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Coaching Kindergarten Educators through Design-Based Research to Enact Technology-Enhanced Reading Instruction

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Abstract: The integration of technology into classrooms at all levels of education is ubiquitous, however, some educators are experiencing challenges in implementing technology into their instruction. This study sought to identify ways to support Kindergarten educators (teachers and Early Childhood Educators [ECEs]) to enhance reading instruction with technology-infused lessons. The principal investigator assumed the role of a technology coach and used Design-Based Research (DBR) as both a method and professional development approach. Data collection included field notes, interviews, and surveys with educator participants (n=4). Data were analyzed using an inductive analysis approach; open-ended coding was used to create nodes, and then axial coding was used to create themes to illustrate the data set. The investigators verified and labelled these themes. Findings indicated that support can be provided to Kindergarten educators by enacting iterative cycles of DBR professional learning, anticipating and diagnosing educators' needs, providing differentiated support, engaging in researcher self-determined problem solving, and liaising with administration. These supports were found to help mitigate barriers that educators faced when implementing technology into their reading programs. The findings provide implications for practice such as using

modelling and scaffolding as part of the coaching strategy to implement effective programs of professional learning to support Kindergarten educators in providing instruction through technology-enhanced practices.

Keywords: technology coaching, Kindergarten educators, Design-Based Research (DBR), reading instruction

Résumé: L'intégration de la technologie dans les salles de classe à tous les niveaux d'enseignement est omniprésente, cependant, certains éducateurs ont des difficultés à mettre la technologie en œuvre dans leur enseignement. Cette étude visait à identifier des moyens pour aider les éducateurs de la maternelle (enseignants et éducateurs de la petite enfance [EPE]) à améliorer l'enseignement de la lecture avec des leçons intégrant la technologie. Le chercheur principal a assumé le rôle de coach technologique et a utilisé la recherche basée sur le design (DBR) à la fois comme méthode et comme approche de développement professionnel. La collecte de données comprenait des notes de terrain, des entrevues et des sondages auprès des éducateurs participants (n = 4). Les données ont été analysées en utilisant une approche d'analyse inductive; un codage ouvert a été utilisé pour créer des nœuds, puis un codage axial a été utilisé pour créer des thèmes afin d'illustrer l'ensemble de données. Les enquêteurs ont vérifié et étiqueté ces thèmes. Les résultats indiquent qu'un soutien peut être fourni aux éducateurs de la maternelle en adoptant des cycles itératifs d'apprentissage professionnel DBR, en anticipant et en diagnostiquant les besoins des éducateurs, en fournissant un soutien différencié, en participant à la résolution de problèmes auto-déterminée par les chercheurs et en assurant la liaison avec l'administration. On a constaté que ces soutiens aidaient à atténuer les obstacles auxquels les éducateurs se heurtaient lorsqu'ils implémentaient la technologie dans leurs programmes de lecture. Les résultats ont des implications pour la pratique, comme l'utilisation de la modélisation et de l'échafaudage dans le cadre de la stratégie de coaching pour mettre en œuvre des programmes efficaces d'apprentissage professionnel pour aider les éducateurs de maternelle à dispenser un enseignement grâce à des pratiques améliorées par la technologie.

Mots clés: coaching technologique, éducateurs de maternelle, recherche basée sur la conception, instruction de lecture

Introduction

Current and future generations of students require educators who are competent with digital practices and who implement these practices into their early literacy programs (McGlynn-Stewart et al., 2017). With the rapid development of technology and its integration into classrooms, Kindergarten teachers and ECEs are experiencing challenges in how to strategically implement technology into their Kindergarten programs (Lynch, 2014), specifically in reading instruction (Voogt & McKenney, 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 Kindergarten teachers and ECEs. Moreover, there is a lack of research on how Kindergarten educators self-determine how to enhance their practices through methods such as Design-Based Research (Design Based Research Collective [DBRC], 2003). Herein, supporting Kindergarten educators in implementing technology to enhance their pedagogies, and in turn support student development, is a timely inquiry. This was the impetus for this study's research question: How can Kindergarten educators be supported through Design-Based Research (DBR) to implement technology-enhanced reading instruction and support student reading development?

Conceptual Framework and Literature Review

Technology has ample benefits when integrated into the classroom, especially for young learners (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. In general, technology use is urged and implemented in schools across the world, but the saturation of technology in education has not yet permeated into early childhood contexts (Parette et al., 2010). As such, Kindergarten

teachers and ECEs should understand the value of technology and integrate it into their instruction so it is relevant for younger generations (Parette et al., 2010).

The conceptual model that frames this study is Technological Pedagogical and Content Knowledge (TPACK; Mishra & Koehler, 2006; Thompson & Mishra, 2007). 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 each domain (pedagogical, content, or technological) as interrelated and interconnected pieces, rather than in complete isolation. This framework requires vast knowledge of multiple structures, including Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK), and together as TPACK (Mishra & Koehler, 2006). Belo et al. (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, candidates were not always provided with the information or skills on how to use technology to support early literacy. Additionally, Boschman et al. (2015) found that teachers need assistance implementing TPACK into their practices. 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 was used as a conceptual model to help understand and garner insights into professional learning to support educators' technology-integrated practices rather than a theoretical framework.

Barriers of Technology Implementation

Several practitioners and researchers have cited challenges when implementing technology into the classroom (Finger & Houguet, 2009; Flewitt et al., 2015; Hsu, 2016;

Shanley et al., 2017; Voogt & McKenney, 2017). Researchers have categorized the challenges that many educators encounter into extrinsic and intrinsic barriers. Extrinsic barriers include: lack of time to implement technology (Finger & Houguet, 2009; Flewitt et al., 2015; Hsu, 2016; Shanley et al., 2017), lack of resources and unreliable technology (Finger & Houguet, 2009), lack of availability (Nikolopoulou & Gailamas, 2015), and physical set-up (Radano, 2018). Intrinsic barriers include lack of professional knowledge or understanding on how to implement technology and lack of professional development/training (Finger & Houguet, 2009; Hsu, 2016; Shanley et al., 2017), or lack of confidence (Nikolopoulou & Gailamas, 2015). Despite the type of barriers or challenges that educators experience, it is necessary that they "receive appropriate, timely, and effective support to develop successful technology-based classroom systems" (Shanley et al., 2017, p. 826). Of particular interest in this present study, is the dearth of research into the potential barriers and associated supports that Kindergarten educators require to address the challenges of integrating technology into their classrooms.

As illustration, McKenney and Voogt (2017) highlight that "technology applications can make important contributions to improving learning outcomes in the domain of early literacy. However, to fully exploit the potential of educational technologies, teachers must have specific knowledge and skills" (p. 1). Additionally, Pyle et al. (2018) explain that Kindergarten teachers exhibit a dichotomous attitude towards any type of exploration or play, and literacy instruction; fifty per cent of the teachers in their study reported that direct instruction was the method that they planned for in literacy programming. Pyle et al. (2018) also documented that teachers have difficulty integrating play into literacy instruction. Given the limited research that exists on literacy instruction, play, and technology, it is timely to identify the attitudes,

knowledge and skills of Kindergarten educators with technology implementation. It is from that juncture that Kindergarten teachers and ECEs can then be supported in their professional development towards implementing technology into literacy instruction.

Effective Professional Development

Effective professional development is particularly pertinent in today's educational and societal landscapes. Given that the world is changing at a rapid pace, educators are required to stay current in order to support and prepare students (Caena, 2011). Educators' professional development needs and growth are individualized, meaning that a one-size-fits-all model is not optimal (Learning First Alliance, 2000). Birman et al. (2000) state that there is an inverse relationship between the number of teachers and quality of professional development: the greater the number of teachers that are included in professional development, the lower the quality of the professional development. When it comes to creating and implementing professional development 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).

Seminal work by Birman et al. (2000) outlines nine structural and core features that should be the foundation of professional development; other educational researchers have validated this work (e.g., Bates & Morgan, 2018; Darling-Hammond et al., 2017). The structural and core features of professional development are: form, duration, collective participation and collaboration, content focus, active learning, coherence, models and modelling, coaching and expert support, and feedback and reflection (Birman et al., 2000). These components of effective professional development should be used as guidelines with a strong focus on teacher engagement, teacher individuality, teachers' 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 (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 solution-based theory and method (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 an investigator and allows educators to self-determine how to enhance their practices. Since many educators experience difficulties with technology integration (Lynch, 2014), this study documented how Kindergarten educator participants worked together with an investigator to manage feasible ways to integrate technology into their reading instruction, which was accomplished through DBR.

Intervention Design and Methods

This qualitative study employed DBR as both a research framework and professional development model. The research setting was in one K-8 moderate-to-high socioeconomic school in a small-to-medium school district in Southern Ontario, Canada. In this province, Kindergarten is a two-year program: Year 1 Kindergarten students are 4 years of age and Year 2 Kindergarten students are 5 years of age. Participants included two Kindergarten teachers and their ECE teaching partners. In the first classroom (K1) was the Kindergarten teacher, Scarlett, with 14 years of experience and in her position for 2 years, and the ECE, Christina, with 18 years of experience and in her position for 7 years. In the second classroom (K2) was the Kindergarten teacher, Riley, in her current position for 18 years, and the ECE, Jamie, with 11 years of

experience, and in her position for 6 years. Each participant chose their own pseudonym to be represented by in the research.

The first author was the principal investigator, licensed teacher, educational technology expert, and novice DBR researcher. She facilitated the DBR sessions with the participants, collected the data, and analyzed it. The second author was a collaborator with a great deal of experience facilitating professional learning and DBR as an educational researcher. She attended the initial meeting with the participants and acted as a corroborator for the data analysis and synthesis of the results.

Intervention Design

The principal investigator engaged in DBR that aimed to maintain the integrity and the professional needs of the educator participants through collaboration. This was achieved through six iterations in which the principal investigator met with each of the two educator dyads (Kindergarten teachers and ECEs) to appreciate their goals for implementing technology into their classrooms. Together, they then co-planned and delivered these technology-enhanced reading lessons. Each participant designed, planned, and enacted six SMART Board lessons with the support of the principal investigator; this took place over six iterations spanning four months in the Fall/Winter. Based on her knowledge of the TPACK model and the identified needs of the educators, the principal investigator provided them with the information and skills on how to use technology to support early literacy (Voogt & McKenney, 2017). The principal investigator deployed TPACK as a conceptual model to ensure that she was addressing the technology-integration professional learning support that these educators needed.

Specifically, the lessons in K1 consisted of a focus on matching uppercase and lowercase letters and phonics for the Year 1 Kindergarten students, along with sight word

matching and memory games for the Year 2 Kindergarten students. The lessons in K2 consisted of picture to word and letter matching for the Year 1 Kindergarten students, and word family rhymes and 'fill in the blank' sentences for the Year 2 Kindergarten students. Table 1 is a summary of the iterations, the roles, and actions taken by the principal investigator and the participants.

Data Collection and Analysis

In accordance with data triangulation (Golafshani, 2003), multiple types of data were collected over the course of four months with both the Kindergarten teachers and ECEs including surveys, interviews, as well as field notes from co-planning meetings and observations of lessons. These data were gathered across the iteration phases of the study (see Table 1). The interviews and surveys were administered pre- and post-intervention and 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 principal investigator took field notes during co-planning/evaluative meetings and observations of lessons, documenting both observations and researcher interpretations. Audio-recorded data from the interviews were first transcribed by the principal investigator.

The first step in preliminary data analysis that the principal investigator took was to create an intervention matrix to map potential relationships among participants, lesson sequence, and the type of the interventions. Two intervention categories were created Level 1 (L1) and Level 2 (L2). An L1 intervention was when the principal investigator assisted the educator(s) during the lesson through a verbal cue; L2 intervention was when the question or issue was too complicated to explain with words, so the principal investigator had to provide a demonstration.

Table 1

Description of Iterations and Scaffolding Lesson Creation and Set-Up

Iteration	Description	Lesson made by	Technology set-up by
1	Initial meeting Pre-Observation Pre-Survey Pre-Interview		
2	Instructional meeting Co-Planning meeting		
3	Observation: Lesson 1	Investigator	Investigator
	Observation: Lesson 2	Investigator	Investigator
	Observation: Lesson 3	Investigator	Investigator helped educators
	Observation: Lesson 4	Investigator (for K2), teacher (for K1)	Investigator helped educators
	Observation: Lesson 5	ECE for K1, Re-use a lesson (K2)	Educators (w/ help as needed)
	Observation: Lesson 6	Educators	Educators (w/ help as needed)
4	Co-Evaluative meeting		
5	Observation: Lesson 7	Educators	Educators (w/ help as needed)
	Observation: Lesson 8	Educators	Educators (w/ help as needed)
	Observation: Lesson 9	Educators	Educators
	Observation: Lesson 10	Educators	Educators
	Observation: Lesson 11	Educators	Educators
	Observation: Lesson 12	Educators	Educators
6	Post-Survey Post-Interview		

The interventions were then mapped onto the DBR iterations and the number of interventions were averaged over the number of lessons, respective to each educator, and after Lessons 1-6, 7-12, and 1-12 collectively. This process of creating an intervention matrix was corroborated with the co-investigator and this provided detailed and synthesized data to then descriptively analyze.

Data were descriptively analyzed using an inductive analysis approach in which prominent themes emerged from frequent occurrences in the raw data (Thomas, 2006). The investigator uploaded the raw data (interviews and field notes) into a qualitative software program, NVivo (n.d.) and used open-ended coding to create nodes (Johnson & Christensen, 2004). The principal investigator and co-investigator then cross-confirmed the nodes, agreeing on the representativeness of them. Axial coding was used to create themes to illustrate the data set (Johnson & Christensen, 2004). The two investigators then met again to verify these themes and label them in light of the existing literature.

Findings

The response to the research question elicits a description of how Kindergarten educators were coached through DBR to implement technology-enhanced reading instruction. The overarching finding was that the principal investigator needed to assume the role of a coach to support the educator participants in various ways. The data analyses yielded five salient themes that elaborate on the process and type of support for the educators: iterative nature of professional learning, anticipating and diagnosing educators' needs, differentiating support for educators, providing investigator self-determined problem solving, and liaising with administration. Each of these findings is described below with illustrative quotes and examples.

Iterative Nature of Professional Learning

The principal investigator supported the participants in their professional learning by engaging them in the process of DBR. The participants perceived that 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 the repetitiveness of the professional learning cycles helped them solidify the knowledge and skills they were learning. For example, participants stated:

> With your guidance, and step-by-step instructions and I think the repetitiveness … 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)

> 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 extend their learning was an important aspect of the intervention. Overall, the iterative nature (DBRC, 2003) of the DBR framework and method was perceived as beneficial by the participants in their professional learning of integrating technology into their reading instruction.

Anticipating and Diagnosing Educator Needs

An initial and integral part of the principal investigator's support to educators included anticipating their needs. In multiple instances, the principal investigator made decisions

that would benefit the educators by considering their professional learning needs, their roles as educators, and their prior knowledge. For example, the principal investigator 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. (Field notes, October 24, 2018)

Here, the principal investigator was able to anticipate the needs of the educators in order to best support their professional learning. The investigator 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 investigator realized that since the majority of the educators had not used a SMART Board before, that they would not be able to engage in co-planning since they were not aware of its capabilities. The investigator anticipated the needs of the participants and realized that this lesson to familiarize them with the technology was integral for the educators to participate in the subsequent co-planning meeting.

Another example of anticipating the educators' needs occurred when Lesson 4 was enacted three 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 one 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" (Field notes, 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" (Field notes, December 19, 2018). The lapse in time was due to extraneous factors, and the principal investigator did anticipate attrition of their skills during this time since the educators did not have SMART Boards in their classrooms. Based on this information, the principal investigator anticipated the educators' needs, used her professional judgement, and scaffolded the educators by setting up the SMART Board for Lesson 4 and modelling an existing lesson. Overall, the principal investigator 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 principal investigator provided them with. As educators differentiate for their students, they appreciated the same differentiation when it came to their professional learning. In this study, the educators were working through the same technology implementation steps together, so it was important for the principal investigator to validate their needs and objectives and differentiate for them. Differentiation was achieved through the principal investigator helping the educators one-on-one. The educators completed their lessons in the morning until first break; this was when the teachers (not ECEs) had a break for recess. During this time, the principal investigator 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 teaching partners (teachers and ECEs together). It is important to note that most of these meetings included just the teachers, as ECEs did not have the same breaks. However, when the

ECEs wanted to meet, the principal investigator created a time that worked with their schedules.

> 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. (Field notes, December 19, 2018)

> 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. (Field notes, January 16, 2019)

At the end of January, after the co-evaluative meeting, Christina demonstrated an interest in furthering her learning. The principal investigator 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 principal investigator respected this and set up a date that worked for Christina. The principal investigator also had Christina prepare a list of what she would like to do with the SMART Notebook program so that the lesson could target 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. (Field notes, 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 investigator 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 actually having it in their classroom are such huge differences. I told them that this is a great idea. (Field notes, February 1, 2019)

Differentiation of support was also evident throughout the lessons that the educators enacted. The support that each educator required was different, so the investigator had to adapt her coaching to best fit the individual 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 principal investigator's assistance for another lesson. The principal investigator helped K2 set up their lesson; however, for K1 the teacher set it up.

The differentiation that the principal investigator provided for the educators varied and was adapted to their individual professional learning needs. This differentiation on multiple levels allowed the principal investigator to meet each of the educators where they were at in order to enhance their practice using technology in reading lessons.

Researcher Self-Determined Problem Solving

To resolve any issues that arose, intervening was self-determined by the principal investigator who deemed it necessary to immediately address many problems during the research in situ. "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" (Field notes, 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 they often would not notice. The principal investigator immediately addressed this issue by enabling a setting so that the educators could use the iPads with confidence that their students would remain in the application they intended for them. "The teachers were amazed by this and very thankful" (Field notes, October 24, 2018).

An additional example was the SMART Board in the library, after being installed, did not have a computer hooked up to it. The principal investigator, therefore, did not have the *SMART Notebook 18* program that was needed to demonstrate how to use the SMART Board. Immediately, the principal investigator 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. (Field notes, November 1, 2018)

This immediate problem solving allowed the principal investigator 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 principal investigator allowed the study to continue with few issues. Although, many other problems arose that the principal investigator could not always solve.

Liaising With Administration

Liaising with administration was also an aspect of support carried out by the principal investigator to assist the educators. The principal investigator 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 principal investigator found that collegially liaising with administration helped in solving certain problems. 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. (Field notes, February 7, 2019)

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

> [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]. (Field note, January 16, 2019)

In this example, the principal assured the principal investigator 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" (Field notes, December 19, 2018). Throughout the research, the principal was a source of enablement for the investigator; it was important that the principal investigator liaise and coordinate with administration to support the participants in enacting technology-rich reading instruction.

Discussion

With the burgeoning use of technology to enhance teaching and learning, educators are experiencing increasing difficulty in 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). This study sought to drill into the nexus between these two contemporary challenges: implementing technology in the classroom and providing effective early literacy instruction in Kindergarten. The findings describe how Kindergarten teachers and ECEs can be coached through DBR to implement technology-enhanced reading instruction to support their students' reading development. The support that was provided to the participants mimicked the Gradual Release of Responsibility (GRR; Pearson & Gallagher, 1983) model, suggesting that this framework can be used to mitigate barriers that educators face in technology implementation. The principal investigator acted as a coach and facilitator as she

provided focused lessons and guided instruction, while the educator participants took part in collaborative learning, and then independent practice (Fisher & Frey, 2008).

It is important to note that in accordance with DBR, in order to begin to support the educators to implement technology, the principal investigator needed to identify and be responsive to their skills, knowledge and practice—this prefatory practice contributed greatly to their professional learning. Pre-intervention, the principal investigator observed that the educators' technology use focused on learning through games and play, which are both teacher-directed (Play Learning Lab, 2018). The principal investigator was respectful of their chosen practice and used it to formulate the focus of some of the lessons and the professional learning. Fundamentally, the principal investigator also supported an unstructured, play-based teaching method (opposite of teacher-directed); however, as an early childhood investigator, she recognized that multiple types of play exist, and should all be used in moderation in the technology-enhanced classroom.

Additionally, previous literature highlights the importance of the iterative cycles of intervention in DBR (DBRC, 2003; Wang & Hannafin, 2005). This literature coincides with a 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 was important in their professional learning. 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 study.

It is worth taking a holistic evaluation of the educator participants' use of technology at the beginning and end of this study's professional learning intervention. A method of characterizing the nature of educators' technology use within instruction is the Substitution, Augmentation, Modification, Redefinition model (SAMR; Puentedura, 2006a). This emerged as a finding (after working with the educators) rather than a framework that was put forth in the beginning stages of planning the research. After reviewing the findings, the investigators realized that SAMR could be used as a potential future professional development framework. Typically, educators start at the bottom, with Substitution and progress up the model's hierarchy to Augmentation, then Modification and finally to Redefinition, which includes advanced ways of teaching with technology (Hamilton et al., 2016). When considering the participants in this research, initially they were using very limited technology in their teaching practices; the principal investigator recognized this and placed them 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. Augmentation is 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 duration of the study (17 professional learning 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; this aligned with Modification.

Overall, the principal investigator was responsive to the participants' practices; how the participants were supported in their technology professional learning can be interpreted pre- through post-intervention, using the SAMR model. Additionally, the iterative and ongoing nature of the research design, as substantiated in the DBR 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.

Implications for Practice

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 in implementing technology into their reading instruction.

First, the model of professional learning employed in this research could be implemented by technology or digital coaches during their sessions/interactions with Kindergarten teachers and ECEs who strive to implement technology to support the early reading development of their students. For example, this study found that differentiation of support for educators was an effective feature of the method used. Shanley et al. (2017) also suggest that coaches target under and overconfident 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, an implication for practice is that coaching support often needs to be intense, sustained, and dedicated. In practice, this dictates that school districts employ several technology coaches. This is an important financial implication for school administration to consider,

however it should not be a deterrent, given the effectiveness of technology interventions on educator practices.

The implementation barriers identified in this study have implications for the practices of digital or technology coaches who seek to 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 mitigate barriers that the participants experienced. Specifically, coaches might use the SAMR framework (Puentedura, 2006a) as a model to address where educators are in their practice and support them to enhance their technological practices to higher levels in the SAMR hierarchy. Using SAMR to diagnose where educators are at in their practice might allow coaches to more accurately address educators' 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).

It is strongly recommended that after coaching support is removed, there should be a sustainability plan in place for continued implementation and ongoing educator scaffolding. Without continued support, educators may not maintain the practices bolstered by the coaching support. As Cviko et al. (2012) found, the principal plays an important role for technology implementation and sustainability in schools.

Limitations

As with any type of research, this study comes with notable limitations that are important to consider when interpreting the findings or considering future research. Limitations to generalizability came from three main sources. First, this study employed

a small sample size of four Kindergarten educators and it took place in a moderate-to-high socioeconomic school. Another limitation was the short implementation time frame of the research. The last notable limitation 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 investigator 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).

Conclusion

Professional development for educators is the impetus to enhancing their practices (Kennedy, 2016) with the goal of enriching student learning. Relatedly, McGlynn-Stewart et al. (2017) state that current and future 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 (Canadian Index of Wellbeing [CIW], 2016) including reading—one of the most fundamental skills. The findings of this study illuminate that DBR can be used and implemented by technology or digital coaches during their professional learning support for Kindergarten teachers and ECEs in integrating technology into reading lessons. Based on the current model of professional learning support, it was found that coaching support needs to be intense, sustained, and dedicated. Additionally, the GRR model can be employed to mitigate the potential barriers that occur in a professional learning context. Overall, the support that coaches provide to educators has the breadth to enhance their instruction and enrich student learning, therefore having vast positive implications. This study sought to address these issues by providing coaching to Kindergarten educators through a DBR

framework 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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