beneficial for educators. Pre-intervention, all educators agreed that "technology is a good tool for collaboration with other teachers when building unit plans." Additionally, three out of four educators agreed that "technology has changed the way I teach." Lastly, all educators agreed that "most technology would improve my ability to teach." Overall, participants agreed that technology benefit them as educators.

In sum, pre-intervention, it was found that educators perceived that technology was beneficial for both students and educators, however, they did express concurrently that there were disadvantageous for students. Post-intervention interviews and surveys demonstrated some changes in these educators' attitudes.

Perception of technology on students and educators: Post-intervention. Post-intervention, participants perceptions of technology on students and educators sustained some changes, including decreases in two areas: technology does not benefit students and technology benefits educators.

Technology does not benefit students. This was an area of change for educators' perceived attitudes. In the post-interview, none of the educators perceived that technology was not beneficial for students. However, in the post-survey (i.e., Winter 2019), two educators responded differently than the pre-survey to the statement "there are more discipline problems"; specifically, the K2 educators, Jamie and Riley, changed their answers from "strongly disagree" and "disagree" (respectively) to "agree." Furthermore, Jamie and Riley of K2 allowed students to use the SMART Board during exploration time. Although they did not have this as an option before, they expressed the attitude pre-intervention that technology did not have a place during exploration. Riley stated that "I'd even let them, during our exploration time, pick two friends to go and use the [activities] … on the SMART Notebook" (Riley, Interview 2). This was a change in attitude that then affected their practice.

Technology benefits educators. Change occurred with educators' perceptions of how technology benefits them. One educator (Jamie) disagreed with the statement "most technology would improve my ability to teach." Change also occurred for both Jamie and Christina for the statement "technology has changed the way I teach"; Jamie's answer changed from "agree" to "disagree," and Christina's answer changed from "disagree" to "agree." Interestingly, in the pre-interview, none of educators mentioned anything about what they perceived were the benefits of technology, however in the post-interview and post-survey, two educators, Christina and Riley definitively expressed this shift in attitude. Christina stated that "there are many advantages of having technology in the classroom, which can assist in our daily planning and co-planning, which can assist with a big part of our challenges we face day to day" (Christina, Survey 2, February 11, 2019). Then, Riley stated that:

> I really do feel like it will take our teaching to a different level than before we had it … I just think it brings us to like, 2019 … so I think It's a really positive, positive change and I can see it just becoming part of our daily routine and

> instruction. I just think it's really user friendly to use, that program, for a teacher to put it together, and then for a teacher to use. (Riley, Interview 2)

Overall, it was found that post-intervention participants believed more strongly that technology benefits them as educators; however, post-survey changes with regards to technology benefitting their students was inconclusive.

Affective response to technology in the classroom: Pre-intervention. Pre-intervention affective responses to technology in the classroom included a perceived lack of confidence and frustration with respect to the reliability of technology.

Lack of confidence. Pre-intervention, all of the educators expressed a perceived lack of confidence in their technological abilities. Riley explained "I think it would be overwhelming to do it [the SMART Board] by yourself. I think it would take a lot longer to get to know the full use of it" (Riley, Interview 1). Jamie stated that "I said you [students] turn them [iPads] on and you figure them out … you don't know any more than I know on them" (Jamie, Interview 1). During an observation, "Scarlett then says 'you're [the researcher] probably kicking yourself for coming to this school … all four of us [the participants] are so technologically illiterate'" (Fieldnote, January 16, 2019). As well, Scarlett explained that: "I am a little bit apprehensive, like I think technology is great, I'm just not, well versed in it, so it frightens me a little bit … [SMART Boards] really make me nervous" (Scarlett, Interview 1). Overall, three out of four educators demonstrated a perceived lack of confidence regarding technological practices in their pre-interviews.

Frustration. Pre-intervention, it was found that participants perceived that technology was unreliable. Three out of four educators agreed with pre-survey statement that "technology is unreliable."

Affective response to technology in the classroom: Post-intervention. Participants' perceived affective responses to technology in the classroom changed post-intervention from a lack of confidence to confidence. Surprisingly, post-intervention there was an increase in frustration levels with regards to unreliable technology.

Confidence. There was a positive change in perceived confidence post-intervention. The participants stated that: "Uhm, I wasn't, no, at all. Now I feel that I am pretty confident" (Jamie, Interview 2); "I'm much more confident than I was first interview" (Scarlett, Interview 2); "Yes I felt like I was confident, uhm, yeah I didn't feel like I was nervous in any way, or uncomfortable" (Christina, Interview 2); "so now, yes I do feel confident using [the SMART Lab activities]" (Riley, Interview 2).

Overall, the educators perceived an increase in their confidence post-intervention in implementing technology in the classroom. These types of self-assured comments were only heard in the post-interviews, where there were also fewer references to lack of confidence by participants compared to their pre-interview comments.

Frustration. There was more frustration post-intervention expressed by the participants with regards to unreliable technology. Two educators indicated a change in their response to the statement that "technology is unreliable" in the post-survey. Riley now "strongly agreed" that technology was unreliable and Scarlett "agreed" that technology was unreliable. These views were also brought up by educators in their interviews.

I think just those little glitches that, with the computer … and those days we couldn't get on because of signing in … and I just feel that if we only had one password in regards to everything. … I just think there's too much to remember. It's a lot … for us. I have to write things down to remember all these passwords and things so I think that having one would be a lot easier and more helpful. (Christina, Interview 2)

Yeah, just, like the computer screen not [working] … like still having issues with getting the technology up and going. Even the times that we came down to the library and … if you hadn't have been there to help us troubleshoot it and get it up on the screen, we would have just walked away and left. (Riley, Interview 2)

I think because our projector had so many cords that me and [Riley] were so fed up with it that we didn't even attempt to do anything with it … I couldn't even find my Chromebook charge cord half the time … so that was frustrating. (Jamie, Interview 2)

The sources of frustration for the participants were from what they believed to be the lack of reliability of the technology. Three out of the four educators explicitly noted these frustrations in their interviews. It is interesting to note that these frustrations stem from activities that relate to initial set-up of technology. These frustrations could not have been expressed or anticipated at the time of pre-intervention due to lack of technology and thus, participants' perceived frustration levels increased post-intervention.

Perceived growth in technological competency: pre-intervention. In the pre-survey, participants evaluated their technological competency as "weak" to "adequate."

On the statement "learning how to use new applications (e.g., software and programs)," two participants ranked themselves as "adequate" (Riley and Christina) and two participants ranked themselves as "weak" (Jamie and Scarlett). On the statement "troubleshooting problems that occur when using technology," Riley, Jamie, and Scarlett ranked themselves as "weak," and Christina ranked herself as "adequate." On the pre-survey statement "integrating technology into my daily instruction," Riley, Jamie, and Christina ranked themselves as "adequate," and Scarlett ranked herself as "weak." Lastly, participants ranked the statement "using technology to differentiate instruction" as "adequate" (Riley and Christina) or "weak" (Jamie and Scarlett). Pre-intervention, participants perceived themselves as "weak" to "adequate" in their technological competency based on ranking four skills that relate to the integration of technology in their practices.

Perceived growth in technological competency: post-intervention. Participants expressed attitudes of perceived growth in their own technological competency post-intervention. The participants articulated their perceived improvement during the post-survey and post-interview. In the post-survey, Jamie and Scarlett perceived their growth on "learning how to use new applications" as "adequate" compared to "weak" in the pre-survey. Scarlett and Christina perceived changes post-survey on the statement "troubleshooting problems that occur when using technology"; Scarlett felt "adequate" (compared to "weak" pre-survey) and Christina felt "weak" (compared to "adequate" pre-survey). On the post-survey statement "integrating technology into my daily instruction," Riley perceived improvement from "adequate" to "strong" and Scarlett perceived improvement from "weak" to "adequate." Lastly, on the statement "using technology to differentiate instruction," Riley perceived improvement from "adequate" to "strong" and Jamie and Scarlett perceived improvement from "weak" to "adequate."

Evidently, post-intervention, three participants still perceived themselves as "weak" to "adequate," but one participant perceived herself as "strong" in technological competency. Two participants also revealed their perceived growth in technological competency during the post-interviews. Christina stated that "we've come so far, yes we have!" (Christina, Interview 2). Additionally, the researcher stated "you've learned a lot, give yourself credit" to which Scarlett replied "I feel like I have, but again … technology is still…" (Scarlett, Interview 2). These statements illuminate the perceived growth in Christina and Scarlett, while concurrently highlighting the hesitancy that Scarlett still felt after the intervention, despite the growth that she did experience.

Nine positive changes occurred (perceived competency increased), and three negative changes occurred (perceived competency decreased) for all four participants. Specifically, Riley and Jamie perceived two positive changes, Scarlett perceived four positive changes and Christina perceived one negative change.

Perceived systemic conditions for technology: pre-intervention. The participants' perceptions of the systemic conditions for their technological professional learning were indicated on their pre-surveys and in their pre-interviews. On the pre-survey, participants ranked statements on a scale of 1 to 5; 1 meant "not urgent" and 5 meant "urgent." Three systemic areas arose as urgent needs for the participants: more support, more training, and more time.

Support. Educators perceived that they require "more support from administration when it comes to my technology needs" (PowerUp What Works, n.d.) Riley ranked this pre-intervention statement a 4, Jamie ranked this a 5, and Scarlett and Christina ranked this statement a 3. Additionally, participants ranked “more technical support to keep computers and applications running” , a 5 (Riley and Jamie), a 4 (Christina), and a 3 (Scarlett). In the pre-interviews, Jamie and Riley also noted the issue of perceived lack of attention from administration. Jamie stated that “we’re over here in the corner … we’re far in the corner” with regards to being the last two classrooms in the school to receive a SMART Board (both Kindergarten classes). Additionally, Riley stated that “Everyone else has got things, and this is what they’ve given us. … With our new principal … she gets it better … whereas other principals, we’re at the bottom of the when it comes to technology” (Riley, Interview 1). These comments illuminate that the participants perceived a need for increased administration support to implement technology into their classroom practices.

Training. Prior to the intervention, the participants perceived it as urgent that they receive training with regards to technology. Riley, Jamie, and Christina ranked “more training to use technology” and “more options for PD in areas of technology” as a 5, and Scarlett ranked them a 4. The statement “help aligning the integration of technology with the implementation of curriculum expectations” was ranked a 5 by Riley and Christina, a 4 by Jamie, and a 3 by Scarlett. Additionally, participants ranked the statement “school systems expect us to learn new technologies without formal training” as “strongly agree” (Riley, Jamie, and Scarlett) and “agree” (Christina). On the pre-survey, Christina also stated that “I feel more training is needed to assist educators to expose children to modern tools and resources, enabling them to develop skills that they will need for their future”

(Christina, Survey 1). It was apparent that the participants' pre-intervention perceptions were that they required more training for technology implementation.

Time. With regards to time, there were three statements that participants ranked to indicate their perceived need for more time to implement technology. Participants ranked "more time to use applications" as a 5 (Riley, Jamie, and Christina) and as 4 (Scarlett). Participants ranked "more time to integrate technology into my curriculum" as a 5 (Riley and Christina) and a 3 (Jamie and Scarlett). Participants ranked "more opportunities to collaborate with colleagues on how to use technology" as a 5 (Christina), 4 (Riley and Jamie), and a 3 (Scarlett). Participants agreed (Riley and Christina) or "strongly agreed" (Jamie and Scarlett) with the statement "there is too much technological change coming too fast without enough support for teachers." These results demonstrate that participants perceived it as urgent that they require more time to be able to use technology in their practices.

Perceived systemic conditions for technology: Post-intervention. Changes occurred in the participants' perceived systemic conditions for technology professional learning post-intervention in the three areas of support, training, and time.

Support. Post-survey, when asked about the amount of support that they believed that they needed to receive, Christina ranked "more support from administration when it comes to my technology needs" a 5 (compared to a 3 pre-survey). This demonstrates a notable increase in her perception of a need for support after she has had the intervention from the DBR study. Additionally, Christina ranked "more technical support to keep computers and applications running" at a 5 post-survey (compared to a 4). Christina perceived a change in amount of support she required to implement technology, now, she saw the urgency of this kind of assistance as more urgent post-survey compared to her pre-survey responses.

Training. Post-survey, Jamie and Scarlett reported that they did not have the same urgency for “more options for PD in the areas of technology” as their self-reported scores shifted from a 5 to a 4, and a 4 to a 3, respectively. Jamie also expressed less urgency for “help aligning the integration of technology with the implementation of curriculum expectations” as her scores moved from a 4 to a 3. Post-interview, Scarlett stated that “I think even when they add a SMART Board to your class, they shouldn’t just be throwing [it] in there [and] say ‘see ya’… there should be a mandatory training … if they’re [going to] spend that kind of money on something” (Scarlett, Interview 2). Despite the decrease in perceived urgencies for training, educators still perceived it as critical post-intervention that they require more training when implementing technology into the classroom.

Time. Post-survey, Jamie ranked “more time to use applications” as a 4 (instead of a 5 pre-survey). Additionally, Jamie ranked the statement of “more opportunities to collaborate with colleagues on how to use technology” with a 3 (compared to a 4 pre-survey) and Christina ranked this statement a 2 (compared to a 3 pre-survey). Jamie responded to the statement “there is too much technological change coming too fast without enough support for teachers” as “strongly agree” (compared to “agree” in the pre-survey). These results demonstrate that even though there were three positive changes in rankings (i.e., rankings decreased), and one negative change (i.e.. ranking increased), on the post-survey participants still perceived that it was important that they receive more time to implement new technologies.

Largely, participants' perceived attitudes changed from pre-intervention to post-intervention. Educators perceived that technology benefits students and educators, while simultaneously perceiving that there were some drawbacks to technology for students. With regards to affective responses to technology in the classroom, participants also experienced changed perceptions including increased confidence yet increased frustration levels with unreliable technology. It was also found that participants expressed perceived growth in their own technological competency post-intervention. Lastly, participants perceived that there were systemic conditions for technology professional learning: more support, training, and time.

Educators' Skills

It was clear that participants' technology skills underwent change during the course of this research. Pre-intervention, three of the four educators had never used a SMART Board before. The instructional and co-planning meetings provided participants with basic knowledge of the SMART Board and the SMART Notebook Program, as well as SMART Learning Suite Online.

Educators' skills: Lessons 1 to 6. In lessons 1 to 6, participants experienced difficulties with the hardware and software of the SMART Board, as they were still learning how to use them. For example, in lesson 3, "I guide [Christina] on turning on the SMART Board and playing the video on YouTube …[during the lesson] the start menu pops up but she doesn't even notice, I click off of it" (Fieldnote, November 23, 2018). Also in lesson 3, "I walk [Jamie] through how to turn on the SMART Board, find the Google Chrome app, search YouTube and get the video going" (Fieldnote, November 23, 2018). In lesson 6, "[the student] accidentally clicks the pencil feature and it freezes the screen. … Riley doesn't know how to get out of it. I get up and show her to press the green 'x' at the top right of the screen" (Fieldnote, January 21, 2019). Lastly, in lesson 6, "Scarlett's lesson is on SMART Learning Suite Online. She navigates to the website and signs in. Her lesson isn't there. I check on her laptop and she used a different email to log in" (Fieldnote, January 21, 2019). These were instances where the participants required help learning how to operate the SMART Board and its software during a lesson. Impromptu help and troubleshooting from the researcher were required for the participants to learn how to deal with issues that arose during their lessons.

Educators' skills: Lessons 7 to 12. In lessons 7 to 12, participants were more apt to demonstrate the skills they had learned. For example, when using the SMART Board software and a menu popped up or new tabs were opened accidentally, the participants were able to adeptly navigate back to the lesson without support from the researcher. On average, the researcher intervened in the lessons fewer times with regards to support or troubleshooting help.

Technological skill increase. Throughout the lessons, the participants increased in their skills related to operating and enacting lessons using the SMART Board and the SMART Lab activities. By lesson 6, all educators were creating their own SMART Notebook lessons, and by lessons 10-12, all educators were using skills that they learned through the course of the research in their lessons. For example, in lesson 12, "[Riley] starts [the video] and the noise is too loud. She adeptly moves over to the other side of the SMART Board to turn [down] the sound" (Fieldnote, February 1, 2019);

> …as Riley leans to help him, she clicks something with her hand and the screen toggles to the home page of the SMART Board. … She looks back at the board

> and examines it. She clicks the shortcut to Smart Learning Suite Online and the lesson comes back up! (Fieldnote, February 1, 2019)

Also during lesson 12, "[Jamie] says 'oops you can't put your hand on it like that.' She closes the new tab [that the student opened]" (Fieldnote, February 1, 2019). Furthermore, "during the break, Jamie told me that she tried a new [activity] again today, a game show one using a Dr. Seuss book the students love" (Fieldnote, January 25, 2019). Scarlett demonstrated the skills she learned during lesson 12 when "a student jumps to try and get a high letter and [it] goes back to the SMART Board home page, [Scarlett] looks confused again and then clicks onto the shortcut and gets back to the lesson" (Fieldnote, February 1, 2019). Additionally, for lesson 10, "[Scarlett] would have had to download the pictures and upload them…this is a great demonstration of learning" (Fieldnote, January 25, 2019). "[Christina] turns on the smartboard and plugs in her Chromebook … she adeptly navigates to HDMI 1 (Fieldnote, February 1, 2019). Additionally, "Christina says 'I don't know if you noticed but I changed the eagle and ant on Jamie's matching activity to an egg and an apple. … She said that they were calling the ant a bug. She said she went in and changed it, and it was easy to do" (Fieldnote, February 1, 2019). All of these examples demonstrate skills that the participants did not have at the beginning of the study; they learned these over the course of the research, and implemented them into their lessons.

Reduction of interventions during lessons. Throughout the lessons, the researcher observed that the participants experienced changes in the amount and type of interventions they required. The interventions were classified as level one (L1) if the researcher verbally explained, or a level two (L2) if the researcher needed to demonstrate or show the participants how to fix or do something. It was found that Riley, Scarlett, and Christina increased in the number of L1 interventions they required and decreased in the number of L2 interventions they required by the end of the research. Jamie decreased in both L1 and L2 interventions. The average number of interventions for each participant for lessons 1 to 6 and 7 to 12 are as follows: Riley's L1 interventions increased from 1.25 to 1.66, and L2 interventions decreased from 2.25 to 0.66; Jamie's L1 interventions decreased from 2.5 to 1.33, and L2 interventions decreased from 2.5 to 0.33; Scarlett's L1 interventions increased from 1 to 2, and L2 interventions decreased from 1 to 0; Christina's L1 interventions increased from 1.33 to 2.33, and L2 interventions decreased from 3 to 1.66. These changes are also represented in chart form, which can be found in Appendix G.

Although there were skill increases from the beginning of the intervention, as well as a decrease in interventions during the lessons, the participants still required troubleshooting support in lessons 7 to 12, and were not completely independent in enacting SMART Board lessons.

Educators' Practices and Future Applications

This chapter has documented how the participants underwent a change in their practices through the duration of this study. The following results describe the participants' transfer of practice as a function of the DBR intervention facilitated by the researcher. The participants also illuminated future applications for the skills and knowledge they gained during the research such as furthering their learning and application of skills and knowledge.

Transfer of practice. There is evidence that the participants' pedagogy experienced a moderate shift from a traditional delivery mode to a technologically enhanced delivery mode. The researcher perceived this as an enactment of TPACK (Mishra & Koehler, 2006) in practice. The educators began this study, with regards to SMART Board technology, with PCK. When the researcher introduced, trained, and supported the participants with the SMART Board, she noticed a change in practice aligning with TPACK: the participants seamlessly integrated PCK with T (technology) without direct or explicit instruction from the researcher. The participants adapted their instruction to align with using the SMART Board, as well as the SMART Board functions to align with their instruction. For example, "the words disappear pretty quickly [in this activity] so Scarlett has to keep saying [them so the students can match them]… this takes a lot of scaffolding from Scarlett but she is…staying patient and explaining" (Fieldnote, January 24, 2019). Additionally, "[Christina has modified [the game] to have only 10 cards [instead of 20] (Fieldnote, January 24, 2019). Examples of changes in Riley and Jamie's practice include:

> [Riley] is asking them first to answer [the question], and then when they know they can go up, find it, and match it … this is a good way to make sure they at least know part of the question and reduce wait-time at the board. (Fieldnote, February 1, 2019)
>
> …the first student goes up and [Jamie] says start with a picture, he goes to pick the letter and she says "wait what does elephant start with?" She is really getting them to slow down and identify the letter and sound … this is great pedagogy with technology. Students go so fast with technology so it is really good

> to slow them down. They get so excited they go too fast. (Fieldnote, February 1, 2019)

The participants were able to transfer their pedagogies and instruction from traditional methods to SMART Board enabled methods without any direction or training. This demonstrates the transfer of practice from PCK to TPACK (Mishra & Koehler, 2006).

Educators' future applications. Post-intervention the participants demonstrated extensions of the knowledge and skills that they gained during the study. Two participants stated that they wanted to further their learning in technology in the classroom. Two participants also intended to transfer their skills and knowledge to their colleagues.

Furthering their learning. Post intervention, two educators expressed interest in furthering their learning as a result of the current research. Riley elucidates:

> I'd like to get to the point where we could, at our exploration time, if the kids take videos, or explaining things they do, incorporating technology into that, so almost like their own learning portfolio but them being able to show up on the SMART Board and talk to the [class] about what they did and what they're doing … that's one of my goals, to incorporate it into their exploration time and what they're doing and getting their work up there for them to then present and share with the class. (Riley, Interview 2)

Additionally, Christina elaborated on her post-survey that "This additional tech learning experience has wanted me to further my knowledge and has wanted me to go above and beyond my comfort zone, pushing me to want to learn more, make mistakes, and ask more questions" (Christina, Survey 2). These two participants demonstrated that the current research provided them with the opportunity to be able to grow their knowledge and skill set to be able to manipulate how they want to use technology in the classroom, and ultimately, to further their journey in professional learning.

Collegial transfer of skills and knowledge. In the post-interview, two educators indicated that they would be able to share the skills and knowledge they have learned through the course of the research with other teachers. This intention suggests that they had new-found confidence and perceived that they could transfer their knowledge as an extension of their learning in this professional learning project. Scarlett stated that “I would definitely be able to show someone what we’ve done and maybe it would help them” (Scarlett, Interview 2). Riley explained that:

> I’ve had some teachers walk in and they’re like “what is that?” and I’ve told them and they’re like “wow,” they don’t know about it so yeah I’ve told them, “it’s really easy, you go on this SMART Notebook and you can make these [activities], just put in your information.” (Riley, Interview 2)

It was found that for two of the educator participants, there was an intention to transfer knowledge or skills to colleagues as a result of this study.

Summary for Research Question 2 Results

There were four distinct attitudinal perceptions of the participants. First, pre-intervention, participants perceived technology as beneficial for students and educators, while simultaneously perceiving that technology did not always benefit students. However, post-intervention, participants only perceived that technology was still beneficial for students and educators. Participants also had affective responses to technology in their classrooms; pre-intervention, participants experienced a lack of confidence with technology as well as frustration with unreliable technology. However, post-intervention, educators experienced increased confidence in implementing technology but also increased frustration with unreliable technology. Participants also experienced changes in their perceived growth in technological competency. Pre-intervention, participants perceived themselves as weak to adequate in their technological competency. Post-intervention, more positive changes in their perceived technological competency were evident; however, they still perceived their competency as weak to adequate, overall. Lastly, participants perceived three systemic conditions for technological professional learning including more: support, training, and time to learn about and integrate technology into their pedagogies.

Participants also increased in their skills and knowledge in operating a SMART Board and enacting lessons. During the first six lessons, impromptu help and troubleshooting were required for the participants to learn how to deal with issues that arose during their lessons. During lessons 7 to 12, the participants demonstrated the skills they had learned by independently creating lessons, as well as troubleshooting some issues on their own that they were not able to do at the beginning of the study. Although their skills and knowledge increased, the participants still required some troubleshooting support in lessons 7 to 12. Furthermore, it was also found that the number and type of interventions that the researcher provided the participants with during the lessons changed: three participants experienced a decrease in L2 interventions and increase in L2 interventions, while one participant experienced a decrease in both types of interventions. This demonstrates a positive change in the amount and type of help that the participants required during the lessons.

Lastly, it was found that participants demonstrated a change in several aspects of their practice. Participants were able to transfer their pedagogies and instruction from traditional methods to technology-enhanced methods without any additional training or support. This demonstrates the transfer of practice from PCK to TPACK (Mishra & Koehler, 2006). Additionally, two participants demonstrated a will to further their technological professional development as a result of their participation, and two educators stated that they have, or would, teach what they have learned to colleagues, demonstrating a transfer of knowledge or skills. Overall, the attitudes, skills, and practices of participants in this research underwent change, however, they faced many barriers that influenced their experience with technology-enhanced instruction.

Research Question 3: How to Mitigate Barriers in Technology Implementation

This section will describe a series of technology implementation barriers as results for research question 3: What barriers do Kindergarten educators face in the delivery of technology-enhanced reading instruction? How can these barriers be mitigated by using the instructional resources and strategies available to them? In this research, barriers are defined as internal or external, and impactful on educators' ability to implement technology into their practice. External barriers are those that are not associated with an individual educator, whereas internal barriers are innate to an individual educator. Overall, there were more external barriers than internal barriers. It should be noted that some of these barriers have also been previously outlined as systemic conditions for technology professional learning in the results section above for research question 2.

External Barriers

The external barriers that the participants reported in this study include: unreliable technology, administrative, lack of time, inadvertent incidents, physical, and technology's influence on student learning. Barriers are presented in order of significance, determined by the most frequently mentioned barriers first, as found through data analysis.

Unreliable technology. The most significant external barrier that the educators encountered was related to the unreliability of technology. Numerous times during the SMART Board lessons, the technology did not work. For example, "the first student comes up and the feature we need to work (word spinning) doesn't work online" (Fieldnote, December 19, 2018). The educators were very aware of these kinds of glitches and cited them as such in the co-planning meeting or post-interviews. During the co-planning meeting, Christina stated that "[she] didn't realize how many issues could go wrong when they started" (Fieldnote, January 22, 2019), referring to websites or the software not working, or issues logging in. During the interviews, Christina also stated "I think just those little glitches … with the computer … that we had and working our way through them" (Christina, Interview 2) and Jamie stated that:

> it was kind of frustrating that there was something was always not fully working, like there was either a cord missing, or my Chromebook didn't work…all these different little things, I think that was probably a barrier because things like that I kind of get, like…frazzled with. (Jamie, Interview 2)

Riley explained in her post-interview that:

> so that part is tough when the technology isn't reliable and consistent. …I don't have a tech background so I need it to be up and working, cause every little

> problem, I don't know what to do and then we would end up not using it. (Riley, Interview 2)

The lack of reliability of technology was one of the most significant barriers when educators were attempting to implement technology into their reading instruction.

Administrative. Administrative barriers in the implementation of this research were either barriers created by school board infrastructure or the principal at the school. The principal, although very supportive, was not fully cognizant of all the technological details that needed to be in place to facilitate the professional learning project in a timely manner. The following are excerpts from the researcher's fieldnotes related to the principal's administrative decisions:

> [Principal] doesn't seem convinced of some of the barriers. Ironically, this is a barrier in itself. (Fieldnote, February 1, 2019)
>
> …a SMART Board came (supposed to be for K2) but [Principal] felt that the grade 8 class needed it more. She knows that [the Kindergarten] teachers need it, and it would have been so amazing to get this in while I was here. (Fieldnote, January 16, 2019)
>
> I go to tell [principal] that the computer won't let the teachers log on, she is on the phone with IT already. I ask him why and he says that it may have been taken off the domain, it needs to be put back on. [Principal] said that makes sense because it was sitting around for months. He said he has someone coming out to the school on Wednesday, he will add it to the ticket. I brought this issue up [one month] ago, it could have been fixed by now. (Fieldnote, February 7, 2019)

In addition, there were administrative barriers that were reflective of the school board's infrastructure and procedures related to technology. For example,

> This school board has three emails for their teachers. They don't know when to use what to log into what. It is very frustrating. This is one of the barriers. If I wasn't here, they wouldn't have been able to do their lesson because they don't have a laptop to hook up to the SMART Board. (Fieldnote, January 21, 2019)

This affected all the educators, as during at least one point in the study each participant had this problem, and one educator explained this barrier in her interview:

> Those days we couldn't get on because of signing in and I just feel that if we only had one [email] in regards to everything, you know if there was only one…to remember and sign in with. …Either long version of [school board name] or short version, initials, this, that. (Christina, Interview 2)

Other barriers related to decisions made at the school board level included a lack of hardware or software in classrooms.

> I don't think that we use them to the full extent that we could…with the iPads, just not having a ton of programs on them and I think there's probably so much more out there that if we had free access to put what we wanted on them, we could use them better, and then obviously a Smart Board, I would love to get a SMART Board because I think there's so much we can do with that. (Riley, Interview 1)

> When I go to turn on the smartboard…I realize quickly that it is not hooked up to a computer, so it does not have SMART Notebook 18 on it. I search around for a few minutes but could not find anything so instead of wasting time, I

> suggest to Scarlett and ECE that we just look off of my laptop. (Fieldnote, November 1, 2018)

Even when the SMART Board was installed in the one classroom, there were still barriers. Jamie stated in her post-interview that "[the SMART Board] is blocking our plug so that's kind of a problem. …Now they're telling us that it's not to [electrical] code, that it's blocking the [electrical box]…they're saying that that's not allowed" (Jamie, Interview 2).

The administrative barriers were significant and vast within the scope of this research. These issues that arose during this DBR study contributed to a delay in the educators' professional learning activities and implementation.

Lack of time. The participants identified throughout the course of the research intervention that lack of time to plan and prepare to implement technology-enhanced lessons was a barrier that they continuously experienced. In both pre- and post-interviews, the participants elucidated that they did not have enough time to collaborate with their teaching partner to create technology-enhanced lessons. It was more of a barrier for the ECEs because they do not receive planning time or breaks at the same time as their teaching partners. For example, "Yeah we don't have the same breaks and then she goes on prep and…we don't get prep" (Jamie, Interview 1) and "I just think there's a lack of time for planning and to move forward with things" (Christina, Interview 1). Scarlett also identified that there was not enough time for training related to technology-enhanced lessons:

> I'd say "oh I need my prep, I have to do this on my prep" but if they say [digital coach] is coming in for the morning, make yourself available, like she's [going to]

come in the classroom, she'll show you some things, then it's done. (Scarlett, Interview 2)

During the post-interviews, the ECEs stated "oh I think it was time, we didn't have enough time" (Jamie, Interview 2) and that "there's a lot of expectations on us and I just feel that it's very unfair…because we don't have the time" (Christina, Interview 2). It was found that the lack of time for planning and collaborating with each other, as well as the lack of time for training, were barriers for the three of the four participants in this study.

Inadvertent incidents. Technological accidents that happened during SMART Board lessons were coded as inadvertent incidents. For example, this often happened when the interactive screen of the SMART Board was touched either by a student or an educator, and this was not meant to be touched. At the beginning of the study, educators did not know how to respond to these incidents, and this became a barrier because it was an interruption to the lesson. For example, "the student tries to click one on the top row, and can't reach it as Riley leans to help him, she clicks something with her hand and the screen toggles to the home page of the SMART Board" (Fieldnote, February 1, 2019). Additionally, "a student comes up and somehow exits the whole thing …I think it was because there was more than one finger touching it" (Fieldnote, January 24, 2019). At times, educator initiated incidents occurred as well: "Christina is trying to hold the board down [so students can reach it] and she keeps touching things with her fingers by accident" (Fieldnote, January 16, 2019) and "she was going to review the words but accidentally presses the back button with her hand" (Fieldnote, February 1, 2019).

Additionally,

> She's writing and her scarf taps the bottom of the screen [and] it makes a line. She says "I don't know how I did that" I explained what happened and she says "okay so I just press undo?" And goes to the restart button on the game. I say "no that's the restart button" and I show her how to undo. She presses it too many times and undoes words she wrote. (Fieldnote, November 23, 2018)

From these examples, it can be seen that inadvertent incidents were barriers for the educators because when these incidents occurred, they were unable to independently deal with them, which interfered with the enactment of their lessons.

Physical. A significant physical barrier that arose in this study was that the SMART Board was installed too high for the Kindergarten students to reach. In the library, the researcher noted on the first lesson that "it [SMART Board] is not low enough for K students. It is on a 15-inch track but it doesn't stay [down]. This means that [the educators have] to hold it" (Fieldnote, November 15, 2018). Additionally, "a student asks her to bring the SMART Board down more and she [the teacher] says 'I can't!'" (Fieldnote, February 1, 2019) and "she has to help them because it is too high for them to reach" (Fieldnote, January 21, 2019). Christina noted in the co-planning meeting that a challenge she encountered was "realizing when you're creating a lesson for the [JKs] not to make the content too high" (Fieldnote, January 22, 2019). Even after the SMART Board was installed in K2, Jamie indicated during her second interview that they are still encountering physical barriers:

> Now [the board is] telling us that it has to get moved up, but we tried telling them … we don't want it higher because the kids need to touch it. But they don't see

> that from our point of view, so they were like "well they can still reach it" and [I said] "well no, they need to reach the whole thing" yeah so they had me bring up one of the smallest kids and make them touch to see how far and … if they move it up to where they say it needs to go, some of the kids can only touch halfway. So that doesn't make it independent for them, that we'd have to stand there or get a stool or something so that's kind of a problem. (Jamie, Interview 2)

Physical barriers interfered with the students' ability to use the SMART Board autonomously and educators encountered difficulties in enacting their lessons due to this barrier.

Internal Barriers

Internal barriers to technology implementation are those which were directly related to an individual educator's knowledge, attitudes, and perceptions. Results that related to perceived internal barriers include: lack of technology-related knowledge, educators' attitudes, and their perceptions of technology's influence. Barriers are presented in order of significance, determined by the most frequently mentioned barriers first, as found through data analysis.

Lack of technology-related knowledge. An internal barrier expressed by the participants was their lack of technology-related knowledge. At the beginning of the study, Riley stated that "when the SMART Board comes in, I think I definitely want someone to come in and show me how to use it and what it can do and what's out there for it" (Riley, Interview 1). Additionally, fieldnotes revealed the many difficulties that the educators had with technology. For example, "she doesn't know how to do this because on her Chromebook it is all just automatically logged in" (Fieldnote, November 23, 2018), “she opens the pen mode again but doesn’t realize so I tell her” (Fieldnote, January 24, 2019), and “she clicks the next arrow and it doesn’t work because it’s in writing mode. I tell her she has to [cancel]out of writing mode to be able to move on” (Fieldnote, January 24, 2017). Over the course of the intervention, some of these gaps in knowledge were filled. For example, Jamie stated that:

> I don’t know how to do these things so when a problem arises I’m like “oh my gosh I don’t know what to do now” so I think that was probably the biggest barrier … things just not lining up which I think even now, I would never have thought to take my Chrome Book and plug it into the library [SMART Board] but it’s so simple, there’s just so many. (Jamie, Interview 2)

The initial lack of technology-related knowledge was a significant internal barrier that educators faced. This impacted the delivery of their SMART Board lessons because many times, the SMART Lab Activity the students were working on would restart, or encounter other user errors.

Attitude. The educator participants held distinct attitudes regarding technology including their lack of confidence, fear, and concerns of breaking technology. Scarlett stated that “my experience with the SMART Board and technology is not so great so I was very reluctant to move on on my own kind of thing” (Scarlett, Interview 2). Riley said that “I find with Kindergarten…we seem to be sort of the bottom of the list for technology…but it’s like they want to get the grade 8s set, the grade 7s, and it filters down, and what we have is the leftovers” (Riley, Interview 1) and Jamie stated that “I was … intimidated by it [technology]” (Jamie, Interview 2). One educator expressed that she was worried about breaking technology: “I was afraid to break something you know

… I'm always…I'm just more worried that I'm going to do something wrong and it's going to [mess] up anything" (Scarlett, Interview 2). Three out of four participants experienced these negative attitudes as a barrier to their professional growth, including lack of confidence and one participant was concerned about breaking technology.

Perceptions of technology's influence. The final internal barrier relates to the educators' perceptions that technology created behaviour management issues and consequently impacted student learning. Two educators from K1 held these perceptions which in turn influenced their practices. For example, "the kids tend to choose to go to taking pictures or videos so we really have to watch what they're doing there" (Scarlett, Interview 1). In her first interview, Christina explained:

> …because the other day one of ours was on YouTube and was viewing something and it just like caught me off guard, to be quite honest with you, I've never seen a child go on YouTube as of yet, until now. …So I just right away like you know tried to get him off of it and I explained to him that he's not allowed to go on YouTube. It seems like they want to go and they want to find specific things that they like. (Christina, Interview 1)

Christina also stated in her second interview that "trying to keep the children calm, and sitting [when technology was being used]…I think that part was the more challenging part" (Christina, Interview 2). It was apparent to the researcher that this perception that technology actually contributed to student behaviours was an internal barrier for two of the educators.

Overall, external barriers to technology implementation found in this research included: unreliable technology, administrative, lack of time, inadvertent incidents, and physical barriers. Internal barriers to technology implementation found in this research were the participants' lack of technology knowledge, their attitudes and perceptions of technology's influence on student learning. It should be noted that some barriers influence each other, and are interconnected while others stand alone. For example, some physical barriers were created by administration. Additionally, some external barriers were created by internal barriers, such as inadvertent accidents created by lack of technology-related knowledge. Providing educators with the knowledge and resources to mitigate barriers is important in their professional learning journey to become autonomous users of technology in their practice.

Researcher and Educator Identified Ways to Mitigate Barriers

Based on the previous results that identify the barriers that educators incurred in implementing technology into the Kindergarten classroom, potentially mitigating for such barriers is an important next step. The second part of research question 3 prompted the researcher to determine if the educators knew how to seek help as a result of the course of the study. Indeed, participants identified numerous ways to mitigate for different barriers such as to seek assistance from a coach or another educator. In this research, it was found that coaches can help educators mitigate barriers they face of technology implementation by providing ongoing professional learning and support. Additionally, it was found that educators can engage in collegial collaboration, and self-determined professional learning to further mitigate barriers. These findings for mitigating barriers mimic the framework Gradual Release of Responsibility (Pearson & Gallagher, 1983) in which the researcher provided focused lessons and guided instruction, and the educators (learners) took part in collaborative learning and independent practice (Fisher & Frey, 2008).

Ongoing professional learning and support. Ongoing professional learning and support may take the form of coaching support, technology-specific training, and school board support. In this study the educators and the researcher recognized these supports as potential ways to help mitigate barriers that arose in the face of technology implementation. This sub-finding embodies the first step of Gradual Release of Responsibility (Pearson & Gallagher, 1983) where the teacher provides focused lessons ("I do it") and guided instruction ("we do it") to the learner (Fisher & Frey, 2008). This was accomplished through coaching support and technology-specific training.

Coaching support. It was found that barriers such as attitude and lack of technology knowledge could be mitigated through the support of a coach when it came to implementing technology in Kindergarten reading lessons. In this study, it took 44 hours of coaching support offered through the DBR iterations from the researcher for the participants to learn how to use a SMART Board and be able to create and enact basic SMART Board activities using SMART Lab pre-made formats. The participants perceived this coaching and support that they received in the research as helpful and a positive contributing factor to their professional learning regarding implementation of technology. "I think your guidance through it all, I think your help, your assistance … there was just so much learning that has happened over the last 3 months, it's just incredible" (Christina, Interview 2). Additionally, "I love what we've done and having you here has been a huge help … we would not be anywhere near where we are if we didn't have you guiding and helping us with it. …The whole process has been great" (Riley, Interview 2). Jamie describes that:

> If I didn't have this, I don't think I would nearly know as much as I do now. … Even the one lesson when I was copying and pasting, images and stuff like that, I wouldn't have thought to do any of that if you wouldn't have told me that was an option, so that was huge. So I think I perceived it to be really, really helpful. (Jamie, Interview 2)

Overall, coaching support was perceived by the educators as valuable and contributed to their technological professional learning.

Technology-specific training. Pre-intervention, the educator participants in this study indicated that they did not have any training with regards to specific technology enhancing teaching practices. They recognized the value of the DBR iterations and even noted that they needed consistent and sustained support in order to make progress. Specifically, two educators cited that when there were time lapses in the training they received, that they forgot some of what they had learned. Jamie stated: "cause you forget things when you don't do things for a couple weeks it's easy to just kind of forget how you got around the smart online or whatever" (Jamie, Interview 2). Scarlett also stated:

> I don't have a [SMART Board] in the class right?... That's what I found. When you're telling me I'm like "oh yeah yeah I get it" and then [I] go back and [I'm] like "oh wait," you know cause it was like 3 days later, 4 days later, and I'm trying to do it myself, I'm like "ohh I can't remember that step." (Scarlett, Interview 2)

Post-intervention, the educators of K1 indicated that they would like more training specific to the SMART Board or other technologies in the classroom. Christina stated that "The need of further training, workshops and support is lacking in our workplace. With the increase in technology, teachers need to be prepared and knowledgeable in all areas from programming to troubleshooting" (Christina, Survey 2). Scarlett explains:

> I would like to take something on [the] SMART Board … I don't think the [school] board has anything, or like to take a course. … I would be more [inclined to wait] until I had a SMART Board in my classroom. I've often talked, and I think I said it in my first interview too, about taking the Technology Part 1. (Scarlett, Interview 2)

It was found that three of four educators value training and professional learning as ways to mitigate barriers they face with technology implementation. However, it was also found that two of the participants needed training and support that was consistent.

School board support. Educators expressed their recognition during pre- and post- interviews that the school board had a digital coach to support them when implementing technology. This was more specific, and identified by the participants than the "coaching support" from the previous finding. Additionally, educators recognized post-intervention that the ITS help desk through the school board was also a valuable source of support for them.

Digital coach. Three educators realized that they were able to have the digital coach of the school board help them in technology implementation. This was an important realization for sustaining new technological practices. Jamie identified that "I don't know what their job title is, technology [coaches] from the board. I've seen them in the school a lot" (Jamie, Interview 2) and Riley recognized that "I guess then I would go to our digital … the technology coach and do it that way … [she] comes in I think every few weeks and you can set up on your prep and meet with her and do that" (Riley, Interview 1). Lastly, Scarlett explained: "yeah and … that's what they would say right … [digital coach] is available. … But if they say [digital coach] is coming in for the morning, make yourself available, she's [going to] come in the classroom, she'll show you some things, then it's done" (Scarlett, Interview 2).

ITS help desk. Educators also realized that the school boards' ITS help desk was another source of support post-study for any technological troubleshooting issues. When the educators in K2 got a SMART Board in their classroom they became aware that they needed to contact the help desk regarding issues. Riley explained that "well we do have the help desk that we can go to. … I would follow through and try to [solve the problem], because [the SMART Board is] such a valuable resource and tool" (Riley, Interview 2). Jamie also elucidated that "the help desk seems to be a big help … and now I know how easy the help desk is and stuff too, cause I've never really had to do that …we've never really had any technology" (Jamie, Interview 2).

Overall, educators did identify that school board supports were in place to help support them when implementing and troubleshooting technology in the classroom. This is an important realization as educators should be aware of and able to use the resources available to them when faced with barriers such as their lack of technology-related knowledge, unreliable technology, administrative and physical barriers, as well as inadvertent incidents.

Collegial collaboration. All educators identified collegial collaboration and support as a useful way of mitigating barriers. This embodies the third step of the Gradual Release of Responsibility framework (Pearson & Gallagher, 1983), where the learners engage in collaborative learning ("You do it together"; Fisher & Frey, 2008). Collegial collaboration occurred in two ways: asking other teachers for specific help or support, and collaborating in creating technology-enhanced lessons. In asking other teachers in the school for support, participants explained that: "I know other teachers know more than I do, so I usually just go and ask them if I'm stuck on something" (Jamie, Interview 2); Riley explained that "there's always one or two teachers on staff who seem to have more technology experience or base that will lend their expertise" (Riley, Interview 1); and Scarlett stated that "I think probably in the school most of them are probably more … advanced with the SMART Boards because they have them, so I would probably go to them more" (Scarlett, Interview 2).

Throughout the study, the educators had opportunities to collaborate with each other, as teaching partners in the same classroom, and as Kindergarten teachers or ECEs. The educators realized that this time was valuable and allowed each of the educators to support one another in their shared journey of technology integration. The participants brought this up as an option to help mitigate barriers in the post-interview. For example: "I think even the time that [Jamie] and I had together, I think we learned together. What she didn't know I was helping her with, what I didn't know, vice versa, right? So I think having that time helped" (Christina, Interview 2). Scarlett, Jamie, and Riley all commented on the value of collaboration:

> So that was kind of nice we talked about this as well and helping each other through it and coming up with ideas for our lessons. But it was kind of nice to hear how my [teaching] partner … perceived what needs to be done and … she

has the different eye than I do … So it was nice to … co-plan that kind of stuff so you can see where you're going. (Scarlett, Interview 2)

Me and [Riley] work so close we run everything past each other. I don't think I would have done even as much without her help too because we both kind of went into this blind and we both kind of were like okay together we can … and then we were like proud of each other when we did something. … I wanted to show her the ones I made and she wanted to show me the ones she made … Me and [Riley] have a really, really good relationship I think. We're both excited about it together. (Jamie, Interview 2)

Yeah if we didn't have [time to collaborate], I wouldn't have been able to learn all the stuff and do everything I did so I think that those were … why we are where we are with what we're able to do with it, so I found them really, really good. (Riley, Interview 2)

Christina more explicitly stated that "I think the more time that we have and if we can co-plan with our teachers as well, I think it would be more effective" (Christina, Interview 2). Christina also mentioned in her second interview that she would like to collaborate with the grade 1 and 2 teachers at her school. She recognized that she can collaborate and learn from them as well:

I think they're doing a fabulous job the grade one and two teachers, like I can see …that there's just so much…and I think that working together with them because they've had all this experience you know ahead of us. I think that they know so much more than us so working together with them would be great. (Christina, Interview 2)

These self-acknowledged ways of engaging in collegial collaboration through seeking support from others was perceived by the educators to help mitigate barriers they encountered when implementing technology into their practice. Further, time for collegial collaboration should be perceived as important by coaches, principals, and the school board, and should be prioritized to mitigate barriers that educators face.

Self-determined professional learning. Educators realized that they could engage in their own self-determined professional learning by finding supplementary resources. This finding was insightful and embodied the Gradual Release of Responsibility (Pearson & Gallagher, 1983) step 4, where independent learning takes place ("You do it alone"; Fisher & Frey, 2008).

Three of the four educators recognized their ability to seek out independent sources of support and expressed this in their interviews. "I know even…people have told me that you can go [online] in and put 'SMART Board lessons'…and people have put like whole lessons on that you can take off and use" (Riley, Interview 1).

> I think the whole thing is really manageable. I think…I've got the basics of putting [a lesson] together and I'm going to continue. …I want to learn how to do more and I think you've provided us with a folder. …I know I can go to YouTube, and find out how to do things, so I feel like that is manageable, like just learn little things, expand my knowledge and abilities on it. (Riley, Interview 2)

Scarlett also said that "or maybe even in the summer, jump into looking into how a SMART Board works" (Scarlett, Interview 2) and Jamie stated "Yeah and all those tutorials…I think those will be really helpful too" (Jamie, Interview 2). Self-determined professional learning was perceived as a way to mitigate barriers autonomously as educators, and take control of their own professional learning.

Summary for Research Question 3 Results

The educator participants came to realize that barriers to technology integration can be mitigated on many different levels, including ongoing professional learning and support, such as coaching support, technology-specific training, and school board support, and also through collegial collaboration, and self-determined professional learning. These various levels of support to mitigate barriers mimic the Gradual Release of Responsibility (Pearson & Gallagher, 1983) framework. As explained by Fisher and Frey (2008), "the framework purposely shifts the cognitive load from teacher-as-model, to joint responsibility of teacher and learner, to independent practice and application by the learning" (p. 2). This framework is multifaceted and it can be implemented as a way to mitigate barriers that educators face in enacting technology-enhanced lessons for their reading instruction.

Chapter Summary

It was found that multiple types of support provided by a researcher were able to assist Kindergarten educators in their professional learning, including: diagnosing and anticipating educator needs, differentiation of support for educators, researcher self-determined problem solving, iterative nature of professional learning, and liaising with administration.

Participants perceived technology as beneficial for students and educators. It was found that participants experienced increased confidence and frustration post-intervention. Even though participants increased in their technological competency, they still perceived their skills as weak to adequate. Lastly, participants were able to evaluate and identify some of the systemic conditions for technological professional learning including requiring more support, training, and time to learn about and integrate technology into their pedagogies.

Participants also increased in their skills and knowledge in operating a SMART Board and enacting lessons. Although their skills and knowledge increased, the participants still required some troubleshooting support at the end of the intervention. It was also found that the number and type of interventions provided by the researcher during lessons, on average, decreased over the duration of the DBR study.

With regards to participants' practice, they were able to transfer pedagogies and instruction from traditional methods to technologically enhanced methods. Additionally, two participants expressed that they wanted to further their technological learning, as well as transfer their knowledge or skills to colleagues.

Participants experienced a myriad of barriers in the face of technology implementation, including both external and internal barriers. External barriers that were found in this study include: technology is unreliable, administrative, lack of time, inadvertent incidents, physical, and lack of training. Internal barriers found in this study include: lack of technology-related knowledge, attitude and perceptions about technology's influence on student learning.

Lastly, participants identified many ways to mitigate the aforementioned barriers. Participants identified that coaches can help educators mitigate barriers they face with technology implementation by providing ongoing professional learning, support, and training, and participants identified that they can engage in collegial collaboration and self-determined professional learning to further mitigate barriers.

CHAPTER FIVE: SUMMARY, DISCUSSION, AND IMPLICATIONS

With the burgeoning use of technology to enhance teaching and learning, educators are experiencing increasing difficulty when implementing technology into their practices and classrooms (Lynch, 2014). Additionally, reading is an important skill to establish in Kindergarten, and some educators struggle to effectively integrate technology into their early reading instruction (Voogt & McKenny, 2017). The adopted definition of early literacy for this research includes the purposeful integration of the componential and holistic views of literacy (Snow, 2008), as it relates to reading development and pedagogy. The purpose of this qualitative study was to identify and mitigate barriers that Kindergarten teachers and ECEs faced in the implementation of technology and provide them with technology-driven interventions to support student reading development. The findings from this research will provide educators, researchers, practitioners, and stakeholders with information to offer effective early years programming and close the gap between research and practice.

Summary of Study

DBR was used as the framework for this study, providing Kindergarten educator participants with iterative cycles of technology implementation and reflection. Data collection consisted of pre- and post-surveys, pre- and post-interviews, as well as fieldnotes of educator implemented technology reading lessons. Data analysis was conducted using the NVivo qualitative software program. The researcher employed open-ended coding to create nodes, and then axial coding to create themes to illustrate the data set (Johnson & Christensen, 2004).

The results of the study identified ways to support Kindergarten teachers and ECEs through DBR to implement technology-enhanced reading instruction to support student reading development. The intervention elicited changes in educators' perceived attitudes, skills, and practices. Results also illuminated the vast barriers that Kindergarten educators experience in the face of technology implementation. It was also found that there are many ways that these barriers that educators face in technology implementation into reading practices can be mitigated, as identified by the participants.

Discussion

Research question one sought to identify how Kindergarten teachers and ECEs could be supported through DBR to implement technology-enhanced reading instruction to support student reading development. In accordance with DBR, to support the educators to implement technology, the researcher was responsive to their skills, knowledge, and practice which contributed to their professional learning. Pre-intervention, it was observed that the educators' practice with technology utilized learning through games and playful learning, which are both on the teacher-directed end of the Play Continuum (Play Learning Lab, 2018). The researcher was responsive to this practice and used it to formulate the focus of the professional learning. The researcher supported this type teaching method throughout the study; however, as an early childhood researcher, she also recognized that other types of play exist and should be used in the technology-enhanced classroom.

Specifically, when considering the Substitution, Augmentation, Modification, Redefinition model (SAMR; Puentedura, 2006a), educators usually start at the bottom, with Substitution, and progress up the model's hierarchy, to Redefinition, to achieve more advanced ways of teaching with technology (Hamilton, Rosenberg, & Akcaoglu, 2016). When initially considering the participants in this research, they were using limited technology in their teaching practices; the researcher recognized that they were at the Substitution level of SAMR. Substitution is where technology "acts as a direct tool substitute, with no functional change" (Puentedura, 2006b, slide 3). However, after integrating the SMART Board lessons, it was evident that they had moved up to the Augmentation level where technology "acts as a direct tool substitute, with functional improvement" (Puentedura, 2006b, slide 3). The functional improvement of the technology was the interactive multimedia that the participants used to deliver the reading lessons (Grochowski, 2016). Given the short course of the study (17 sessions), along with the steep learning curve for the educators, the professional learning intervention could only support the participants growth through to Augmentation. However, by the end of the research study, Riley and Christina demonstrated that they were ready to move onto Modification level. Riley explicitly stated what she wanted to do next with technology as her professional learning goals that arose as a function of the study; these goals aligned with Modification.

Additionally, previous literature highlights the importance of the iterative cycles of intervention in DBR (DBRC, 2003; Wang & Hannafin, 2005). This literature coincides with the finding in this research: the participants perceived the ongoing and iterative support they received as something that enhanced and encouraged their technological growth and practices. The participants valued this support and noted it as important in their PL. Similarly, Shanley et al. (2017) state that "ongoing monitoring and support are also important to track changes in instructor buy-in and confidence with technology.

Observations, practitioner notes, and regular, formal professional development allow for a more accurate picture of technology-based intervention implementation and timely support provision" (p. 826). All of these elements were present in the professional learning support offered to the participants in this current study.

Overall, the researcher was responsive to the participants' practices and how the researcher supported the participants in their technology PL can be interpreted post-intervention, using the SAMR model. Additionally, the iterative and ongoing nature of the research design, as substantiated in the literature (DBRC, 2003; Shanley et al., 2017; Wang & Hannafin, 2005) provided participants with the support they required to enact technology integration into their reading instruction.

Research question 2 was posed to garner the Kindergarten educators' perceptions of their attitudes, skills, and practices of technology-enhanced reading instruction prior to and after engaging in professional learning. Hatzigianni and Kalaitzidis (2018) state that "the majority of [ECEs] see very young children as 'young explorers' and 'creators,' they resist the passive nature of technological engagements" (p. 892). This describes the pre-intervention sentiment of the participants in this study because they perceived disadvantages of technology for students and did not want their Kindergarten students to use technology during exploration. Post-intervention, educators no longer expressed these concerns, and one educator dyad actually began to encourage students use the SMART Board during exploration time. This post-intervention practice is supported by McGlynn-Stewart, Hobman, et al. (2017), where using open-ended technology applications during exploration time facilitated and enhanced children's play and literacy skills.

Previous research has found that confidence has a strong effect on teachers' attitudes when it comes to implementing technology and the provision of support has a significant impact on educator confidence (Blackwell, Lauricella, & Wartella, 2014). Although this study did not report on the specific variables that affected the participants' confidence, the participants expressed an increase in confidence from pre-intervention to post-intervention. The increase of confidence was likely due to the enhancement in skills that the participants experienced. For example, they started with limited SMART Board skills, and gained many skills throughout the course of the study; this made them more confident to implement SMART Board technology into their instruction. Previous research supports that educator confidence in using technology can be supported and increased through skills and knowledge (Ertmer & Ottenbreit-Leftwich, 2010).

Another interesting finding from this research was the increase in skills that the participants experienced and the decrease in amount and nature of interventions that they required during their lessons. These findings demonstrate that the participants benefited from the support that they received, and that they integrated the new knowledge and skills into their practices. The growth in their skills could be a result of multiple factors, including but not limited to: the support from the researcher; the collaboration that occurred between participants; the extra time to set aside and dedicated to learning new skills and knowledge; change in attitudes; increase in confidence; or the increase in access to technology. Unfortunately, previous literature on the increase in educators' technology skills and decrease in amount and nature of support is an area in which minimal research has been conducted. It should be pointed out that the increased skills of the four educator participants with regards to specific technology cannot be generalized, however the findings from the current study do demonstrate the growth that occurred within the participants and are therefore important to highlight.

Another interesting finding from this current research was the shift in practice that occurred: the participants' pedagogy shifted from a traditional delivery mode to a technologically-enhanced delivery mode. The participants were very experienced with Kindergarten reading pedagogy and content, and therefore did not need the researcher to support them with this. This was the point of entry for the researcher to introduce enhancements to their technological practice. Once this was introduced, the participants independently adapted and integrated their existing pedagogical practices to include the new technology practices. The researcher perceived this shift in practice as the enactment of TPACK (Mishra & Koehler, 2006). This is contrary to findings from McGlynn-Stewart, Hobman, et al. (2017) who found that "support, both technical and pedagogical, was seen as essential for the successful implementation" (p. 120). Further, although McKnight et al. (2016) did not detail findings on the transfer of pedagogical practices when implementing technology, they did find "that when technology was introduced, it sometimes changed the pedagogical model" (p. 207). This corroborates with previous research that pedagogy should come before technology.

Overall, the existing literature on educators' attitudes, skills, and practices with technology-enhanced reading instruction is scarce; more research is required to corroborate any changes gleaned from this present research. Herein, in the face of technology implementation, educators' attitudes, skills, and practices changed, however, there were barriers that the participants faced during technology implementation.

Research question 3 queried about the barriers that Kindergarten teachers and ECEs face in the delivery of technology-enhanced reading instruction. Flewitt et al. (2015) reported that "technical difficulties...sometimes disrupted the flow of learning-teaching episodes" (p. 302); this can create frustration for the educator and students. In the current research, it was found that unreliable technology was the most common external barrier. Similar to Flewitt et al. (2015), in this study, unreliable technology and technical difficulties did interfere with the lessons, as many times in a lesson, the educator participants would have to stop the lesson and have the researcher help problem solve or fix the issue. Furthermore, Bauer & Kenton (2005) found that although the educator participants in their study were skilled and confident with technology integration, they were not implementing technology on a consistent or regular basis. The barriers to technology implementation were hardware, time, student skills, and the internet (Bauer & Kenton, 2005); the former two align with barriers in the current study. Many researchers corroborate that unreliable technology is a barrier in technology implementation for educators (Kurt & Ciftci, 2012; Radano, 2018; Shanley et al., 2017).

Radano (2018) found that the height of a SMART Board was too high for Kindergarten students to use properly, which was a barrier that educators faced in technology implementation. In this study, the educators also faced the same physical barrier: the SMART Board was not installed physically low enough for the students to be able to use it autonomously. The SMART Board in the library that was used for the majority of this study was mounted on a vertical track, however, it was not working properly, so the educators had to hold it down (so it would not revert back up to its high resting position) for the lesson so the students could reach it. Often, the educators had to complete the activity for the students because they could not reach the SMART Board. Additionally, at the end of the study when K2 received a SMART Board in their classroom, it was installed at an appropriate level, but then had to be re-installed higher because it was initially installed over an electrical box. This physical barrier frequently impeded with the facilitation of lessons and the autonomous use by students; this can be attributed to administrative oversight.

A predominant barrier well documented in the literature is the lack of technology training and knowledge of contemporary educators (Finger & Houguet, 2009; Hsu, 2016; Kurt & Ciftci, 2012; Shanley et al., 2017). The current research also corroborated this barrier of training and knowledge. At the beginning of the study, the participants cited that they would benefit from more technology-related training and at the end of the study, they still expressed the need for more. Participants' lack of technology knowledge was a constant barrier during their lessons, as the researcher had to intervene many times to help troubleshoot or explain. Lack of technology related training and knowledge can contribute to educators' confidence: the more training and knowledge, the more confident educators may become implementing technology, which in turn influences their attitude (Blackwell et al., 2014). This association echoes Inan and Lowther's (2010) finding that the implementation of technology is a result of relationships between internal (e.g., confidence) and external (e.g., technology reliability) barriers.

Another interesting barrier found in this research was the educator participants' biases with respect to technology's influence on student learning. Initially, the participants expressed their beliefs that technology was an external barrier to students' learning. However, after observing the educators and their practices, it became clear to the researcher that this was an internal barrier, stemming from their beliefs and attitudes about pedagogy. They had a preconceived notion of the purpose of technology in an early learning context. The participants held traditional views when it came to literacy and technology, resulting in the belief that technology does not have a place to enhance literacy during exploration play. However, it was found by the end of the study that the beliefs had changed for the educators of K2, who began integrating the SMART Board into the students' exploration time. The perception of barriers here provided interesting insight into the beliefs and attitudes of the participants, and this was used by the researcher to provide individualized professional learning opportunities.

Shanley et al. (2017) found that educators who were faced with external barriers demonstrated the best implementation of technology. Furthermore, it was found that internal barriers had a greater impact on an educators' implementation of technology compared to external barriers (Shanley et al., 2017). Interestingly, this corroborates with the experience that one participant in the current study had. Initially, Scarlett experienced the greatest internal barriers of the four participants. The researcher discerned that although Scarlett experienced the same external barriers as the other participants, she did not perceive these to be as important as other barriers compared to her lack of confidence and concerns about breaking the technology. This suggests that educators with significant internal barriers do not perceive external barriers to be as important compared to the magnitude of their internal barriers. Shanley et al. (2017) also stated that "the quantity of barriers reported, in addition to the type or order of barrier, may be critical implementation factors" (p. 825). This further corroborates the difficulties that barriers pose for educators' professional learning when it comes to implementing technology, and that the mere quantity of barriers is not a good indicator, rather, the type in combination with quantity can provided a more robust picture. Despite the vast literature on the barriers that educators face when implementing technology, limited research exists on how to mitigate these barriers.

The second part of research question 3 was a documentation of how educators' technology barriers can be mitigated by using the instructional resources and strategies available to them. Mitigation is an important part of identifying barriers to allow educators to overcome challenges that they may encounter. It was found that collegial collaboration was one way to mitigate barriers such as lack of time, inadvertent incidents, attitudes, and lack of technology-related knowledge. The collaborative nature of this study mimics Professional Learning Communities (PLCs), which "involve teachers in site-based, ongoing, collaborative professional development" (Linder, Post, & Calabrese, 2012, p. 13), and have been found to be used in high-performing school systems (Jensen, Sonnemann, Roberts-Hull, & Hunter, 2016). Although there was planned collaboration in this research, some of it also occurred as impromptu sessions among the educators. Additionally, participants realized that they could benefit from self-determined professional learning by going to the internet or taking courses independently. Both of these findings are corroborated by McKnight et al. (2016):

> Teachers found informal discussions and demonstrations from colleagues, as well as online videos and websites, to be more helpful than PD the district or school provided. Teachers were resourceful in creating their own 'just-in-time' learning opportunities outside of the usual district PD offerings, to address immediate technology integration concerns. (p. 207)

Additionally, this study's findings align with those from Jensen and Iannone (2018) and Cordingley and Bell (2012) who highlight the benefits of communities of practice and networks that occur through Continued Professional Learning (CPL). This research fostered collaboration among teachers, ECEs, and a researcher, and found that the participants perceived this collaboration to be very helpful in their PL. The collaboration that occurred in this research was also corroborated by Darling-Hammond et al. (2017) who emphasize the need for collaborative practices in PL; this need has been well established in the literature, as cited above, however the use of collaboration as a means to mitigate barriers that educators face in technology implementation is a new way of looking at the role of collaboration.

Implications for Practice

The findings of this research present implications for practice that should be considered when supporting educators in implementing technology into their reading instruction. These implications may be considered by educators, coaches, support staff, vice-principals, principals, school board administration, or stakeholders.

The types of effective support found in this research (see research question 1) could be used and implemented by technology or digital coaches during their professional learning support for Kindergarten teachers and ECEs in implementing technology into reading lessons to support the reading development of their students. For example, this study found that differentiation of support for educators was an effective support method. Shanley et al. (2017) also suggest that coaches target under- and over-confident educators when it comes to technology to provide the differentiated, direct support that these educators need. Based on the current model of professional learning support, the implication for practice is that coaching support often needs to be intense and dedicated. In practice, this dictates that school boards employ several technology coaches. This is an important barrier for school board administration and principals to consider, however, it should not be a deterrent given the perceived effectiveness of technology interventions on educator practices. More empirical research is required to corroborate these implications.

The systemic conditions identified in this research (e.g., educators identified that they required more support, training, and time) can be used by principals and school board administration to target the potential needs of their educators. McKnight et al. (2016) also suggest that school boards should consider contextual factors when implementing technology, not just the technology. The contextual factors that McKnight et al. (2016) found align with some barriers that were found in this study, such as resources, coaching support, training, technical assistance, and school and administration support. Awareness of educators' beliefs and attitudes allows administration at the school and school board level to respond appropriately to educators to provide them with the skills, resources, and knowledge that they require to effectively program for their students. Many levels of administrators can support educators when implementing technology in the classroom, and to do so, they should be aware of the barriers that educators face.

The barriers found in this study have implications for the practices of digital or technology coaches who might now better understand the educators they are working with, and how to best support them. Furthermore, this study has highlighted ways that coaches and other professional learning facilitators might target how to mitigate barriers that the participants experienced. Specifically, coaches might use the SAMR framework

(Puentedura, 2006a) as a model or set of tools to address where educators are in their practice and support them to enhance their technological practices. Using SAMR to diagnose educators' current practice levels might allow coaches to more accurately address educator needs. Similarly, Shanley et al. (2017) suggest that "troubleshooting guides and targeted trainings that prepare all instructors for potential pitfalls and provide specific strategies for overcoming seemingly insignificant barriers may be one way to support instructors who are implementing technology-based interventions" (p. 826).

Although this was not a finding within the current research, the researcher realized that after the coaching support, there should be a sustainability plan in place for continued implementation and support. Without continued support, educators may not maintain the practices bolstered by the coaching support, or transfer newly learned skills to other platforms or digital tools. As Cviko et al. (2012) found, the principal plays an important role for technology implementation and sustainability in schools.

Overall, this research provides numerous implications for practice that should be considered by educators, technology coaches, schools, school board administration, and stakeholders. Implications for practice based on this research can provide insight for implementing technology training or support to educators.

Implications for Theory

In addition to implications for practice, the findings of this research also have theoretical implications. These implications connect to the theoretical framework of the study, Dewey's (1934) progressivism, the original proposed conceptual model of the study, TPACK (Mishra & Koehler, 2006), as well as a model that was applied to the results of the study, the Gradual Release of Responsibility (Pearson & Gallagher, 1983).

This research was situated in Dewey's theory of progressivist education. This study supported educators who were creating their own new knowledge as professional learners. The educator participants constructed their knowledge while learning to implement new technology within the limitations of their capabilities as actors of the school system, and of society. This resulted in the educators confronting many barriers and challenges. According to Dewey, the instructor (in this study, the researcher who facilitated the professional learning) should consider the learner's environment (Sadker & Sadker, 2005). Indeed, the researcher evaluated the educator participants' beliefs, attitudes, skills, and practices prior to implementing the intervention. In keeping with progressivism, the educator participants then implemented technology into their curricula and practices for the first time. As Johnson et al. (2014) state, change is a constant, and Dewey views educators' practice as a variable that is always being tested and enhanced (Edmunds & Edmunds, 2015). In this study, through the framework and method of DBR, the changes in educators' practices were situated within Dewey's notions of progressivism. This study provides implications for theory based on the notion that learners can be experienced educators in their own professional learning context, enhancing their knowledge and skills with technology to assist their young learners.

The conceptual model of this research, TPACK (Mishra & Koehler, 2006), asserts that TK, PK, and CK are interrelated knowledge spheres that work together to produce TPACK. However, the results of this study found that when educators are well established in their PK and CK practices, integrating PK and CK into TK is less challenging than expected. This suggests that as a theory, TPACK might be applied with less rigidity in its implementation, and that flexibility in the interrelationship between PK, CK, and TK might be required. Educators established in their practice with sound pedagogical practices and substantive content knowledge, may still require extensive coaching on the integration of technology, but not on the integration of PK or CK into TK. This posits TK as a more individualized concept of TPACK practice. However, it should be noted that each educator is different, and some may require coaching on how to integrate TPACK structures. Additionally, more research is required to expand upon these implications.

When interpreting the findings of the current research, another model that brings clarity to the results is the Gradual Release of Responsibility (Pearson & Gallagher, 1983). The implications for use of this model within the research is that Gradual Release of Responsibility can be employed to mitigate the potential barriers in a professional learning context. The steps of the model aligned with how Kindergarten teachers and ECEs view themselves as able to mitigate barriers they face in technology implementation into their reading lessons to support students. The educators needed to observe, be guided and then supported in their practice prior to independent implementation. As noted in the next section, future research might consider the Gradual Release of Responsibility model in professional learning programs.

Implications for Future Research

This study provides opportunities to consider implications for future research. Simple considerations include replicating the method of this study but with the addition of different types of technology, such as iPads, tablets, or different software on the SMART Board. Additionally, the same method could be replicated with different grades.

When considering the Play Continuum (Play Learning Lab, 2018), future research could document the support of educators in exploring different types of play into their technology-enhanced Kindergarten literacy programs. Perhaps, bringing educators who are dominant in different types of play together and supporting them in collegial collaboration could achieve new levels of understanding. For example, in the current research, the educators were dominant in teacher-directed types of play for literacy learning; they could be partnered with educators who are dominant in free play practices, and engage in PL together to inherit other types of play through collegial collaboration.

Kindergarten educators in Ontario have a teaching partner to collaborate with; however, there are many other educators in schools that could collaborate to enhance their mutual technology-enhanced literacy instruction. Future research might also consider the collaborations between English as a Second Language teachers, French as a Second Language teachers, teacher librarians, or special education teachers with classroom teachers. Such pairings might enhance collegial collaboration school-wide, as the dyads would have to work together to implement technology in a seamless way.

Future research could also consider the application of the Gradual Release of Responsibility (Pearson & Gallagher, 1983) model in professional learning. Described as a finding in Chapter 4, this model might be used to mitigate barriers that Kindergarten teachers and ECEs experience in the face of technology implementation into their reading lessons. Specifically, the Gradual Release of Responsibility model could be used in a study where educators who are technology leaders, assume the role of the coach working on-site with their educator colleagues. Additionally, future research could explore the

Gradual Increase of Responsibility (Collet, 2012), as this model was also found to support coaches to scaffold educators in enhancing their practices.

A final implication for future research could consider the role of teacher candidates. Voogt and McKenney (2017) posit that many teacher candidates are not provided with enough training on implementing technology into their early literacy practices. An impetus for future research might have teacher candidates learn about specific technologies for early reading instruction, and then mentor classroom teachers as part of their teacher education technology course. Supporting colleagues in professional learning is a focus in most teacher education courses, and this might be an innovative future research prospect that is applied in a common curriculum area such as early reading. Overall, there are numerous implications for future research that could be considered when creating new studies that explore implementing technology into educators' reading practices; the limitations of the current study should also be considered for future research.

Limitations

The current study comes with notable limitations that are important to consider when interpreting the results. Limitations to generalizability come from three main sources. First, this study employed a very small sample size of four educators; generalizability is not possible due to this. Additionally, this research took place in a middle- to upper-class school site which also renders it ungeneralizable. The last limitation to generalizability was that this study only evaluated one type of technology, SMART Boards and SMART technology, which limits generalizability to other types of educational technology.

Another limitation was the short implementation time frame of the research. Each participant conducted approximately six reading lessons using the SMART Board. This is a meagre amount, as more lessons would have allowed the educators to further solidify the skills they learned and overcome barriers. With more implementation time, the researcher could have further observed their practice further and provided more support and training. Future research could explore a longer intervention phase.

Van Eekelen, Vermunt, and Boshuizen (2006) found that “three manifestations of a will (or no will) to learn can be labeled as follows: 1. not seeing why there’s a need to learn; 2. wondering how to learn; and 3. eager to learn” (p. 414). In terms of conducting research in education, any of these manifestations could be a limitation. In the current study, the limitation was that the participants fell under the latter two manifestations of “wondering how to learn” and “eager to learn.” Given that not all educators have a will to learn, working with educators who are eager to learn was a limitation in itself. However, it is important to note that that an educator’s will to learn can vary based on the topic or subject, as it is not a fixed trait (Van Eekelen et al., 2006).

The last notable limitation in the current research was that the participants completed self-reports of their practices, skills, and attitudes towards technology. Participants who fill out self-reported surveys may provide the answers that they think the researcher wants to hear, or report answers that are ameliorated. This is an acquiescence response bias, which is “the tendency for survey respondents to agree with statements regardless of their content” (Lavrakas, 2008, p. 3).

Professional development for educators is the impetus to enhancing their practices (Kennedy, 2016) with the goal of enriching student learning. Relatedly, McGlynn-Stewart, Hobman, et al. (2017) state that current and future generations of students require educators who are competent with digital practices and implementing these practices into their early literacy programs. Furthermore, Kindergarten students require high quality instruction to provide a strong foundation of skills to carry forward (CIW, 2016; Davies et al., 2016; OECD, 2012), including reading, one of the most fundamental skills. Overall, this study sought to address these issues by providing training and support to Kindergarten educators to implement technology into their instruction to bolster student reading development; this has proven to be a timely focus in this rapidly changing world.

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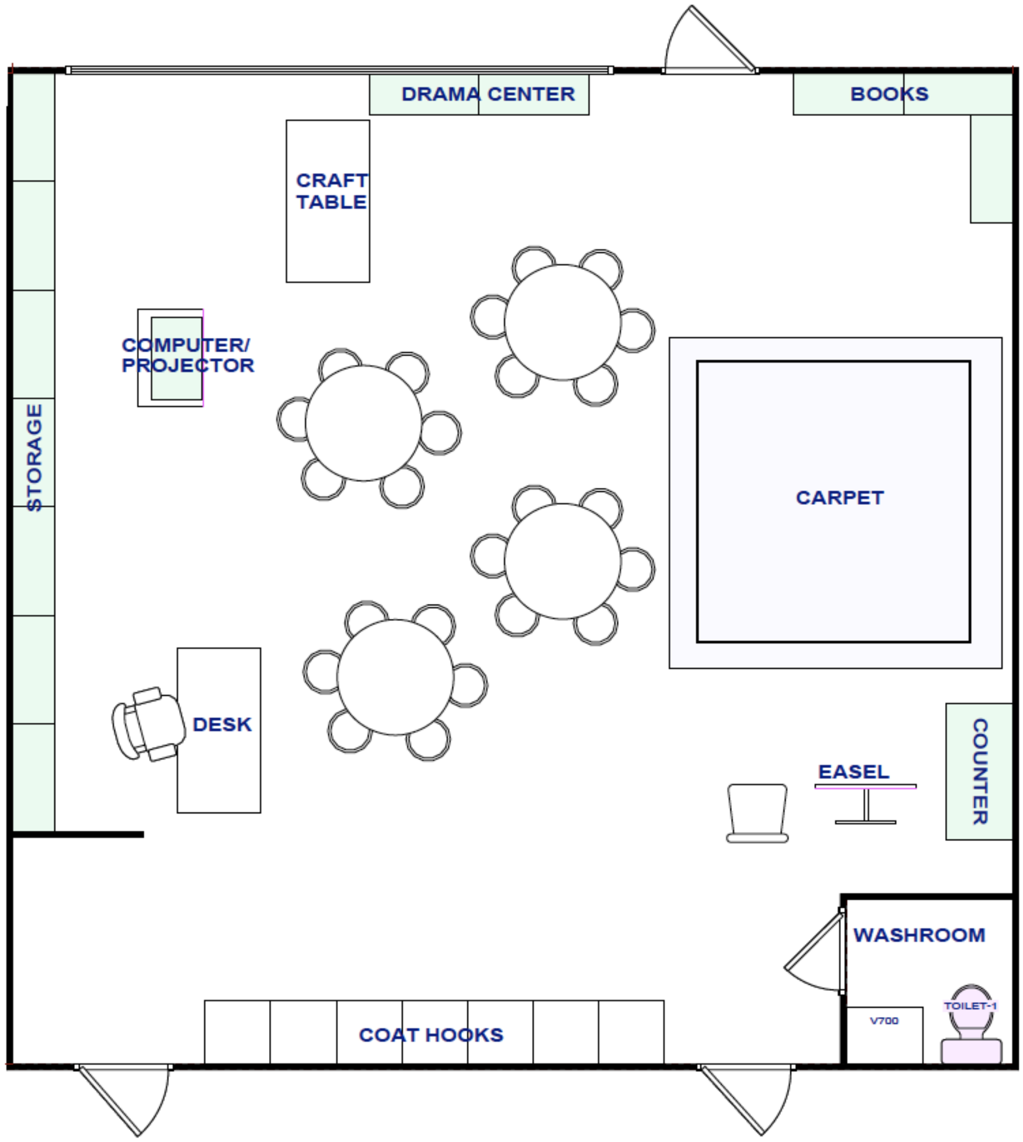
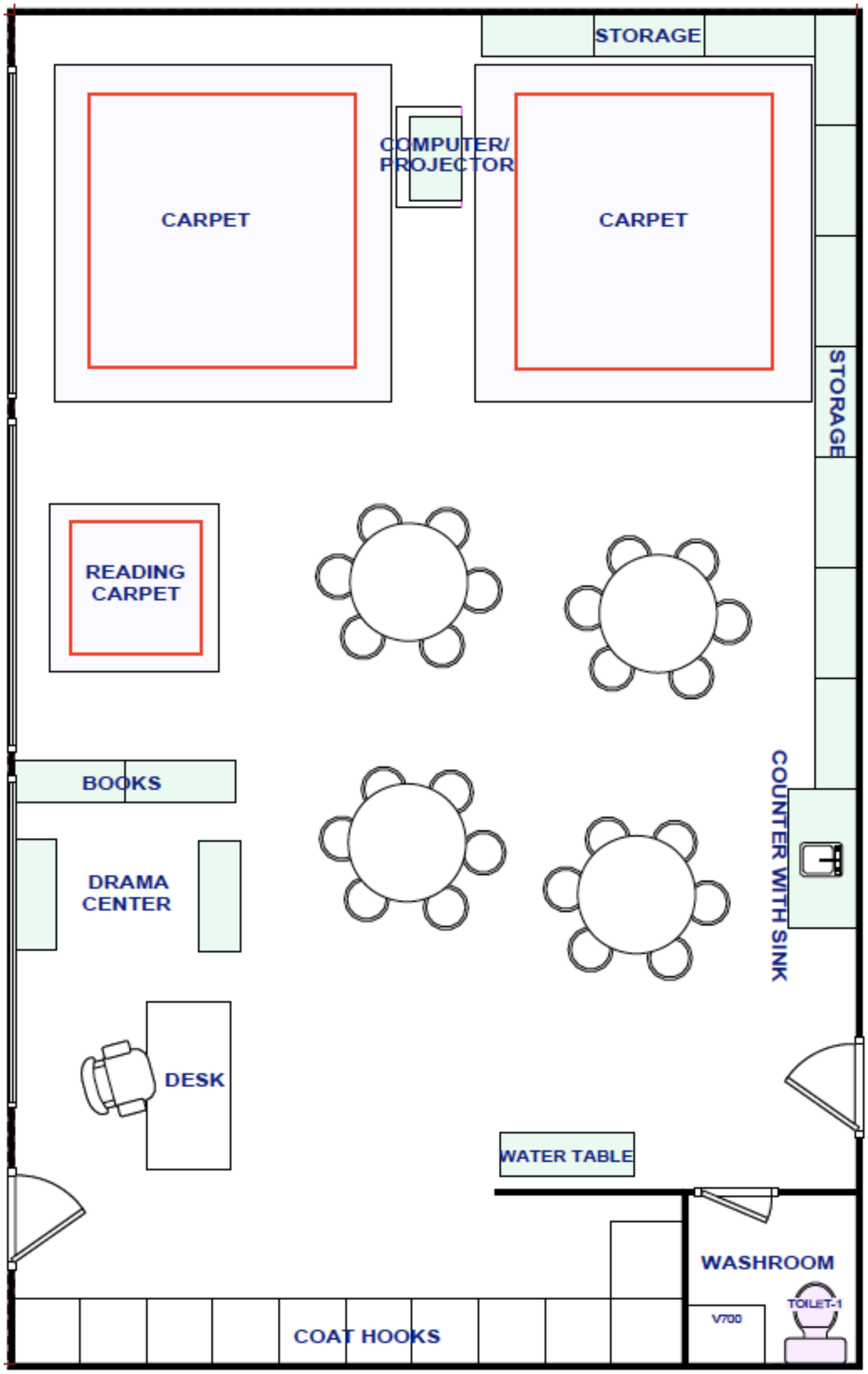
Appendix A

K1 Classroom Map



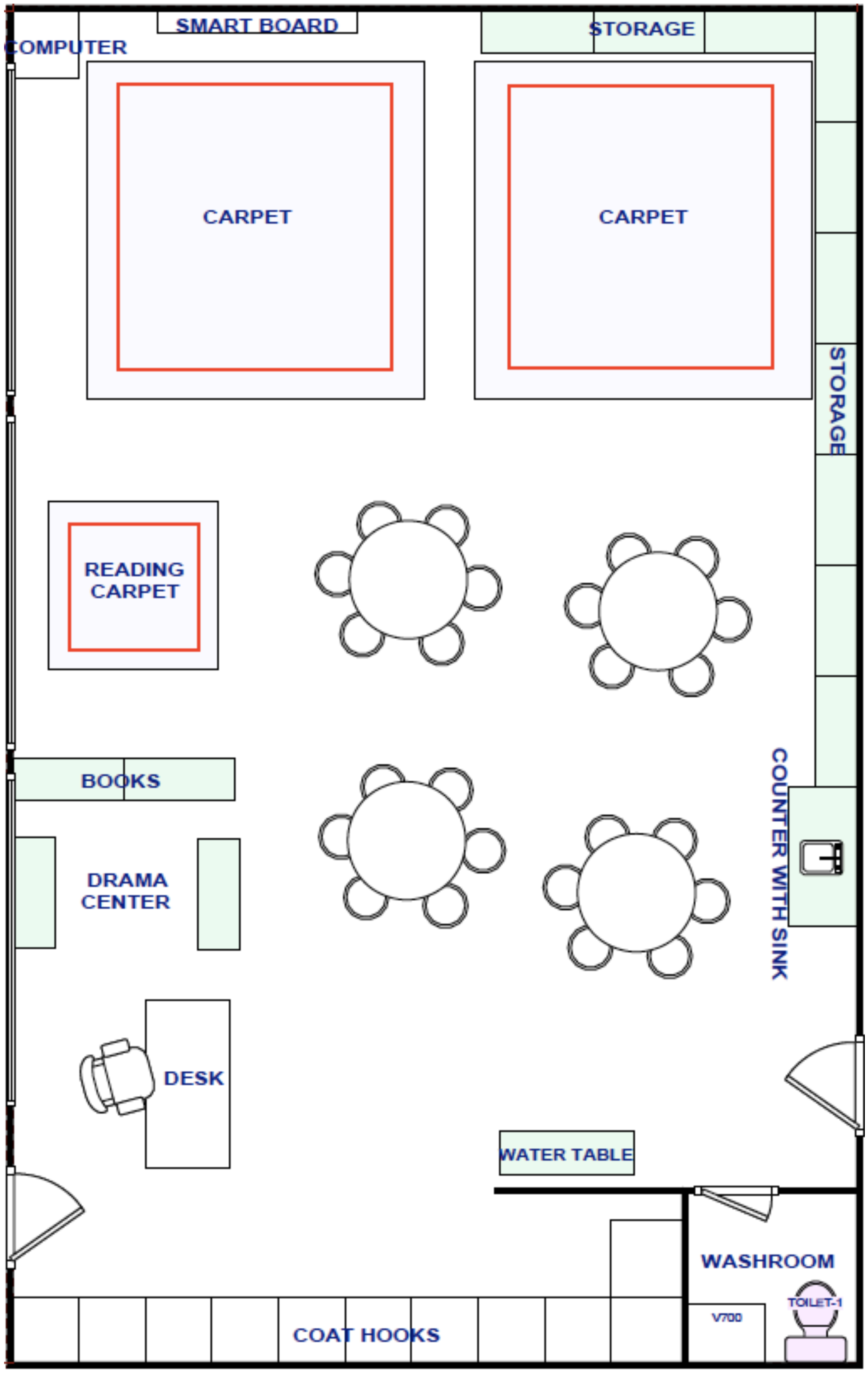
Appendix B

K2 Pre-Intervention Classroom Map



Appendix C

K2 Post-Intervention Classroom Drawing



Appendix D

Survey

Quick Teacher Technology Survey: Adapted from PowerUp What Works

Section 1: General Technology Use in Education
The questions in this section ask about general technology use. Please read each statement and rate your skill and the importance you place on each of the tasks by circling the number that corresponds to your response.

Competency	Proficiency			Importance		
Learning how to use new applications (software & programs)	Weak	Adequate	Strong	Low	Medium	High
Acting as a guide for students when researching on the internet	Weak	Adequate	Strong	Low	Medium	High
Troubleshooting problems that occur when using technology	Weak	Adequate	Strong	Low	Medium	High
Integrating technology into daily instruction	Weak	Adequate	Strong	Low	Medium	High
Using technology to differentiate instruction	Weak	Adequate	Strong	Low	Medium	High

Section 2: Specific Technology Use in the Classroom
The questions in this section ask about the specific technologies you use in your classroom instruction, and the frequency with which you use them. Please read a description of each technology and rate the amount of time you spend working with that technology in your classroom.

Technology Description	Never	Yearly	Monthly	Weekly	Daily
Applications and Internet					
Internet for developing lesson plans/ideas	O	O	O	O	O
Apps for tablets	O	O	O	O	O
Assistive Technology Tools	O	O	O	O	O
Test Preparation	O	O	O	O	O
Web Design	O	O	O	O	O
Management Programs for Student Data	O	O	O	O	O
Hardware					
Computer in the Classroom	O	O	O	O	O
Active Board (e.g. White Board)	O	O	O	O	O
Mobile Devices	O	O	O	O	O
Tablets	O	O	O	O	O
Digital Video Cameras	O	O	O	O	O

Please list any additional comments you have about technologies in your system, school, and/or classroom:

Section 3: Opinions and Attitudes on Technology Integration

The questions in this section ask for your honest opinions about different technologies, their role in education, and the future of different technologies.

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
When using the Internet…					
Students create products that show higher levels of learning	O	O	O	O	O
There are more discipline problems	O	O	O	O	O
Students are motivated	O	O	O	O	O
Students go to inappropriate sites	O	O	O	O	O
There is more student collaboration	O	O	O	O	O
Plagiarism becomes a bigger problem	O	O	O	O	O
The abundance of unreliable sources is disturbing	O	O	O	O	O
I think….					
Electronic media will replace printed text within 5 years	O	O	O	O	O
Most technology would improve my ability to teach	O	O	O	O	O
Technology has changed the way that I teach	O	O	O	O	O
Students are more knowledgeable than I when it comes to technology	O	O	O	O	O
School systems expect us to learn new technologies without formal training	O	O	O	O	O
There is too much technological change coming too fast without enough support for teachers	O	O	O	O	O
Technology is a good tool for collaboration with other teachers when building unit plans	O	O	O	O	O
Technology is unreliable	O	O	O	O	O

Please list any other thoughts opinions or attitudes on technology integration:

Section 4: Areas of Improvement / Technical Needs

The questions in this section are designed to determine what your technology needs are both school-wide and in your classroom.

I Need…	**Less Urgent…………………..More Urgent**				
More time to learn to use applications	1	2	3	4	5
More time to integrate technology into my curriculum	1	2	3	4	5
More training to use technology	1	2	3	4	5
More support from administration when it comes to my technology needs	1	2	3	4	5
More technical support to keep computers and applications running	1	2	3	4	5
More access to technology tools to integrate in my classroom instruction	1	2	3	4	5
Faster access to the internet	1	2	3	4	5
More opportunities to collaborate with colleagues on how to use technology	1	2	3	4	5
More options for professional development in the areas of technology	1	2	3	4	5
Help aligning the integration of technology with the implementation of curriculum expectations	1	2	3	4	5

Please list any other thoughts about technology needs, training, or assistance:

Appendix E

Pre-Interview Prompts

Background Questions

1. What teaching related experience do you have?
   a. Teacher: What grades/ages have you taught? For how long?
   b. How long have you been teaching Kindergarten?
2. Do you have any Additional Qualifications, Additional Basic Qualifications or any other relevant qualifications ?
3. Have you attended any technology or literacy related Professional Developments?

Resource Availability

4. Can you identify the resources available at your school, or to you, that relate to literacy, both technology and non-technology?
5. Which of these have you used?

Resource Implementation

6. Did you receive training or support in using and/or implementing these resources?
7. Have you been successful in using them?
8. What results have you seen?
9. Were you comfortable using them?
10. Why haven't you used ___?

Student Related

11. Based on your professional judgement, which students have you self-identified as needing support in literacy?
12. What have you been doing to support them so far? What literacy areas do they need support in?
13. What changes with technology would you like to see in your classroom?
14. How do you assess for students who are at-risk?

Collaboration

15. Do you and the ECE/teacher collaborate together?
    a. How often?
    b. How is that accomplished?
    c. Do you try new ideas with each other's support?
16. Are there other people in the school you collaborate or learn with?
17. Do you learn with other teachers in the school?
18. Do you feel like you would benefit from the help of a support person when it comes to implementation of technology? Is there a Digital Technology Coach in your school board? Other staff that help with technology questions or issues?
19. How do you see technology implementation into your classroom working?
    a. What are requirements for it being implemented (i.e. only 10 minutes a day etc.)?
    b. Is there anything that makes you apprehensive to implement technology?

Appendix F

Post-Interview Prompts

Resource Implementation

1. What new resources did you end up using during the course of this study?
    a. Which resource was effective in your opinion?
    b. What made this resource effective?
2. Were you confident in facilitating literacy learning with this/these resource(s)?
3. Did you think implementing these resources was successful?
4. How do you see yourself using this experience in future practice?
    a. How might the utility of this/these resource(s) transfer to other students?
    b. Other classrooms?
5. Did you experience any barriers? If so, how can these barriers be mitigated by using the instructional resources and strategies available to you?

Student Related

6. Based on your professional judgement, how did the students benefit from technology- enhanced literacy instruction?
7. Can you see yourself continuing this instruction with the students?
    a. How/what makes this manageable/unmanageable?
8. Has this implementation of technology-enhanced literacy instruction contributed to the type of change you wanted to see in your classroom?

Collaboration

9. How did you perceive the co-planning, co-implementing and co-evaluative meetings to work?
10. Did the chance to reflect and change practices during the co-evaluative meetings assist you in implementing the lessons with higher self-efficacy?
11. Did you benefit from the time to collaborate with your teaching partner? If so, in what ways did you benefit; if not, what would have made this experience more beneficial?
12. Are there other people in the school you would share your learning and these ideas with? Outside of the school?
13. Do you see yourself continuing to implement these practices in the future?
    a. Why or why not?
    b. Would you make any modifications?
        i. What would they be?
        ii. Why would you make them?

Appendix G

Intervention Matrix

		Riley			Jamie			Scarlett			Christina		
Iteration	Lesson	L1	L2	E	L1	L2	E	L1	L2	E	L1	L2	E
3	L1				1	4	0				3	1	2
	L2	2	1	1				1	0	0			
	L3				4	1	0				1	5	0
	L4	0	3	0				0	1	0			
	L5	2	2		Absent						0	3	0
	L6	1	3	0				2	2	0			
	Total	5	9	1	5	5	0	3	3	0	4	9	2
	Average	1.25	2.25	-	2.5	2.5	0	1	1	0	1.33	3	1
5	L7	3	2	0				5	0	0			
	L8				1	0	0				4	1	0
	L9	2	0	0				1	0	0			
	L10				2	1	0				2	3	0
	L11							0	0	0	1	1	0
	L12	0	0	0	1	0	0						
	Total 7-12	5	2	0	4	1	0	6	0	0	7	5	0
	Average	1.66	0.66	0	1.33	0.33	0	2	0	0	2.33	1.66	0