Chapter Two

Literature Review

Primarily Blended — Reading

Introduction

Children are unique individuals with specific needs that are exclusive to them. They grow and move through different stages of development at various paces. Childhood development looks different for each child, so why, in so many ways, does our education system not honour this? The new British Columbia Education Plan states, "the key focus is personalized learning" (BC Ministry of Education, 2015, p. 1). Children learn at different paces and through a variety of learning styles that need to be recognized and embraced.

This literature review is an examination of how a blended learning model can be applied to facilitate personalization in the area of Reading instruction for primary students. It addresses what blended learning is, why educators may choose to use it and what model of blended learning is most effective in a face-to-face diverse primary classroom. It establishes how a blended model can personalize student learning and enhance engagement. The review identifies some of the barriers to implementing a blended learning environment faced by educators.

Early Primary students enter school with various strengths and abilities. In order for them to learn to read there are certain skills that need to be mastered. According to the 2016 research report, "Read About It: Scientific Evidence for Effective Teaching of Reading" there are 5 key areas that are crucial in the success of learning to read. The findings state that these 5 areas are:

1. Phonemic awareness: The ability to hear and identify individual sounds in spoken words

2. Phonics: The relationship between the letters of written language and the sounds of

spoken language

3. Fluency: The capacity to read text accurately and quickly

4. Vocabulary: All the words students must know to communicate effectively

5. Comprehension: The ability to understand what has been read (Hempenstall & Buckingham, 2016, pp. 4-5)

The very fact that students develop and learn to read at different rates leads to the importance of establishing a blended learning model. A blended model will grant students the ability to learn at their individual, developmental pace, and master concepts through personalized learning.

Through my research investigations, I will demonstrate how specifically implementing a Station Rotation blended learning model for reading instruction will allow primary school students to grow and learn at their individual level and pace to meet the mandate of the new BC curriculum.

Defining Blended Learning

There are a wide variety of pedagogical teaching methods available to educators today, and blended learning is among them. What is blended learning? Blended learning is defined as education delivered in part online and in part face-to-face. Students are in control of some element of their learning being it time, place, path and/or pace. As well, the subject the student is learning online and face-to-face is connected to create an integrated learning experience (Horn & Staker, 2015). Horn and Staker (2015) identify the four main models of blended learning as the Rotation model, Flex model, A La Carte and the Enriched Virtual model.

Rotation Model. In the Rotation model there are four-sub categories-Station Rotation, Lab Rotation, Flipped Classroom and Individual Rotation. In the Station Rotation model,

typically students work with the teacher in small groups at their targeted skill level, and then

rotate through an in class technology station and a peer and/or individual station to put the skills

learned at the teacher station into practice. Lab Rotation is like Station Rotation but students

move to a computer lab for the technology rotation. Flipped classroom consists of students

independently receiving online lectures or lessons and then using classroom time with the

teacher to solidify understanding. Finally, the Individual Rotation model has students rotating

through on an individual, customized schedule set-up through either the teacher or through a

computerized algorithm. (Horn & Staker, 2015)

Flex Model. The Flex model, unlike the Rotation model, starts "with online learning and

add[s] physical supports and connections where valuable" (Horn & Staker, 2015, p.47). Online

learning is the main component of student learning in the Flex model.

A La Carte. The A La Carte blended learning model is mostly implemented at the high

school level. Students take some entirely online courses while also attending classes at a face-to-

face bricks and mortar school (Horn & Staker, 2015).

Enriched Virtual Model. The Enriched Virtual blended learning model is set up so

students have set days and times that they are in a face-to-face classroom environment, and the

remainder of the time they work independently online whenever and from wherever they prefer

(Horn & Staker, 2015).

It is quite common for schools to use a variety of these models by combining them in

different ways to reach a customized program (Staker & Horn, 2012, p. 2). Now that we have an

understanding of the different blended learning models we need to look at why educators would

choose to blend the face-to-face primary classroom with an online component.

Why Blended Learning?

The primary classroom, like most K-12 classrooms, is filled with students that have varying, complex and unique learning needs. The days of teaching to the middle level in hopes of reaching the majority of students are gone. Kaye Thorne (2006) author of eBook, "Essential Creativity in the Classroom-Inspiring Kids" states, "blended learning represents a real opportunity to create learning experiences which can provide the right learning at the right time and in the right place for each and every individual" (p. 105). Educators strive to meet individual student's needs and personalize a learning program to fit those needs. Using a Station Rotation blended learning model is one way for primary teachers to customize programs for individual students. Allowing students to work at their own pace and providing time for practice has been shown to benefit the struggling student (Schechter, Macaruso, Kazakoff, & Brooke, 2015).

There are six main reasons why educators may choose to implement a blended learning model, or models, into their practice, including pedagogical richness, access to knowledge, social interaction, personal agency, cost effectiveness, and ease of revision. However, the overwhelming rationale for implementing blended learning is the combination of the best of both worlds (Bonk & Graham, 2005). Stein and Graham (2014) state, "the wealth and availability of information continues to grow at astounding rates, and the skills and knowledge that workers need to thrive in this twenty- first century are ever changing" (p. 12). Exposing students to the digital world prepares them for their futures and the jobs that are yet to be invented. A deeper, more thought-provoking reason for the application of blended learning comes from Thorne (2006)

It [blended learning] presents an elegant solution to the challenges of tailoring learning and development to the needs of individuals. It also represents an opportunity to integrate

the innovative and technological advances offered by online learning with the interaction and participation offered in the best of traditional learning (p. 104).

Utilizing blended learning in the classroom assists educators in successfully adapting learning for students through different, more innovative, means to deliver the curriculum. According to Stein and Graham (2014), "Educational research suggests blended courses are more effective compared to both face-to-face and online" (p. 15). A 2009 report on 51 empirical studies, comparing online education with traditional face-to-face courses, concluded that combining online and face-to-face instruction created a greater educational advantage for students (Stein, J., & Graham, 2014). If blended learning creates greater educational advantages, educators need to look more deeply at what method and devices would be best utilized in a face-to-face bricks and mortar primary classroom when applying this delivery model.

Considerations to Blending the Primary Classroom

Devices and screen time. Technology brings with it a level of skill, dexterity and patience most primary students have yet to achieve. According to Neumann and Neumann (2017), "Unlike personal computers that require more complex fine motor skills to operate, the intuitive touch-based interface of tablets make them easy to use" (p. 204), allowing even young students the opportunity to interact with and learn through technology. Most educators would agree that it is not an ideal situation for young primary students to be in front of screens for long periods of time. The time spent on devices must be thoughtfully considered to ensure students are engaged in active vs. passive screen time.

In their paper titled, "Active Versus Passive Screen Time for Young Children," the authors describe active screen time as time spent engaging in either cognitive or physical activities such as video games or homework. Whereas, they describe passive, sedentary screen

time as watching television or videos (Sweetser, Penelope, Johnson Daniel, Ozdowska Anne, 2012). The authors go on to state, "there is a substantial body of research that illustrates the benefits of Active Screen Time in terms of cognitive skills and development" (p. 96). With this information in mind it is important that students are exposed to different technologies that allow for active screen time that enhances their learning. The benefits of active screen time and allowing students to work at their own pace or level, needs to outweigh the negatives associated with passive screen time. The Station Rotation model of blended learning affords the educator a well-balanced amount of active screen time, which benefits the learner, engaged in these digital learning experiences.

Station Rotation blended learning model. The Station Rotation model seems the obvious choice for adapting the face-to-face primary classroom setting. Many traditional classrooms already have a similar form of rotations minus the technology rotation. With a Station Rotation delivery model, students would be accessing individually levelled online content for approximately 15-20 minutes during the technology rotation aspect.

A case study of the Station Rotation model in a third grade classroom suggests five lessons for future educators to consider when implementing blended learning into their face-to-face classroom. These five suggestions include giving yourself permission to make mistakes and learn from those mistakes, to be flexible, to start small, and to not worry about blending every subject, every day, to remember that teaching a whole class lesson is needed sometimes, and to collaborate with other blended learning educators (Truitt, 2016).

There are many additional considerations educators need to examine before implementing a Station Rotation blended learning model into their practice. Before introducing

technology into classroom rotations we need to consider the benefits and challenges that we may face when blending a primary face-to-face classroom using a station rotation model.

The Pedagogical Benefits and Challenges to a Station Rotation Blended Learning Model

      The benefits. There are four key benefits to implementing the Station Rotation model in a primary classroom. The first benefit is that it frees up the educator and allows them to work on targeted skills, with small groups of students. Secondly, it allows students to work at their individual pace mastering skills and creating more engagement with their work. Thirdly, it allows for student creativity by engaging with different technology applications and finally, it allows for flexibility of student movement within the different rotation groups depending on their prior knowledge and strengths of a topic (Casey, 2016).

      The challenges. With any new idea that we bring to the classroom to make learning more accessible, and engaging, we must be aware that there will also be challenges. Challenges are not necessarily negative however. Armed with knowledge of possible challenges prepares the educator and allows time for them to face these challenges head on. Some challenges encountered in a study of a fourth grade class were technology applications not working properly or technology updates interrupting the learning during a rotation, off task behaviour of students during the independent technology rotation and, the noise level in the classroom in general, and particularly, while transitioning from station to station (Casey, 2016). While these create an added stress for teachers in regards to classroom management, they don't outweigh the benefits of implementing a Station Rotation model in a primary face-to-face classroom.

      Routines and relationship building are essential to help address these challenges. A study conducted in primary classrooms at the beginning of the school year found effective teachers

build relationships and routines with their students, which teaches students how to be self-regulated learners (Bohn, Roehrig, & Pressley, 2004). Building routines and expectations not only around classroom culture and expectations, but also around the use and expectations around technology is imperative. Once these expectations and routines are formed, educators will have the tools necessary to begin personalizing reading (or other instruction) for students engaging in a Station Rotation model.

Personalizing Reading Instruction for Primary Students

What exactly do primary teachers want to improve for their struggling to read students? What is missing for these students that is a barrier to their learning and engagement? Many students lack the very basic reading skills such as the ability to rhyme, identify rhymes, hear and say phonics sounds, and blend sounds to create words. Would students advance in these areas if they were given the opportunity to have targeted small group, teacher led lessons, complimented with specific skill development through the use of technology?

One study, conducted over two consecutive school years using iPads with the lowest reading group of first graders, found students made elevated average gains, increases in time-on-task behaviour, increased engagement when using targeted reading skills and improved reading skills overall (Burns, Larabee, & Jennifer, 2014).

Similarly, a group of four kindergarten students using a computerized tutoring program focusing on letter sounds resulted in improvements in letter sound knowledge and fluency. The authors state, "educational technologies may work best as supporters and facilitators of quality reading instruction rather than replacements for teaching" (Burns et al., 2014, p. 452).

Another study used a Computer-Assisted Learning (CAL) program, Accelerated Reader (AR), where the study results confirmed that computer-assisted learning had a positive impact on

elementary students' reading achievement. The study noted that students who engaged in the CAL reading program had greater learning gains than that of their traditionally-taught peers (Shannon, Styers, Wilkerson, & Peery, 2015). This demonstrates the need for a blended learning model, like Station Rotation, for meeting the targeted needs of primary students. Using a Station Rotation model to personalize reading instruction sounds like a direct-route to meeting individual student needs, but there are barriers to implementing a blended learning program that need to be considered.

Barriers to Implementing a Blended Learning Program

There are always barriers to implementing any new or different way of teaching, but if we identify and arm ourselves with background knowledge the barriers become less obstructive, and more like minor hurdles to clear. In 'Knocking Down Barriers' the authors identify two main barriers for the face-to-face elementary education system to consider before implementing a blended learning program. These barriers include the redesigning of teacher roles and the purchase and management of the technology and infrastructure (Horn, Gu, & Evans, 2015). Traditionally, teacher roles in the elementary classroom include teaching all the subjects areas to their entire class of students. For blended learning success, this may need to develop into a more cooperative teaching model with more open spaces and multiple teachers supervising the learning (Horn et al., 2015).

Another barrier faced by educators wanting to begin a blended learning program is that of technology and infrastructure. Funding is always an issue in education and implementing technology brings with it the need to purchase and manage technological devices and infrastructure. Educators need to advocate the benefits that technology brings to the personalization of student learning. When the powers that be have a clearer understanding of

these benefits they are more apt to find ways to implement. This could be as simple as looking to other districts already doing something similar to what they envision, allowing students to bring their own device and only providing devices for those students who do not have one, and finally looking at outside funding and or grants that can be applied for in order to get started (Horn et al., 2015).

Conclusions

Technology is a huge part of everyday life in the 21st Century. New applications and devices are being created almost daily to seemingly enhance and improve our day-to-day lives. Just as students today are not like those of thirty years ago, nor should the education system stay the same as the model developed during the industrial revolution. Technology is, and should be, playing a new role in the education of students today. One of the positive aspects of technology is its role in facilitating a more personalized education for individual learners. Students are not all the same, and therefore their educational programs should not all look alike. Every student should be given the opportunity to learn and grow at his or her individual pace. Utilizing a Station Rotation blended learning model in the primary face-to-face classroom supports this personalization. As the 20th Century educational reformer John Dewey (n.d.) stated, "If we teach today's students as we taught yesterdays, we rob them of tomorrow."

British Columbia educators need to understand what, and how, technology can reform the education system for the 21st Century. They need to be advocates for technology and blended learning models in order to meet the government's mandate to personalize student learning and promote critical and creative thinking, collaboration and communication ("BC's New Curriculum," n.d.). As Stein and Graham (2014) contend, "using connected mobile tools such as Smartphones, tablets, and laptops, we purposefully "blend" physical and online activities to

create optimal experiences" (p. 9). Together with technology we can meet the needs of all students and personalize the education system in support of the 'educated citizen' described in the new curriculum.

The findings of this comprehensive literature review will be applied to the design and development of my Master of Education in Educational Leadership (MEdL) Major Project as presented in Ch. 3 of this process paper.

<div align="center">**Literature Review**</div>

<div align="center">**Primarily Blended — Writing**</div>

Introduction

In my face-to-face primary grade 1 and 2 classroom, I have been interested in looking at how mobile technology can support my beginning writers. In researching my Critical Challenge Question, *"How can a blended learning model be applied to facilitate personalization of writing instruction for primary students?"* I have found that there is some literature to specifically support blended learning in a primary face to face classroom, but many gaps still exist. In this literature review, I investigate how technology can support writing in a face-to-face classroom which also engages a blended learning delivery model.

It seems as though blended delivery is still a topic that challenges the beliefs of many educators. Education is changing. It is changing at a rapid pace, and not everyone is ready for the changes that need to come. Today's students are not the same students as in the past who were dependent on teachers and parents to directly deliver information or knowledge. Students are now using iPads, iPods, Smartphones, computers and software programs in every aspect of their lives, (Alkhamis, 2015). To keep our students engaged, and to prepare them for their futures, educators must be willing to embrace the changes in education and pedagogy. Technology is evolving at such a rapid rate, and we need to evolve our teaching styles alongside this shift. Technology and mobile devices can play a key role in our teaching and in our students learning. These tools can be used to effectively support a blended delivery model.

The Change Towards Blended Learning

Change in education is coming, and not everyone is ready for it**.** Our culture of teaching and learning is a deeply embedded ideal, often defined by how we were taught— it is all we

know, after all (McLeod et al, 2014). Technology in education is becoming a new reality, and students in the 21st Century are benefiting from the positive change it brings. Blended learning and the use of technology in primary classrooms, is still a very new concept. To have a blended model work in a primary classroom it will be essential to understand what blended learning is. Blended learning has a two-part definition. (Horn and Staker, 2012) explain that,

> blended learning is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace and, at least in part, at a supervised brick-and-mortar location away from home (p.3).

Elements of blended learning. The two elements of blended learning that are essential for any program are: student control over path and pace; as well as being present in a classroom for part of the students' learning. What students learn online must influence what they learn face-to-face, and it is necessary for the teacher to be involved and be tracking (through the online program's teacher feedback feature) what students are doing at home so that they can support and scaffold students learning at school. This could facilitate a teacher sharing a program with students that they access at both home and school— where the teacher is provided formative feedback as to how their students are progressing via questions within the program. (Horn and Staker, 2012) state that someone associated with the brick-and-mortar setting provides the supervision for online learning, rather than a parent or other adult. Teachers are still essential to a successful online or blended learning program. Blended learning, as a whole, looks different in many settings. Teachers can apply a blended model of learning to many face-to-face classrooms given the appropriate amount of technology and structure is in place to support this delivery option.

Thibault et al., (2015) found that the connections among agents and tools in a blended learning environment are rich and diverse, enhancing the process of distributed cognition across its elements. Blended learning can be a beneficial practice for both the educator as well as the learner as blended learning leads to personalization in education. To effectively blend a face-to-face primary classroom, it could be beneficial to implement a Rotation model of education in a face to face classroom.

The Rotation Model

A Rotation model is a model that best supports a blended face-to-face classroom. (Horn and Staker, 2012) define a Rotation model – as, "a program in which within a given course or subject (e.g., math), students rotate on a fixed schedule or at the teacher's discretion between learning modalities, at least one of which is online learning" (p.8). Teachers are able to personalize learning for students and this will ensure that student centered learning is at the forefront of all learning opportunities. Using a Rotation model, teachers with student-centered beliefs can integrate technology in the classroom in more student-centered ways (Ertmer and Ottenbreit-Leftwich, 2010). In a primary classroom, blended learning can be applied to have students working in a Rotation model, where they are in a classroom every day, but where they still have choice over time, place and pace of their learning in a specific subject area. This control of time and place may have students choosing which days of the week they use technology.

A Rotation model would support a primary classroom that is using mobile technology such as iPads or a class set of Chromebooks. Mobile learning eliminates the need to have special dedicated computer labs and offers teachers full freedom to let students work with online applications whenever they need to (UNESCO, 2010).

Station Rotation model. Specifically, within the described Rotation model, a Station Rotation approach is the most practical application of blended learning in a primary classroom. A Station Rotation model is a Rotation model implementation where a given course or subject (e.g., Math) has students rotate on a fixed schedule, or at the teacher's discretion, among classroom-based learning modalities. The rotation includes at least one station with Internet access for online learning, (Horn and Staker, 2012). Using a Station Rotation model would support the learning that is already taking place in most primary classrooms. Students are accustomed to seeing the Station Rotation approach, so if teachers are utilizing that model and implementing technology rotations, students would be gently scaffolded into using technology. Before we can let students begin to delve into the technology and applications that we want them to be using, students need to be informed about digital citizenship and internet safety.

Digital Citizenship and Internet Safety in Primary Classrooms

The Internet can be a large, formidable open resource. It can be a source of anxiety for educators when they start to use a blended learning model. Wohlwend (2009) emphasized that understanding technology has become an important preparation for life. When we, as educators, choose what technology to bring into our classrooms, and also our students lives, we must be mindful to choose programs that are safe and that support our students in being informed digital citizens. All too often we hear of students who have used the Internet in a negative way, for example, bullying other children using social media. It is important to instill early on, a set of values and beliefs around being responsible digital stewards. As primary classrooms typically form class sets of beliefs and values, we can build from the values and classroom guidelines that we already have in place and apply them to online classrooms or content.

Children need to be taught that what they share online stays there. They need to be informed that they are responsible for what they put out into the networked world. They also need to know that the Internet is not always safe, and that there are things we can do to protect ourselves amidst a technology-infused world. The current generation of students was born into a society where technology is ubiquitous, and this generation is very familiar, and comfortable, with technology (Alkhamis, 2015). This level of comfort can sometimes lead students into a false sense of security. When using technology with students, it is important to be aware of what they are doing with their mobile devices as well as constantly leading by example as to how they should behave when they are using Internet-connected mobile devices. When teachers evaluate and select the apps and programs that students use, they need to be aware of the specific purpose and be making the best decisions that they can regarding suitability and appropriate use. Educators should be testing the programs before implementing them with a class so that they can see where some of the challenges may lie.

Personal Writing, Story Writing and Mobile Devices in Writing

Mobile learning needs to be understood as an emerging repertoire of learning and teaching practices rooted in the belief that interaction and collaboration within a traditional classroom are often not as effective as they could be (UNESCO, 2010). Mobile devices will enable students to collaborate and interact with one another in new ways. For example, students can use devices to work collaboratively to create stories. Paul (2016) states that his general guiding principle is "to use handwriting to process and digital tools to create and demonstrate" (paragraph 8). Utilizing mobile devices to create edited books using applications such as Book Creator or Pictello are great ways to showcase student's writing in a non-traditional manner. Mobile devices can be utilized for students within a pre-existing writing program. A Rotation

model can be employed, whereby students share a device with a partner, or they work on devices during specific teacher-chosen days. Mobile devices will enable students to stretch themselves, and express themselves in many new ways that are not accessible to them without technology available in classrooms.

Bratitsis et al., (2012) reported that computers attracted students' attention and provided strong motivation for lengthened engagement in the story writing process. Traditional story writing can be very challenging for primary students, but mobile technology can offer an alternative to traditional paper and pencil writing. Students can illustrate, use pictures or videos to animate and enhance the stories they have written. For primary students in particular, it can be very difficult to record ideas on paper. Technology could be used to document students' brainstorms as audio recordings to listen back when they need new ideas— like a digital brainstorm. Young children often become frustrated with the difficulties they encounter as they attempt to record their ideas on paper (Christensen, 2017). It is important to remember that students of all abilities need access to learning tools that work for them. Mobile devices are one way for students to access writing even when they find writing challenging.

Access for Students with Special Needs— Assistive Technology

The use of mobile devices in primary classrooms directly improves student agency, engagement and motivation. Mobile devices support the accessibility of content for all learners. Levy (2014) explained that iPad's act as a translation, communication, and individualization tool with unrivaled effectiveness. In so doing, these devices reduce frustration, build confidence, and, well, just *work* in teaching students the skills they need to learn to thrive.

Students with disabilities will benefit from having alternate ways to learn, explore and then demonstrate their understandings. Mobile devices support students working together, and

cooperatively. Students can work together as they dive into new content and apply what they've learned in the classroom (Burns, 2018). The goal of the educator is to always reach our students at both ends of the learning spectrum, and mobile devices and assistive technology make that possible. One of the most important things that we gain from mobile devices and technology in the classroom is that we now have the ability to ensure that all students receive the type of educational experience they need, at the time they need it (McLeod et al, 2014). Being able to personalize our student's education and ensure that they are getting what they need, when they need it is a huge challenge for teachers who already feel they are spread too thin. Teachers cannot always be everywhere they are needed, and it is comforting to know that students can be working at their own pace despite whatever else is happening in the classroom. Mobile devices also support communication between learners, as well as with the teacher. By attending to the needs of learners with disabilities, learning provision is also improved for those who have hidden disabilities and those who learn more effectively when material is presented in alternative ways, (UNESCO, 2010). In short, educators are able to reach all of our learners by engaging mobile technologies.

Mobile devices make learning accessible to all learners and there are many practical ways in which m-Learning supports diverse learners. UNESCO (2010), mentioned tools that can be used, such as dictionaries downloaded to mobile phones or game consoles, that are helpful as reference tools for learners with dyslexia and other learning challenges. Text-to-speech conversion and voice recognition are also helpful for students who may have written output challenges. In having assistive technology available for our students who need it, we are ensuring that students class time and learning experiences are meaningful for them. Universal design for learning is also a concept that lends itself to meaningful learning for individual students. When a

teacher can plan with the "the three principles of UDL: Provide multiple means of engagement, provide multiple means of representation, provide multiple means of action and expression" (CAST, 2014) pg. 59, they will be planning for the needs of all students. The guidelines would be used to evaluate and plan goals, methods, materials, and assessments for the purpose of creating a fully accessible learning environment for all. (CAST,2011). Technology can be used to reach all of our learners, and it can also be used to engage our students who are needing an extra challenge in their learning experiences.

Technology as a Way to Extend Learning for Writers

Mobile devices and m-Learning are ways to extend student's learning and writing. Geist (2011) noted that the iPad is a useful tool for elementary students because it "allows children to manipulate objects in a natural way with little adult intervention" (p. 765). Students who struggle with written output may succeed with little adult support when using an iPad. Students can use multiple programs in order to extend or support their writing. Apple has iMovie, which can be used to create movie trailers. Students can use this app to create a movie trailer for a book, or a story that they have written.

Research shows that online programs used at school need to be ones that can also be accessed at home. When students have access at home as well as at school, they are more likely to continue to write at home— as well as stretch themselves as they can take risks at home when they may have support from adults as well as privacy from peers. Recently, two studies that separately followed fifth and eighth graders who used tablets for learning in class, and at home, found that learning experiences— including writing— improved across the board (Lynch, 2017). This is important to note, as students who are able to access content at school and at home saw improvements in their writing. When we can provide learners with apps and programs

to use at both school and at home, they are able to independently practice needed skills without direct instruction from the teacher.

Students need visual stimulation which could be facilitated by apps, as well as other means, to creatively express themselves. Writing can be enhanced by visual depictions facilitated by easy to use apps. Book Creator, Pictello, and Explain Everything are three iPad apps that are very well rated in terms of accessibility and ease of use for primary students. These apps can be used to brainstorm, plan, write, as well as showcase written work. These apps lead to student's increased engagement with their work, as well as giving students alternative ways to present their learning.

Assessment *for* and *of* Learning

Students have opportunities to show their learning in alternative ways when they are able to use mobile devices. Students are able to work from their own strengths, as well as having the ability to show their learning in multiple ways. Alternate assessment tools can be employed to present learning in a variety of ways. According to the BC Education Plan,

> Students, teachers and families will benefit from more flexibility and choice with respect to how, when and where learning takes place. This means schools must have flexibility to design learning opportunities that really work for students and boards of education need the latitude to organize programs that extend beyond the typical school and classroom format (p.10).

This could have students using iMovie to show a video trailer that they have created for a story they wrote, they could use Pictello to voice over pictures and scenes that they have made— *telling* a narrative story instead of writing it. Students will become activated learners through using iPad technology, while discovering their own skills, and feeling more successful and in

control of their own learning. They may become more motivated to learn simply by choosing, and playing, their own educational games (Geist, 2011). Hung, Hsu, & Rice (2012) suggest that when using online programs, information stored in learning management server logs can provide a very rich source of data for investigating actual learner behaviors— something that is typically very difficult to do in face-to-face environments. Educators can then use this data to inform their teaching. Mobile devices provide rich assessment *for* and assessment *of* learning. These opportunities will support teachers in stretching their learners and providing rich and meaningful learning opportunities for their students. Teachers using alternative means of assessment are able to assess students from an asset-based model rather than a deficit-based model where each student has to represent their learning in the same way.

Conclusions

My research into how to use blended learning to support writing has resulted in some key learnings. These include the fact that the two elements of blended learning that are essential for any program are: student control over path and pace; as well as being in a classroom for part of their learning experience.

Students of all abilities will be supported by a blended classroom utilizing mobile devices. It is important to remember that students of all abilities need access to learning tools that work for them. Mobile devices are one way for students to access writing even when it could be a learning opportunity that they find challenging. By having assistive technology available for our students, we are ensuring that students class time and learning experiences are personalized and meaningful for them.

Educators need to try and bridge the gap between what happens at home, and the learning that happens at school. When students have technology access at home as well as at school, they

are more likely to continue to write at home— as well as stretch themselves by taking risks within a secure space. By using mobile devices to present their learning, students are able to work from their own strengths, as well as having the ability to showcase their learning in multiple ways. Teachers are therefore able to assess students from an asset-based model rather than a deficit-based model where each student has to represent their learning in the same way.

The findings from this comprehensive Literature Review will be applied to my major project design and development as presented in chapter 3 of this Process Paper.

Literature Review

Primarily Blended — Numeracy

Introduction

Schools were originally designed for the industrial age when most students leaving high school entered factory jobs. In today's world, graduating students will be applying for jobs that require a greater knowledge and skill set than their predecessors. We are now in the information age where, with technology, knowledge is at everyone's fingertips. With the demand for 21st Century skills in the workplace, our education system needs to change in order to produce "well-educated citizens who are able to think critically and creatively and adapt to change" ("Curriculum Overview | Building Student Success - BC's New Curriculum," 2018, para. 8).

Students don't learn at the same pace; this attribute even varies from subject to subject (Horn and Staker, 2015). We all have different aptitudes and bring different prior knowledge to each learning experience. This affects the speed of knowledge retention as well as how we gain knowledge. The new BC curriculum sees personalization as a way of ensuring all students' diverse needs are met and students achieve their full potential. Through high quality and engaging learning opportunities, flexible timing and pacing, and with tailored learning supports that meets students' needs ("Curriculum Overview | Building Student Success - BC's New Curriculum," 2018).

One way to personalize learning in a primary classroom, which typically has an adult to child ratio of 1:22, is to use a blended learning delivery model. This practical application led to my Critical Challenge Question '*How can a blended learning model be applied to facilitate personalization of numeracy instruction for primary students?*' which will be addressed by this literature review.

This literature review will define blended learning, reveal which model is best suited in primary education and examine the challenges and benefits of implementing a blended learning model in a face-to-face classroom. It will explore what is essential to personalize numeracy in a face-to-face classroom as well as, consider the current research to determine what mobile devices and apps might help to facilitate the study of Mathematics for primary students. Lastly, the literature review will explore the correlation between the rotation model and achievement in Mathematics in the primary classroom.

What is Blended Learning and Which Model Works Best for Primary Students?

Blended learning is the mix of face-to-face instruction with online learning components. Horn and Staker (2015), define blended learning as "any formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace" (p. 34). The face-to-face aspect takes place in a school or learning center that is away from the student's home. Both learning environments work together to provide the students with an integrated learning experience. Horn and Staker present four main types of blended learning models that are currently being used in various educational settings. These include: the Rotation model; Flex model; A La Carte model; and the Enriched Virtual model.

Face-to-face schools are moving toward a more hybrid model in "an attempt to deliver 'the best of both worlds'— that is, the advantages of online learning combined with all the benefits of the traditional classroom"(Christensen, Horn, & Staker, 2013, p.5). The hybrid models that appear to work best for teachers of primary students, wanting to begin using blended learning are the Rotation models where "students rotate— either on a fixed schedule or at the

teacher's discretion— among learning modalities, at least one of which is online learning" (Horn & Staker, 2015, p. 37).

"One of the key reasons why teachers and schools should consider blending is for the ability to better support different types of learners" (Oliver & Stallings, 2014, p.7). In Mathematics, not all students are learning at the same pace, therefore one lesson cannot possibly address all student needs. Using a Station Rotation approach would allow the teacher to work with smaller groups, while others would be able to work independently on their individual assignments using technology. Research demonstrates that "practicing with the computer increased students' academic engagement rate while allowing for teachers to provide direct instruction to small groups" (Schoppek & Tulis, 2010, p. 10). Using the Rotation model in our face-to-face classroom would allow teachers to help personalize instruction for all learners.

Challenges to Implementing a Station Rotation Model in a Primary Classroom

Despite the advantages that a Station Rotation model, that incorporates mobile devices, offers both over face-to-face instruction and fully online instruction, there are still some barriers to implementing it at the primary level. The most notable challenge is the lack of digital fluency on the part of both the teachers and students (Mirriahi, Alonzo, & Fox, 2015, p. 11). Professional development time is needed for teachers to effectively implement a blended learning environment. This is deemed important as "research reminds us that changing the medium or modality of instruction requires more than just new technology, but also new attitudes and skillsets" (Laura Kassner, 2013, p. 12). It also takes more time to plan a blended learning course than a face-to-face course (Oliver & Stallings, 2014). Teachers must take on the role of an instructional guide versus the traditional deliverer of content.

Primary students also need to learn proper digital skills in order to be successful in a Station Rotation approach. In Kenney and Newcombe's (2011) study they found, "one weakness of the approach mentioned by the students was the difficulty of learning on their own and not being able to immediately ask questions if they were unsure about the material"(p. 9). When working with primary students, it is necessary to scaffold both the technology skills as well as the concept learning skills when designing a Station Rotation program. "Blended teaching presents the content in an attractive manner, due to the various effects, which enables meeting the different levels of the students, and designing activities which are appropriate to the real levels of the students" (Yaghmour, 2016, p. 7). Many primary blending models make use of peer tutors where students are often helping each other during their technology station. Catherine Attard (2013) notes, the lack of having a 1:1 ratio of iPads per students encourages sharing and "sharing promotes reasoning and supports the development of mathematical language" (p. 39). Understanding the benefits and challenges of implementing a Station Rotation model, primary educators need to consider what the essential components are to personalize numeracy instruction in a face-to-face classroom.

What Considerations are Essential to Personalizing Numeracy in a Face-to-Face Blended Classroom?

   Pedagogy to support primary Mathematics instruction. Research on effective Mathematics teaching is based on the constructivist learning theory where students build or construct their knowledge from experience and previous understandings (Simon, 1995). As educators we need to be able to access where students are at, in order to provide activities and problems that are at their level of understanding. Students then can access their prior knowledge to construct new meaning. Students need to be active in this process and the teacher is more of

the guide, allowing the students to construct their understanding. Del & Diaz (2017) state, that students need to "master the basic strategies of computation using them in different contexts" (p. 3). Using a blended learning model allows students to progress at their own speed and develop mastery of these skills. The 20th Century psychologist Lev Vygotsky argued that for optimal learning to occur students need to be in the zone of proximal development (McLeod, 2012). Using a blended learning Station Rotation approach allows teachers to work with smaller groups to promote this optimal learning environment for all students.

Personalized learning. A variety of considerations need to be addressed in order for personalization to happen in the primary classroom. To personalize blended learning, Hunsinger-Hoff (2016) states, "personalized learning can't be realized unless teachers know their students well—their interests, their prior experience and learning, and what motivates them"(p. 3). The author suggests using the first few weeks of school to get to know students by providing them with personal surveys and presenting technical activities that allow the teacher to get to know each student as an individual. These mini lessons should be two-pronged in the sense that you teach a concept as well as provide technical lessons. Not only do teachers need to learn about student's interests and prior knowledge, they also need to learn how their students view themselves as learners. The author goes on to state,

> It is indeed empowering for every student to know that they are smart in some, usually several, ways. Empowering students by guiding them to discover and take pride in their strengths, as well as acknowledge and accept their shortcomings as opportunities can set the stage for a year-long quest in the classroom when intelligences are recognized and celebrated (Hunsinger-Hoff, 2016, p.7).

Mastery learning. To fully personalize learning educators must allow students to master skills in a content area (Horn & Staker, 2015). This is especially important when learning Mathematics as students need mastery of subskills in order to fully grasp higher skills. In typical face-to-face classrooms the time needed to develop mastery skills is simply not available, which often creates frustration for students who are not ready to move on to more advanced skills. One-way blended learning addresses this is through repetition,

> one of the most important features of blended learning, and one of the factors which
>
> contribute to its success, because it enables learners to receive the same message from
>
> several sources, in different forms and at different times (Yaghmour, 2016, p.2).

Kenney & Newcombe (2011) encourage teachers to take time to decide what should be delivered online and what should be taught face-to-face in the blended learning classroom. They advise teachers "to make sure that the two components are blended or integrated thus complementing each other" (p.6). What Mathematics the teacher delivers online must review and assess their understanding of what Mathematics is taught face-to-face. It is imperative that the apps and programs have assessment tools built in that can provide the teacher with information as to what concepts students are grasping and what may need further instruction. This personalization would ensure that their level of instruction was 'just right' in making students feel successful. In Mathematics students don't often grasp concepts the first time therefore "blended learning is more compatible with the pace of the student, which enables it to improve the achievement of the students" (Yaghmour 2016, p. 8).

When student-centered learning is done well, it creates a sense of student agency and ownership for their progress and helps them guide their own learning. This helps students to

develop the learning skills needed to be successful "in today's rapidly changing world, in which knowledge and skills become outdated quickly" (Horn & Staker, 2015, p. xxvi).

Many students are more motivated to complete their work by using technology as it is perceived by young children to be fun and engaging. A study of first year primary students found that "70% of the students consider that learning is easier when educational software is used" (Zaldívar-Colado, Alvarado-Vázquez, & Rubio-Patrón, 2017, p. 8). Since using technology is very motivational what devices are best suited for primary students?

What Devices Can be Used for Implementing Blended Learning?

Research has shown that the use of mobile devices in primary classrooms directly improves student agency, engagement and motivation. Mobile devices increase the accessibility of content for all learners. Levy (2014) explained that, "iPad's act as a translation, communication, and individualization tool with unrivaled effectiveness. In so doing, these devices reduce frustration, build confidence, and, well, just *work* in teaching students the skills they need to learn to thrive" (para. 1). Additionally, students with disabilities benefit from these alternative ways of learning and exploring which also provides them a supplementary way to show their understanding.

There are many advantages to using iPads in the classroom. "Devices within school environments is their ready access to the Internet and other resources, longer battery life, size, and a short learning curve"(Crichton, Pegler, & White, 2012, p. 29). iPads are portable and can be used in a variety of settings. Overall, iPads with their touch screens are the most desirable mobile device to be used in primary classrooms. They're intuitive nature using icons makes navigating apps and websites more manageable for the younger learner. When educators choose

apps for their students they need to take into account the design, versatility and the educational benefits.

What Apps and Websites are Best Suited for Primary Students?

       Design principals. Ease of use needs to be addressed when choosing an app or device for our young learners. "Educational software in general should be easy to use, intuitive, interesting, and, of course, effective in producing learning in students" (Zaldívar-Colado et al., 2017, p. 5).

       Teachers need to consider choosing apps that have clear, direct instructions for students as primary students can be distracted when apps are not straightforward. Apps that use audio are also very important. Zaldivar-Colada et al. (2017) express that,

> given that first-year primary students still do not read well in general, it would help them to concentrate if the educational software gives students instruction through audio, and if students can answer either through audio or through clicking on displayed options (p. 10).

       Another consideration when choosing Mathematical apps and websites for primary students is whether the program builds in the scaffolding skills. When choosing apps for Mathematics, you want to be cognoscente of how the app will help provide the instructor with information on individual student progression and understanding. This information will help guide the instructor as to what to review or teach them next. Many apps have built in diagnostics and will adjust the assignments according to the student's unique skill development. This allows the students to work "on problems requiring skills that are in the associative phase of their development which is efficient because no student is forced to practice procedures he or she has not yet understood or procedures that are already automatic" (Schoppek & Tulis, 2010, p. 3).

This embedded assessment tool "frees teachers from the mundane tasks of grading rote items and provide immediate feedback for students and parents" (M.West, 2013, p. 7).

Evaluating apps and websites. Haelle (2017) suggests filtering apps using the following five key questions. Does it promote active mental engagement (thinking, predicting, questioning, drawing connections, and reflecting)? Will it help focus students learning without having distractions built into the app? Does it scaffold learning? Is it interactive and provide either feedback through the teacher or app? Does it clearly define objectives that can be tracked and assessed by the student or teacher? Given these five key questions educators can make knowledgeable choices when selecting appropriate apps for primary Mathematics instruction.

Apps that are recommended for use in personalization are apps that allow students to show what they know and provide teachers insight into how they approach and solve problems, which "enables teachers to see explicitly how children's brains work differently" (Hunsinger-Hoff, 2016, p. 6). Websites and apps that enable teachers to create customized surveys for students, which provide insight into multiple intelligences, as well as finding students' motivations and interests are valuable because of their ability to gather information as well as assessment, making them great additions to a blended learning classroom.

Choosing Mathematic apps for primary instruction. Mathematical apps that work well with primary students allow the teacher to create assignments and have students' progress at their own pace once they have mastered the previous concepts. These programs need to provide teachers with diagnostic data on individual student understanding. They also need to provide students with immediate feedback and teachers with ongoing assessment, which helps guide the face-to-face small group instruction. These apps also allow students to progress beyond their grade level providing challenges and reducing boredom that they often experience in a traditional

face-to-face classroom. Educators know that when students are working in their 'zone of proximal development' they are more liking to achieve Mathematical fluency.

Correlations Between Blended Learning Rotation Models and Achievement

There are many advantages to blended learning including increasing student information literacy skills, self-regulation and time management skills, self-monitoring of progress due to increased teacher and/or system feedback, motivation and opportunities to work at one's own pace and allowing for increased understanding (Oliver and Stallings, 2014). In a study of third grade students using a Rotation Model in math twice a week showed "that even a moderate amount of individualized practice was associated with large improvements of arithmetic skills and problem solving, even after a follow-up period of 3 months" (Schoppek & Tulis, 2010, p. 2). This extra practice time allowed students to solidify skills in their associative level which allowed students to master a skill before moving on. This skill acquisition is not a short-term gain as demonstrated in another study of first grade students using educational software in Mexico, which showed positive benefits after a year (Zaldívar-Colado et al., 2017). In another study, Yaghmour (2016) also found using a blended learning approach demonstrated statistical difference in student achievement in grade 3 mathematics(Yaghmour, 2016). Evidence that support these findings include individualization, skill practice at 'just right levels', smaller group instruction and student's ability to achieve mastery before moving on.

An additional study with positive results showed eighth graders using Mathematical software to support their blended learning. This study also found "that students who experience greater achievement in a self-paced blended course have more positive attitudes toward Mathematics at the end of the course" (Balentyne & Varga, 2017, p. 67). Although this study was conducted with older children, the correlation between achievement and attitude is also

something to be aware of when teaching younger students. Educators need to ensure students feel good about themselves at an early age and if there is a way of encouraging and promoting a positive attitude towards Mathematics, then they need to follow those suggestions.

Conclusions

An educational shift towards incorporating technology in face-to-face education is needed to better meet the needs of all students and provide them with the skills necessary to be successful in the 21st Century. Through my research I found blended learning to be an effective way to engage our students, while providing instruction and learning on a personalized, individual basis. The educator benefits by receiving instant feedback on the students' progress, and the ability to observe the learners' performance and needs which, subsequently provides information to support small group instruction. Blended learning allows students time to master skills before moving on - it puts them in their optimal zone for learning where the level of difficulty is 'just right'. This in turn makes all learners feel successful and helps develop a positive attitude towards their Mathematical abilities. Students are also more motivated to spend time working through problems, as using technology aligns with what is happening in the technology-enhanced world outside of school.

Blended learning may not be the solution to all of the problems that our education system faces but it allows students flexibility in the way they learn Math. Technology allows students to have access to lessons and resources from online databases, as well as providing them with an avenue to review and practice material independently. Most importantly it allows students to master Mathematical skills while working at their individual pace. Blended learning meets the focus of the new BC curriculum as it provides "flexible teaching and learning, and an emphasis

on building a strong foundation of mathematical understanding and skills"("Mathematics |

Building Student Success - BC's New Curriculum," 2018, para. 4)

Overall, blended learning is an effective way to personalize numeracy in our face-to-face

Math classrooms. The research returned little information on how blended learning might open

communication between home and school. This leaves me to wonder if parents are more aware

of what and how their child learns when engaged in a blended learning program?

The conclusions drawn from this comprehensive literature review will be applied to the

major project design and development as presented in Ch. 3.

References

Primarily Blended — Reading

BC's New Curriculum. (n.d.). Retrieved May 30, 2018, from https://curriculum.gov.bc.ca/

BC Ministry of Education. (2015). *BC Education Plan - Focus on Learning*. Retrieved from

    www.bcedplan.ca

Bohn, C. M., Roehrig, A. D., & Pressley, M. (2004). The First Days of School in the Classrooms

    of Two More Effective and Four Less Effective Primary-Grades Teachers. *The Elementary*

    School Journal, *104*(4), 269–287. Retrieved from http://www.jstor.org/stable/3202942

Bonk, C. J., & Graham, C. R. (2005). Part One - Introduction to Blended Learning (pp. 60–152).

    ProQuest Ebook Central. Retrieved from

    http://ebookcentral.proquest.com/lib/viu/detail.action?docID=700321

Building Student Success - BC's New Curriculum. (n.d.). Retrieved May 22, 2018, from

    https://curriculum.gov.bc.ca/curriculum-updates

Burns, K. M., Larabee, M. K., & Jennifer, M. J. (2014). Effects of an iPad-Supported Phonics

    Intervention on Decoding Performance and Time On-Task. *Journal of Behavioral*

    Education, *23*(4), 449–469. https://doi.org/10.1007/s

Casey, S. (2016). Advantages and Disadvantages of Station Rotation. Retrieved May 20, 2018,

    from https://techinclass1416.wordpress.com/2016/06/02/advantages-and-disadvantages-of-

    station-rotation/

Dewey, J. (n.d.). No Title. Retrieved May 25, 2018, from

    http://www.azquotes.com/quote/513021

Hempenstall, K., & Buckingham, J. (2016). *Read About It : Scientific Evidence for Effective*

    Teaching of Reading Kerry Hempenstall.

Horn, M. B., Gu, A., & Evans, M. (2015). Knocking Down Barriers are implementing blended learning. *Education Digest*, *80*(8), 18–25. Retrieved from https://eric.ed.gov/?id=ED561273

Horn, M. B., & Staker, H. (2015). *blended Using DISRUPTIVE INNOVATION to Improve Schools* (First). San Francisco: Jossey-Bass.

Schechter, R., Macaruso, P., Kazakoff, E. R., & Brooke, E. (2015). Exploration of a Blended Learning Approach to Reading Instruction for Low SES Students in Early Elementary Grades. *Computers in the Schools*, *32*(3–4), 183–200. https://doi.org/10.1080/07380569.2015.1100652

Shannon, L. C., Styers, M. K., Wilkerson, S. B., & Peery, E. (2015). Computer-Assisted Learning in Elementary Reading: A Randomized Control Trial. *Computers in the Schools*, *32*(1), 20–34. https://doi.org/10.1080/07380569.2014.969159

Staker, H., & Horn, M. B. (2012). Classifying K – 12 blended learning. *Innosight Institute*, (May), 22. https://doi.org/10.1007/s10639-007-9037-5

Stein, J., & Graham, C. R. (2014). E. for blended learning a standards-based guide., & Routledge, N. Y. (2014). *Essentials for blended learning*. (M. Vai, Ed.). New York: Routledge.

Sweetser, Penelope, Johnson Daniel, Ozdowska Anne, W. P. (2012). Active versus passive screen time for young children. *Australasian Journal of Early Childhood*, *37*(4), 94–98.

Thorne, K. (2006). 8 Creativity and blended learning. In *Essential Creativity in the Classroom Inspiring Kids* (1st Editio, p. 192). London: Routledge. Retrieved from https://www-taylorfrancis-com.ezproxy.viu.ca/books/9781134204236

Truitt, A. A. (2016). *A CASE STUDY OF THE STATION ROTATION BLENDED LEARNING MODEL IN A THIRD GRADE CLASSROOM*. University of Northern Colorado.

References

Primarily Blended — Writing

Alkhamis, H., Haskins, T., & Aleccia, V. (2015). Implementing iPad apps for elementary

language arts. *International Journal of Education and Social Science*, *2*(10), 12–18.

Bratitsis, T., Kotopoulos, T., & Mandila, K. (2012). Kindergarten children's motivation and

collaboration being triggered via computers while creating digital stories: A case study.
International Journal of Knowledge and Learning, 10, pp. 1-18.

BC Ministry of Education. (2015). BC Education Plan - Focus on Learning, 24. Retrieved from
www.bcedplan.ca

Burns, Monica. (2018). Putting Learning First with New Tech Tools. *Edutopia.* Retrieved from

https://www.edutopia.org/article/putting-learning-first-new-tech-tools.

CAST (2011). Universal Design for Learning (UDL) Guidelines: Full-Text Representation
Universal Design for Learning Guidelines version 2.0.

Christensen, R. A. (2017). The Effects of Using Computer and iPad Story- Writing Applications

for Creative Writing with Kinder Year Students in a Montessori Early Childhood

Program.

Ertmer, P. A., and A. T. Ottenbreit-Leftwich. 2010. "Teacher Technology Change: How

Knowledge, Confidence, Beliefs, and Culture Intersect." *Journal of Research on Technology in Education 42* (3): 255–284

Geist, E. (2011). The game changer: Using iPads in college teacher education classes. *College Student Journal*, 45(4), 758-768.

Gordon. D , Meyer. A , and Rose. D (2014). Theory and Practice: Universal Design for Learning. Retrieved from http://udltheorypractice.cast.org/home?11

Hung, J. L., Hsu, Y. C., & Rice, K. (2012) Integrating data mining in program evaluation of K-12 online education. *Educational Technology and Society,* 15(3), 27-41.

Levy, L. (2014, December 22). 10 Ways iPads Teach Kids With Learning Disabilities. Edudemic [Blog] Retrieved from http://www.edudemic.com/top-10-ways-ipads-are-key-to-teaching-kids-with-learning-disabilities/

Lynch, M. (2015). Do mobile devices in the classroom really improve learning outcomes. *The Conversation [Blog]*. Retrieved from http://theconversation.com/do-mobile-devices-in-the-classroom-really-improve-learning-outcomes-38740

McLeod, S., & Richardson, J. W. (2014). *School administrators and K-12 online and blended learning*. *Handbook of Research on K-12 Online and Blended Learning*. https://doi.org/10.1017/CBO9781107415324.004

Paul, M. (2016). Process with Pencil and Paper, Produce with Technology. *Edutopia.* Retrieved from https://www.edutopia.org/discussion/process-pencil-and-paper-produce-technology

Staker, H. (2011). The Rise of K–12 Blended learning. *Innosight Institute*, *21*(May), 18.

http://doi.org/10.1093/elt/ccq043

Thibaut, P., Curwood, J. S., Carvalho, L., & Simpson, A. (2015). Moving across physical and

online spaces: a case study in a blended primary classroom. *Learning, Media and

Technology*, *40*(4), 458–479. http://doi.org/10.1080/17439884.2014.959971

UNESCO Institute for Information Technologies in Education. (2010). UNESCO IITE Policy

Brief: Mobile Learning for Quality Education and Social Inclusion. *Unesco*, (December),

1–12. https://doi.org/10.1017/S026646231000019X

Wohlwend, K. E. (2009). Early adopters: Playing new literacies and pretending new technologies

in print-centric classrooms. *Journal of Early Childhood Literacy*, 9(2), pp. 117-140

References

Primarily Blended — Numeracy

Attard, C. (2013). teaching with technology: iPads and Primary Mathematics. Retrieved May 14,

2018, from https://files.eric.ed.gov/fulltext/EJ1093126.pdf

Balentyne, P., & Varga, M. A. (2017). Attitudes and Achievement in a Self-Paced Blended

Mathematics Course Balentyne and Varga ATTITUDES AND ACHIEVEMENT IN A

SELF-PACED BLENDED MATHEMATICS COURSE. *Journal of Online Learning

Research*, *3*(1), 55–72. Retrieved from https://www.learntechlib.org/primary/p/173313/

Christensen, C. M., Horn, M. B., & Staker, H. (2013). Is K-12 Blended Learning Disruptive?

Clayton Christensen Institute for Distuptive Innovation, 1–48. Retrieved from

    https://www.christenseninstitute.org/wp-content/uploads/2014/06/Is-K-12-blended-

    learning-disruptive.pdf

Collins, A., & Halverson, R. (n.d.). Rethinking Education in the Age of Technology: The Digital

    Revolution and ... - Allan Collins, Richard Halverson - Google Books. Retrieved July 19,

    2018, from

    https://books.google.ca/books?hl=en&lr=&id=eRhWDwAAQBAJ&oi=fnd&pg=PP1&dq=h

    ow+has+the+typical+classroom+learning+needs+changed&ots=UjOTlgnvvs&sig=prBe-

    LqnE7wKGg18mluAdbGzrP4#v=onepage&q&f=false

Crichton, S., Pegler, K., & White, D. (2012). Personal Devices in Public Settings: Lessons

    Learned From an iPod Touch / iPad Project. *Electronic Journal of E-Learning*, *10*(1), 23–

    31. Retrieved from https://files.eric.ed.gov/fulltext/EJ969433.pdf

Curriculum Overview | Building Student Success - BC's New Curriculum. (2018). Retrieved

    May 14, 2018, from https://curriculum.gov.bc.ca/curriculum/overview

Del, L., & Díaz, E. (2017). The Teaching and Learning Process of Mathematics in the Primary

    Education Stage : a Constructivist Proposal within the Framework of Key Competences,

    12(7), 709–713.

Hunsinger-Hoff, S. (2016). Personalizing Learning with Digital Devices. *Center on Innovations*

    in Learning, 1–30. Retrieved from http://www.centeril.org/publications/PL With Digital

    Devices.pdf

Kenney, J., & Newcombe, E. (2011). Adopting a blended learning approach: Challenges

    encountered and lessons learned in an action research study. *Journal of Asynchronous*

    Learning Network, *15*(1), 45–57. https://doi.org/10.1016/j.sbspro.2014.01.992

Laura Kassner, E. D. (2013). Mix It Up with Blended Learning. *Metropolitan Education Research Consortium MERC*. Retrieved from https://eric.ed.gov/?id=ED548381

Leah Levy. (2014). 10 Ways iPads Teach Kids With Learning Disabilities | Edudemic. Retrieved May 20, 2018, from http://www.edudemic.com/top-10-ways-ipads-are-key-to-teaching-kids-with-learning-disabilities/

M.West, D. (2013). No TitleMobile Learning : Transforming Education, Engaging Student, and Improving Outcames. *Center for Technology Innovation at Brookings*, (September). https://doi.org/10.1007/s10639-013-9250-3

Mathematics | Building Student Success - BC's New Curriculum. (n.d.). Retrieved June 15, 2018, from https://curriculum.gov.bc.ca/curriculum/mathematics/introduction

McLeod, S. (2012). Zone of Proximal Development - Scaffolding | Simply Psychology. Retrieved June 9, 2018, from https://www.simplypsychology.org/Zone-of-Proximal-Development.html

Mirriahi, N., Alonzo, D., & Fox, B. (2015). A blended learning framework for curriculum design and professional development. *Research in Learning Technology*, *23*(1063519). https://doi.org/10.3402/rlt.v23.28451

Oliver, K. M., & Stallings, D. T. (2014). Preparing Teachers for Emerging Blended Learning Environments. *Jl. of Technology and Teacher Education*, *22*(1), 79–103. Retrieved from https://eric.ed.gov/?id=EJ1025141

Schoppek, W., & Tulis, M. (2010). Enhancing arithmetic and word-problem solving skills efficiently by individualized computer-assisted practice. *Journal of Educational Research*, *103*(4), 239–252. https://doi.org/10.1080/00220670903382962

Simon, M. A. (1995). Reconstructing Mathematics Pedagogy from a Constructivist Perspective.

Journal for Research in Mathematics Education, *26*(2), 114. https://doi.org/10.2307/749205

Yaghmour, K. S. (2016). Effectiveness of Blended Teaching Strategy on the Achievement of Third Grade Students in Mathematics. *Journal of Education and Practice*, *7*(5), 65–73. Retrieved from https://files.eric.ed.gov/fulltext/EJ1092394.pdf

Zaldívar-Colado, A., Alvarado-Vázquez, R. I., & Rubio-Patrón, D. E. (2017). Evaluation of Using Mathematics Educational Software for the Learning of First-Year Primary School Students. *Education Sciences*, *7*(4), 1–12. https://doi.org/10.3390/educsci7040079