Motivating movement: Exploring educators' perspectives on supporting preservice elementary teachers to pedagogically integrate digital technology into physical education

by

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We acknowledge and respect the Lək^{w}əŋən (Songhees and X^{w}sepsəm/Esquimalt) Peoples on whose territory the university stands, and the Lək^{w}əŋən and W̲SÁNEĆ Peoples whose historical relationships with the land continue to this day.

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Abstract

The pandemic of physical inactivity is a critical health issue; one that is negatively impacting the health of children worldwide. The continued decrease of children engaging in physical activity is not only negatively impacting their physical health but is seriously impacting their overall wellbeing (Government of Canada, 2023a). Digital technology is a means that has shown to be useful in promoting physical activity in all ages of people, including children in elementary school (Lewis et al., 2017; Parker et al., 2017). Teachers have been both entrusted with finding effective ways of addressing the crucial need for their students to be more physically active (Government of British Columbia, 2023e) and tasked with integrating digital technology into all aspects of education, including into physical education (Government of British Columbia, 2023b), which has the central goal of promoting lifelong physical activity (Katzmarzyk, 2019; Kretschmann, 2015). Research for this study was conducted in the province of British Columbia (BC), Canada where elementary school refers to grades K–7 (Government of British Columbia, 2016). BC elementary schools have a comprehensive school approach to physical activity, which means that all elementary teachers need to be prepared to teach physical education and promote physical activity throughout the school day. This study used a multi-case descriptive case study research design to explore the perspectives of teacher-educators on supporting preservice teachers to integrate digital technology for physical education purposes. Three teacher-educators participated in this study, all of whom teach physical education to preservice teachers in Education programs at three different universities in the province of British Columbia, Canada. Data was gathered through semi-structured interviews and direct observation. The theoretical foundation of this study was Mishra & Koehler's TPACK framework (Mishra & Koehler, 2006) and Vygotsky's Social Constructivism (Vygotsky, 1978).

Armour (2011) and Casey et al. (2017a) provide the conceptualization of pedagogy that informs this study. Findings generated from this study brought to the forefront factors that are impacting teacher-educators' ability to prepare preservice teachers to integrate digital technology. Specifically, the external factors of university resources, program structure, and sociocultural influence; and the internal factors of beliefs, embracing the facilitator role and the willingness to vulnerably explore emerged as impactful. The concept of vulnerable exploration of digital technology integration emerged as an innovative strategy for teachers to consider; this refers to teachers vulnerably exploring digital technology integration alongside their students in a symmetrical zone of proximal development. Teacher-educators in this study fostered pedagogical integration through such strategies as: 1) exposing preservice teachers to various digital technologies; 2) providing preservice teachers with guided exploration time; and encouraging preservice teachers to critically consider how technology is impacting their students' physical activity within and beyond the walls of the classroom. This research led to a suggested adaption of the TPACK framework, one that highlights the importance of pedagogical integration and the significance of sociocultural context; this adapted framework operationalises TPACK and presents an adaption of TPACK in a flower design to visually portray the significance of Growing with Evolving Education. The implications of these findings to practice are that teacher-educators need to constantly adapt and grow to support preservice teachers so that they remain socially relevant and maintain credibility in the lives of 21st century learners.

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Acknowledgments

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Dedications

I dedicate this dissertation with loving thanks to my family

- Norm, Natasha, and Ariel –

& to my mentor Carol

who were alongside me throughout this journey.

The Highland Games Heavy Events to Doctoral Studies:

This research was inspired by a passion to create equitable access to sport. My journey to completing this research started with pioneering women's participation in the Scottish Heavy Events in British Columbia. Being of Scottish heritage and an avid lover of sport, I wanted to compete in the Highland Games Heavy Events and was told it was only for men. Fighting for the right for women to throw in the Heavy Events in BC Highland Games started in 1991 at the Penticton Highland Games, when I had to prove that women should be a part of the games and did so by throwing the men's implements. By 1992, with the support of my family, we had established the women's heavy events as an official part of Highland Games in BC. My personal journey for women's rights in sport fueled my passion for the importance of everyone being supported and encouraged to participate in physical activity. I hope this work affirms the importance of physical education and the need to make physical activities accessible to everyone.

Chapter 1: Introduction

> "Technology will never replace great teachers, but technology in the hands of a great teacher can be transformational." (Couros, 2024, para. 10)

This study explores teacher-educators' perspectives on how they are supporting preservice elementary teachers to pedagogically integrate digital technology into the context of physical education. Throughout this dissertation the term preservice teachers refers to preservice elementary generalist teachers. Chapter one of this study has eight sections. The first introductory section (1.1) explains the overall rationale for the study. The second section (1.2) introduces my background as the researcher and provides insight to what inspired me to conduct this study. Sections 1.3 through 1.7 identify the research problem, provide the purpose of this research, present the research questions, share the significance of the research, define key words and concepts, and acknowledge pandemic considerations (this study occurred during the global COVID pandemic that started in March of 2020). The final section (1.8) of this chapter introduces the contents of the following chapters.

1.1 Rationale for the Study

Lack of physical activity has become a serious global health issue (Anderson & Durstine, 2019; WHO, 2024). Within Canada, lack of physical activity has contributed significantly to a dramatic rise in obesity and to an overall decline in the health of Canadian children (Anderson et al., 2016; González-Álvarez et al., 2020; Government of Canada, 2023a); as such, there is a vital need to educate children on why and how to lead physically active lives, and motivate them to be physically active. Physical education has been identified as having a foundational role in motivating children to be physically active (Katzmarzyk et al., 2019; Tremblay et al., 2016). As Kretschmann (2015) stated, "the characteristic that makes physical education unique among school subjects is human movement and the understanding of the subject as a vehicle of physical

activity" (p.13). The government of British Columbia (2023f) has identified schools as having a key role in addressing children's needs for increased physical activity (Armour & Harris, 2013; Cale et al., 2016) and for providing a solid foundation for lifelong activity (Government of British Columbia, 2022; Lubans et al., 2016). However, for teachers to effectively influence students to be more physically active, teachers must use means that engage students' interest in physical education. One effective means that has recognized is the integration of digital technology (Jones et al., 2017; Krause et al., 2020; Legrain et al., 2015; Lewis et al., 2017; Parker et al., 2017; Phillips et al., 2014). In the 21st century, various forms of digital technology are being used in schools to promote physical activity (Parker et al., 2017; Wyant & Baek, 2019). Robinson and Randall (2017) identify "computers and tablets (especially iPads and SmartBoards), movement-based gaming technologies (e.g., Nintendo Wii, Just Dance), fitness trackers (e.g., heart rate monitors, pedometers, Fitbits, accelerometers, applications [MyFitnessPal]), video analysis software and applications (e.g., Dartfish, Coach's Eye)" (p. 2) as some of the various forms of digital technology being used in physical education.

In keeping with the growing global understanding of the significance of digital technology in society today and in keeping with digital technology being found to be extremely engaging and motivational for the current generation of learners (Szymkowiak et al. 2021), the province of British Columbia supports and encourages digital technology being used to enhance education (Government of British Columbia, 2023b). Further, BC's Curriculum indicates that students are to have opportunities in all areas of education, including physical education (PE), to develop competency in the use of digital technology (Government of British Columbia, 2023b). Part of being competent digital technology users is understanding that digital technology being integrated into education needs to be done effectively (Krause et al., 2020). Armour et al. (2017)

put forth that integrating digital technology into physical education can have positive effects such as motivating children to be physically active; however, they also acknowledge that digital technology integrated into physical education has the potential for negative outcomes if not integrated with good pedagogy. Knowing the significance of digital technology in today's world for acquiring knowledge and keeping in mind the importance of effectively integrating digital technology to achieve the main goal of physical education, promoting physical activity (Kretschmann, 2015), ensuring that preservice elementary teachers are prepared to use digital technology effectively in physical education is an integral part of preservice teacher training (Krause et al., 2020). As Wyant and Baek (2019) acknowledge "it is short sighted to simply dismiss technology or blindly adopt" it into physical education (p.4). However, limited research exists on *how* preservice teachers are being prepared to integrate digital technology into physical education (Armour et al., 2017; Jones et al., 2017; Krause et al., 2020; Wyant et al., 2015). My doctoral research investigates the perspectives of teacher-educators on *how* they are supporting preservice elementary teachers to pedagogically integrate digital technology into physical education.

1.2 Researcher Background

I am a registered nurse, physical education educator, coach, and a teacher-educator in one of the nine Education programs in the province of British Columbia, Canada. Observations and experiences in my various occupations inspired me to complete this research on how preservice teachers are being supported to integrate digital technology into physical education. Firstly, as a registered nurse I see the negative impacts of inactivity on a regular basis. In children, I have noticed a decrease in physical activity, an increase in sedentary behaviour, and a dramatic increase in obesity. This finding is supported by the findings of the Government of Canada

(2023a) who noted that in the last three decades, the obesity rates of Canadian children have nearly tripled and that increasing activity and decreasing sedentary behaviour will help address this issue. It is important to note that sedentary behaviour and obesity are associated with many illnesses, such as cardiovascular disease and diabetes (Gaetano, 2016; Ghozy et al., 2021; McPhee et al., 2020).

Secondly, my work as a physical education educator and a community coach allows me to witness first-hand in children the positive impacts of physical education such as increased physical activity, which results in improved fitness and overall health. Poitras et al.'s (2016) systematic review of 162 studies on the health impact of physical activity in youth ages 5-17 found that physical activity (specifically 60 minutes of moderate to vigorous activity daily) is key in disease prevention and health promotion among children.

Thirdly, as a physical education educator and coach, I use digital technology to educate people of all ages and motivate them to be physically active. Personally, I have found that digital technology is helpful in motivating people to be physically active and in assisting people to learn correct motor patterns, which in turn builds their confidence and further motivates them to be active. Regarding using digital technology to motivate people to move, I help others use wearable tracking devices, such as Fitbits and Garmin watches to track their movements and to facilitate their understanding of the health impacts of physical activity. Specifically, for motor pattern guidance and building confidence in movement, I use video recordings of people's movements and show them the comparison between their movement and others' movement to help them understand how to move. In addition, I use coaching apps, such as Coach's eye, I-analyse, Dartfish, Hudl, and CoachNow to overlay peoples' movements with others who are performing the movement, so that they can analyze their technique. Further, I use the side-by-

side comparison and slow-motion options of body mechanics apps to assist youth in understanding correct movement patterns.

Fourthly, as a teacher-educator and parent, I am aware of how much time Canadian children spend in school and that schools have been identified as key players in making sure children engage in daily physical activity (DPA) (Cale et al., 2016; Government of Canada, 2019). In the physical education methods course that I teach to preservice teachers, I noticed that preservice teachers are interested in digital technology and the role it can play in PE. Therefore, I teach preservice teachers about wearable technologies and how students can use wearables to track their own activity and compare their own fitness to themselves, thereby measuring their own improvement rather than assessing their fitness through comparison to others. In addition, I show preservice teachers how to use videos to promote physical activity such as using video to demonstrate to their students correct form and to encourage movement in their classrooms through the use of videos like "Would you Rather?" Brain Break videos on YouTube (Fix and Play, 2023). The preservice teachers I teach shared that they were not seeing digital technology being used for physical education purposes and that there did not seem to be much support to use digital technology to motivate movement. This piqued my interest in how digital technology was being used in schools for physical education. As I explored the topic of digital technology being used in schools to promote physical activity, I found there was limited research on how teachers were being supported to integrate digital technology into physical education; specifically, I found a significant research gap investigating how preservice elementary teachers are being supported to integrate digital technology into physical education to motivate movement with their students. Knowing the dire need for children to be more active, the responsibility of schools in encouraging children to be physically active, the ability of digital technology to motivate

movement, along with the paucity of research on how preservice elementary teachers are being supported to integrate digital technology into physical education, I was inspired to embark on this study investigating how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into physical education.

1.3 Statement of the Research Problem

As noted in the rationale for this study, children worldwide are increasingly engaging in less physical activity and this is causing an unprecedented increase in the number of overweight and obese children (Carson et al., 2016; Chaput et al., 2016). Canadian children are no exception (Government of Canada, 2023a). A study conducted by Colley et al. (2017) that collected data from 2007 through 2015 on 5,608 Canadian children, ages 6 to 17, found that Canadian children are not meeting the Canadian health recommendations to participate in a minimum of 60 minutes daily of vigorous to moderate physical activity; this representative sample conducted for Statistics Canada indicates that the majority of Canadian children demonstrate a lack of engagement in regular physical activity. As inactivity rates continue to increase, obesity rates of Canadian children also continue to increase; in 2023, the Government of Canada identified that the obesity rate of Canadian children had nearly tripled in the past three decades and highlighted that obesity is a main factor in many health problems, such as: heart disease, diabetes, musculoskeletal issues, low self-esteem, and depression (Government of Canada, 2023a). Consequently, encouraging children to be more active has become a vital societal concern. As previously mentioned, the need for children to be more physically active is so severe that governments are actively seeking large scale interventions, such as identifying schools and teachers as having a significant role in educating students to be physically active (Armour &

Harris, 2013; Cale et al., 2016; Government of British Columbia, 2023f; Piggin & Bairner, 2016).

When taking into consideration that teachers are in a propitious position to be motivators of physical activity and have been made responsible by governments to promote physical activity and develop lifelong physical activity behaviours in their students, preparing teachers with the means to engage students effectively in physical education is paramount. Digital technology has been shown to be an effective way to engage and motivate 21st century students in physical education (Jones et al., 2017; Krause et al., 2020; Lewis et al., 2017; Parker et al., 2017). For example, technologies such as iPads, smartboards, gaming systems, fitness trackers, and video analysis software are being used in schools to motivate students to be physically active (Robinson & Randall, 2017). Further, BC's Curriculum encourages teachers to integrate digital technology into education and indicates that digital technology is to be incorporated into all aspects of learning, including physical education (Government of British Columbia, 2022). However, Jones et al. (2017) identify that "While technology's role within society and education has grown exponentially, there has been no such evidence of equated growth or urgency to integrate technology into physical education" (p. 173). Considering the motivational aspects of digital technology and the attraction of 21st century students to digital technology, there is a need to understand how preservice teachers are being supported to integrate digital technology into physical education (Hasselbring et al., 2000; Howard et al., 2021).

1.4 The Purpose of the Research and the Research Questions

The purpose of this research study is to provide information on and increase understanding of how preservice elementary teachers are being prepared in their education to pedagogically integrate digital technology into physical education. I took the foundational

approach of investigating how teacher-educators are supporting preservice teachers to integrate digital technology and explored this topic through the lens of teacher-educators at approved Bachelor of Education (B.Ed.) programs in British Columbia (BC). I investigated teacher-educators' perspectives using Case Study Research design (CSR). The following central query and investigative sub-questions guided this CSR research study.

The central query of this study was:

> *How are teacher-educators supporting preservice elementary teachers to pedagogically integrate digital technology into physical education?*
>
> The sub-questions that further investigated this central query are:
>
> 1. How do teacher-educators view their roles in preparing preservice teachers to integrate technology into physical education and promote physical activity?
> 2. What factors do teacher-educators identify as supporting or impeding their ability to prepare preservice teachers to integrate technology into physical education?
> 3. How do teacher-educators describe the strategies they are incorporating to support future teachers to integrate technology into physical education to promote physical activity?

1.5 The Significance of this Research

This study contributes to the profession of teaching through providing insight on how teachers are being prepared to pedagogically integrate digital technology into physical education. Specifically, this study provides data on how teacher-educators are supporting preservice elementary teachers that will be teaching physical education in grades K-7, which is significant because this researcher found no other studies investigating how preservice elementary teachers are being supported during their education to integrate digital technology into physical

education. The lack of research in this area highlights the need for this study, which is furthered by elementary teachers having been tasked by the Ministry of Education to integrate digital technology into physical education (Government of British Columbia, 2023b) and having vital roles in assisting Canadian children to be physically active and develop lifelong physical activity behaviors (Kingston et al., 2023).

This study provides insight into what factors are impacting teacher-educators' ability to prepare preservice elementary teachers to integrate digital technology and reveals strategies that are currently being used by teacher-educators to prepare them. Further, this study shares findings on the social relevance of integrating digital technology into physical education. These findings are shared in chapter four and discussed in chapter five, in relation to theoretical frameworks for integration of digital technology, previous research in the area, and practical recommendations. It is expected that the findings of this study will aid Education programs to grow with an ever-evolving education system that is tasked with keeping up with the societal expectation of digital technology enhanced educational environments.

1.6 Key Definitions & Concepts

Child/Children – Person under 19 years of age (Government of Canada, 2023b)

Physical Education in Elementary (grades K – 7) School – the educational subject that is focused on physical activity promotion and facilitating students to establish physically active lifestyles that last for the duration of their lives (Katzmarzyk et al., 2019; Pangrazi and Beighle, 2019; Truelove et al., 2021). Physical education in British Columbia includes physical activity promotion that is expected to occur in three areas throughout the school day: 1) in designated physical education blocks; 2) integrated into various subject areas; and 3) during the school day outside of class time, such as before and after school, and during breaks (Johnson & Turner,

2016). The Government of BC increased daily physical education goals to include "all students from kindergarten to grade 12 get 30 minutes of daily physical activity" throughout the school day (Government of Canada, 2017, para. 18).

Physical Activity – Physical activity is defined as "any bodily movement produced by skeletal muscles that require energy expenditure" (WHO, 2022a).

Sedentary Behaviour – "any waking behaviour characterized by an energy expenditure less than 1.5 metabolic equivalents (METs), while in a sitting, reclining or lying position" (Tremblay et al., 2017, p. 5). METS are Metabolic Equivalent Units and is the measurement used to determine changes in base metabolic rate (Tremblay et al., 2017).

Elementary Teacher – In BC, a teacher that teaches kindergarten to grade 7 (Government of British Columbia, 2016); they are considered generalist teachers as elementary teachers in BC teach many subjects (Make a Future, 2025).

Integration – "the process of becoming an accepted part of society" (para 9) and **"**refers to the process of settlement, interaction with the host society, and social change" (Penninx & Garcés-Mascareñas, 2016, para.1). Although this definition goes on to refer to immigration; this conceptualization of integration is directly applicable to technology integration as digital technology is often likened to immigration. For example, digital users that have more experience and comfort with digital technology are often referred to as digital citizens (ISTE, 2023) and those newer to or more passive with digital technology use are often characterized as digital immigrants (Krause et al., 2020).

Technology Integration - digital technology was initially thought of as novel; however, digital technology has become an accepted part of and is ubiquitous in society (Scherer et al., 2019; Wyant & Baek, 2019). The description of integration including interaction with society

and social change fits with defining technology integration for education, which according to Howard and Thompson (2016) is a "complex and dynamic social process" (p.1877) within the social system of education. Technology integration for this study is conceptualized as the process through which technology is fully accepted into all aspects of education. For technology to be fully integrated into the education system, it would need to be an accepted part and ubiquitous throughout the entire educational structure.

Pedagogy –Mishra and Koehler (2006) describe pedagogy as "the process and practice or methods of teaching and learning" (p. 1025). Armour (2011) puts forth the concept of pedagogy as being the connection/interaction between learners' learning, teachers' teaching, and knowledge in context.

1.7 Pandemic Considerations

In December 2019 the virus COVID-19 was identified in Wuhan, China. The virus quickly developed into a global pandemic (Government of Canada, 2023c; Wu et al., 2020). Due to the pandemic within Canada provincial governments closed postsecondary, high school and elementary schools, and education was moved to online delivery (Doreleyers & Knighton, 2020; Frenette et al., 2020). This resulted in increased use of online resources and need for home internet (Frenette et al., 2020). Due to the pandemic, there was a need for flexible and innovative alternate delivery models in K-12 education in British Columbia (British Columbia Ministry of Education, 2020). This further increased the need for preservice teachers to be prepared to pedagogically integrate digital technology in all subject areas. In addition, the pandemic influenced data collection for this study, which is discussed in chapter three, *Research Methodology.*

1.8 Chapter Introductions

Chapter 1 introduced this research study and provided rationale as to why research is needed into how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into physical education. In Chapter 2, I describe the theoretical frameworks that provided guidance for this research study, as well as share the literature that provided the framework for, awareness of, and insight into why this study was, and further studies are, needed that investigate the preparation of preservice teachers to integrate digital technology into physical education. Chapter 3 puts forth the description of and rationale for the methodology used for this study, and describes the researcher's role, context, participants, data collection procedures, data analysis and validity verification methods. In Chapter 4, I share the findings of this study and articulate the themes that emerged through data analysis. Finally, in Chapter 5, I share the findings situated in consideration of the literature reviewed, as well as put forth new considerations for future research.

Chapter 2: Literature Review

The need for research on how preservice elementary teachers are being supported to pedagogically integrate digital technology into physical education stems from the dual responsibility placed on teachers to effectively integrate digital technology into all courses and to assist in addressing the dire need for children to be more physically active. What furthers the need for research in this area is that even though elementary teachers have been entrusted with physical education and developing students' behaviours to engage in lifelong physical activity (Truelove et al., 2021), and have been given the responsibility of integrating digital technology to do this (Government of British Columbia, 2023b), there exists a gap in literature as to how preservice elementary teachers are being prepared for this task. This chapter shares the literature and theoretical frameworks that formed the foundation of this study that explores how preservice teachers are being supported to pedagogically integrate digital technology into physical education.

Firstly, this chapter commences with an overview on the vital role of teachers in motivating children to be physically active. Secondly, there is a section highlighting that in today's world teachers have a responsibility to integrate digital technology into all areas of education, including physical education. Thirdly, the need for preservice teachers to be prepared in their Education programs to promote physical activity and to be prepared to integrate digital technology into physical education is put forth. Fourthly, the theoretical frameworks that formed the foundation of this study are introduced: 1) Mishra and Koehler's TPACK framework (Mishra & Koehler, 2006), which guided this exploration of technology integration and aided in understanding the complexities of pedagogically integrating digital technology into education and 2) Vygotsky's social constructivism (Vygotsky, 1978), which underpins this study and

highlights the significant influence of social and cultural interactions on learning. This chapter culminates with a summary of chapter two and a preview of chapter three.

2.1 Teachers have Key Roles in Physical Activity Promotion

Promoting physical activity has become a vital societal health issue. The World Health Organization (WHO) (2020) identified that "increasing physical activity is not just an individual issue. It requires a whole of society and culturally relevant approach and therefore demands a collective effort across different sectors and disciplines" (para.3). Education is a discipline that influences numerous peoples' lives and as such physical education in schools plays a key part in the collective effort needed to promote physical activity (Armour & Harris, 2013; Cale et al., 2016; Siedentop & Mars, 2022). In fact, governments have identified teachers as having crucial roles in educating and motivating students to be physically active (Cale et al., 2016; Casey et al., 2017a; Government of British Columbia, 2023f).

2.1.1 The Need for Increased Physical Activity

This widespread lack of physical activity is a worldwide health issue (Anderson & Durstine, 2019). WHO put out a global status report on physical activity in 2022. The WHO (2022b) global status report associates non-communicable diseases (NCD's) with a lack of physical activity and includes in the report that Canadian healthcare costs directly attributable to NCD's and mental health issues associated with physical inactivity is 420, 873, 550 U.S.$ annually. The global status report emphasizes the dire need for Canadians to be more physically active by highlighting that the NCD mortality rate in Canada is 90%. This lack of physical activity has been identified as a main factor in many chronic diseases, including cardiovascular disease, diabetes, and numerous cancers (Government of Canada, 2017; WHO, 2022b). Canada has an extremely high prevalence of physical inactivity among its children and youth (Colley et

al., 2017); in fact, more than 90% of Canadian children and youth ages 5 to 17 are not meeting the current physical activity guidelines of engaging in 60 minutes of moderate to vigorous exercise daily (Government of Canada, 2017).

Children not engaging in enough physical activity is also a major factor in obesity (Anderson et al., 2016; Carson et al., 2016; Chaput et al., 2016; Government of Canada, 2023a). Despite public health efforts to reverse the rise in obesity, the prevalence of obesity in Canada continues to persist (Rao et al., 2016) and is a serious public health concern (Peirson et al., 2015). Obesity contributes to such adverse health outcomes as: diabetes, arthritis, various cancers, depression, and premature death (Gaetano, 2016; Ghozy et al., 2021; Mcphee et al., 2020). Therefore, governments and societies need to continue to recognize the critical level that obesity has reached and support initiatives to reduce sedentary behavior and increase physical activity (Meldrum et al., 2017).

Contemporary research indicates that replacing sedentary behavior with physical activity has a positive impact on health and well-being (Government of British Columbia, 2023d; Lewis et al., 2017). The Poitras et al.' (2016) systematic review briefly mentioned in chapter 1, was a comprehensive systematic review examining the health impact of physical activity in youth ages 5-17. The inclusion criteria for the Poitras et al. review were that studies examine the relationship between objective measurements of physical activity "(accelerometer, heart rate monitor, pedometer, arm band)" (p.S198) and health indicators "(body composition, cardiometabolic biomarkers, physical fitness, behavioural conduct/pro-social behaviour, cognition/academic achievement, quality of life/well-being, harms, bone health, motor skill development, psychological distress, self-esteem)" (p. S197). The review included 162 studies, from 31 countries and included 201 171 participants. Poitras et al. (2016) found that physical

activity (specifically 60 minutes of moderate to vigorous activity daily) is key in disease prevention and health promotion among children. A limitation of this systematic review (which was acknowledged by the authors) is that meta-analysis could not be completed due to the heterogeneity of the means measuring physical activity and health indicators. However, narrative synthesis was provided on all studies included in the systematic review and end results were presented in clear understandable tables.

2.1.2 Teachers' Responsibility

As mentioned, addressing the need for children and youth to be more active requires a societal commitment (WHO, 2020); with the time children and youth spend in school, teachers have the responsibility of delivering quality physical education that educates students on the importance of physical activity, as well as motivates students to be physically active throughout the school day (Armour & Harris, 2013; Cale et al., 2016; Piggin & Bairner, 2016; Government of British Columbia, 2023f). As previously noted, the Canadian physical activity directive for children and youth ages 5-17 is to engage daily in a minimum of 60 minutes of moderate to vigorous exercise (CDC, 2022; Government of Canada, 2016). To support this directive, the Government of BC increased daily physical education goals to include "all students from kindergarten to grade 12 get 30 minutes of daily physical activity" during the school day (Government of Canada, 2017, para. 18).

Pangrazi and Beighle (2019) highlight that "physical activity is a pillar of physical education" (p. xiv). Physical education in schools plays a key role in motivating students to engage in physical activity and to be physically active for life (Katzmarzyk et al., 2019; Kretschmann, 2015). It is important to understand that physical education does not only occur during the few designated blocks of physical education each week; it also occurs when students

are being physically active outside of the structured physical education classes (Johnson & Turner, 2016). In addition, physical education should not be restricted to the designated blocks of structured physical education classes because these classes do not occur often enough for students to meet the physical activity guidelines that are recommended for good health. To help clarify how physical activity and physical education relate to one another, Johnson & Turner (2016) propose that physical education in schools be understood in two ways: 1) as structured physical education classes and 2) as an ongoing occurrence that occurs from engaging in physical activity "which makes it more synonymous with physical activity" (p. 9). This definition fits well with the goal of BC schools to promote physical activity occurring at various times throughout the school day, including during various classes, before and after school, and at breaks (Hills et al., 2015; Johnson & Turner, 2016). Teachers can contribute to students meeting the recommended amount of daily exercise by maximizing student opportunities to be active (Hills et al., 2015). In addition, integrating physical activity into various classrooms to assist learning in other curriculum areas (e.g. mathematics and science) is beneficial to learning (Hills at al., 2015). Mullender-Wijnsma et al. (2016) found that "physically active academic lessons significantly improved mathematics and spelling performance of elementary school children and are therefore a promising new way of teaching" (p. 1). Considering the benefits of physical activity, it makes sense that teachers have been given the responsibility of integrating physical education throughout the school day. As mentioned, teachers also have been given the responsibility of supporting their students to have opportunity to use digital technology in all areas of learning, including physical education, which will be discussed in the next section (Government of British Columbia, 2023b).

2.2 Teachers are Responsible for Integrating Digital Technology into all Areas of Learning

Technology is ubiquitous in our culture today (Casey et al, 2017a; Scherer et al., 2019; Wyant & Baek, 2019). Armour et al. (2017) acknowledge that today's students have grown up in a culture that immerses them in digital technology. BC's Curriculum highlights the cultural influence of digital technology on education, noting that "it is a technology-rich world, where communication is instant and information is immediately accessible. The way we interact with each other personally, socially, and at work has changed forever" (Government of British Columbia, 2023a, para. 4). Therefore, students must be prepared for an increasingly digital world and education in BC needs to actively support learning with technology (Government of British Columbia, 2023a). Wyant & Baek (2019) highlight the importance of including digital technology in education when they acknowledge that "legislators, administrators, and society at large continue to believe that technology can elevate education" (p. 3).

To address the demand for digital technology integration into education, the BC curriculum encourages Information and Communications Technology "[ICT] enabled learning environments" and states that "students need opportunities to develop the competencies required to use current and emerging technologies effectively in all aspects of their learning and life" (Government of British Columbia, 2023b, para. 1). The British Columbia Teacher's Federation (BCTF) also identified digital technology as a priority for education (BCTF, 2020b). In response, BC teachers are trying to figure how to best integrate digital technology for pedagogical practice and address the needs of current students (BCTF, 2020a). BCTF (2020c) states that teachers are "actively negotiating the roles of educational technologies in their daily pedagogical practice" (para. 2). Correspondingly, teachers are working at increasing their use of digital technology in

all areas of education, including integrating digital technology into physical education (Kretschmann, 2016).

2.2.1 Digital Technology in Physical Education

Digital technology has been found to increase student engagement, enhance learning, and be motivational for the current generation of learners (Casey & Jones, 2011; Jones et al., 2017; Legrain et al., 2015; Szymkowiak et al. 2021). Phillips et al. (2014) suggest that educators should endeavour to incorporate technology into their courses to enhance the motivation and learning of digital age students. When specifically considering the integration of digital technology into physical education, digital technology has been shown to increase student engagement and motivation to be physically active (Casey & Jones, 2011; Jones et al., 2017; Krause et al., 2020; Lewis et al., 2017; Parker et al., 2017). Casey and Jones (2011) examined the findings of a research project that explored the impact of video analysis software on the development of motor skills and student engagement in a class of 27 disaffected students at an Australian high school; they found that the use of video technology for the purpose of aiding students to develop their skills of throwing and catching increased student engagement, particularly the engagement of "previously marginalised, disinterested and disaffected students" (Casey & Jones, 2011, p. 58). In the Parker et al. (2017) study described in this section, they indicate that when technology, such as video, is used to present feedback on skill development, technology can turn the assessment process into a meaningful instructional intervention. In Lewis et al.'s (2017) brief literature review of promising areas for research on physical inactivity interventions, they specifically identify the use of technology to promote physical activity as one of these promising areas. Lewis et al. (2017) advocate for large-scale studies to test the effectiveness of specific technology such as innovative apps, and they emphasize the importance of grounding such

studies in theory. With respect to this focus on theoretical grounding, Wyant and Baek (2019) developed a framework for the integration of digital technology into physical education called C.O.P.E. The acronym C.O.P.E. encourages teachers to: 1) Connect – connect technology to pedagogy, 2) On-Budget – facilitate understanding that technology can be a low-cost tool, 3) Personalize – personalize digital technology to fit with their comfort level, and 4) Empower – acknowledge that they will need help with the rapid changes in technology and advocate that Education programs address the need for on-going support. Wyant and Baek highlight that teachers are indeed continually looking for engaging and relevant ways to promote physical activity amongst 21st century students and have found digital technology to be a promising means.

Kretschmann (2015) acknowledges that digital technology has become common place in physical education and is present in such physical activity settings as gymnasiums, sports fields, and schoolyards. Lewis et al. (2017) added that "there is evidence that technology-based interventions, most recently interventions using smartphones and wearable physical activity monitors, are efficacious for increasing physical activity" (p. 117). Notably, digital technology has many characteristics that lend well to promoting physical activity in a broad range of contexts, including in the school setting; for example, digital technology has such beneficial characteristics as self-monitoring, information accessibility, and portability (Lewis et al., 2017). Digital technology's successful promotion of physical activity has led to various digital technologies being used in schools in physical education (Parker et al., 2017; Wyant & Baek, 2019). Robinson and Randall (2017) identified technologies such as: iPads, smartboards, gaming systems, fitness trackers, and video analysis software as some of the various forms of digital technology being used to promote physical activity in schools. Phillips et al. (2014) identified the

following activity apps as examples of digital technology in schools: Super Stretch Yoga HD – flexibility app for young children; VBS physical app – educational and motivational sport videos; dartfish express – physical activity analysis app; C-fit apps – classroom physical activity apps; and MyFitnessPal – movement tracker app. Lee and Gao (2020) noted the following apps being used in schools: Instant Heart Rate Calculator – to track heart rate changes during activity; Garage Band – music app to set the mood and regulate timing of activity; Coach's Eye – activity analysis app; Team Shake – a team generator app for quick and random team generation; Scoreboard – tracks and displays scores during games; and various timer apps (StopWatch, Interval Timer, Motion Challenge) to regulate activities.

A practical example of digital technology being integrated successfully into physical education comes from the narrative account of a physical education specialist from a United States elementary school (Parker et al., 2017). This study comes from one of the chapters in the pedagogical case study research book by Casey, Goodyear and Armour (2017), *Digital Technologies and Learning in Physical Education: Pedagogical Cases*, in which they compile narrative accounts written in the first-person by physical education teachers on how and why they integrated digital technology into their courses. As well, the teachers include their pedagogical intentions and the overall effect of integrating digital technology into their lessons. Each narrative is critically analyzed through the perspectives of people from three other disciplines, one perspective always being provided by a pedagogic expert. This study was analyzed from a developmental perspective, a literary perspective, and a pedagogical expert perspective. This case study provides the narrative account of an elementary physical education teacher who had been teaching physical education for 12 years to over 500 students, ages 6-11, at an American school. This teacher used a variety of digital technologies to enhance physical

education: 1) Kidizoom cameras (handheld cameras) used for peer coaching; 2) iPod Touch (mobile device) which supported the use of various apps, such as Google forms (an administration app for immediate online assessment) and Voice memo (audio recording used for lectures and voice over assessments); and 3) Fit Smart Watches (mobile devices) which provided each student with health data related to their activities. The teacher found using various digital technologies for physical education increased student interest and effectively aided the students' learning fundamental movement skills. In addition, the teacher found the use of digital technology motivated physical activity through the development of self-directed assessment and responsibility skills (Parker et al., 2017).

Although this researcher could find no studies conducted on how teacher-educators are preparing elementary teachers to integrate digital technology for physical education, there have been studies completed on how physical education specialist preservice teachers are being prepared to integrate digital technology in physical education. For example, Wyant et al. (2015) conducted a mixed-methods study at a Mid-Atlantic university that included 12 preservice teachers; qualitative data for this study was gathered through journal entries and semi-structured interviews and quantitative data was collected through questionnaires and surveys. This study by Wyant et al. (2015) investigated the influence of the single-course strategy used for training preservice physical education teachers how to integrate digital technology into physical education. Four themes emerged from this study: 1) technological and technological pedagogical knowledge increased - one course was effective at increasing preservice teachers' knowledge of technology and the role technology could play in their teaching; 2) persistent first-order (cost, access, support) and second-order (beliefs, confidence, knowledge, value) barriers to technology use remain – single-course strategy was found to be not effective at addressing these barriers; 3)

the necessity of experiential hands-on learning - this theme had two sub-hemes: a) hands on learning positively influences teachers use of technology and b) a lack of exposure to technology negatively influences teachers using technology; and 4) variation in warrant for technology use - three types of warrant were found to exist: innovative warrant (values technology and integrating technology with good pedagogy); moderate warrant (embraces some aspects of technology, but overall not concerned with effective integration) and custodial warrant (physical education is perceived as being about fun and not about planned development, assessments, etc.).

Two additional studies that are examples of research being conducted on technology integration in physical education both gather data from teachers that are physical education specialists; these studies are: 1) a study by Baek et al. (2018b), which examined twelve physical education teachers' perceptions of technology-related learning in their preservice, in-service, and graduate education, and 2) a study by Krause and Lynch (2018) on faculty and student' perspectives of TPACK in physical education. The study by Baek et al. (2018b) was conducted at a rural mid-Atlantic university and explored the perspectives of 12 in-service teachers enrolled in graduate physical education studies on their perceived value of technology related learning in three areas of education: preservice education, in-service continuing professional development, and graduate education. Data was gathered using semi-structured interviews and surveys. Four themes emerged from this study: 1) the absence of technology in their own K-12 physical education - all participants commented on never experiencing technology as students in their K-12 education and this negatively impacted their beliefs about technology in physical education; 2) technology-centric experience - participants commented that during their preservice education, technology education was on specific technological knowledge and not on the role of technology in teaching and learning in physical education; 3) broadened awareness through

observation - observation of teacher-educators using technology in their preservice, in-service, and graduate learning experiences broadened their perspectives and beliefs about technology in physical education; and 4) growth through hands-on experience - having opportunities to have hands on experience with technology integration increased their confidence to use technology in physical education.

The study by Krause and Lynch (2018) used a multi-case design to investigate the TPACK related experience of 13 faculty and 32 students in three physical education teacher education programs in the mid-Atlantic United States. Semi structured interviews and focus groups were used to collect data. The findings of this study led to four main themes: 1) basic instruction in technology varied across programs; 2) observation of technology proficient faculty - modeling technology use varied from teacher-educators using technology solely for their own teaching to teacher-educators educating preservice teachers on how to use technology for physical education; 3) integration of technology in field experiences - varied across programs due to availability of technology at various schools; and 4) student' technology proficiency and future technology use - most students felt more prepared to teach with technology when they finished their programs and most indicated that they plan to integrate technology into their future physical education classes. Krause and Lynch (2018) found that due to the lack of research on TPACK for physical education in Education programs, their study's findings provided needed information for teachers planning to teach physical education.

In addition, teacher-educators are key in preparing preservice teachers to provide inclusive education (Olson & Roberts, 2018). Olson and Roberts (2018) interviewed 11 special education teacher-educators on access to general curriculum for students with special needs; to obtain maximum variation in teacher-educator' perspectives, participants were included from

various States across the U.S. The findings from the Olson and Roberts (2018) study revealed that teacher-educators described access to education as needing to be individualized; one way they felt individualized instruction was supported was by making education more accessible through use of alternative devices and technology. Although this study was not specific to physical education, the authors made the point that digital technology provides tools for helping with individualized instruction that is needed for making education accessible for all students of varying abilities. In addition, BCs Curriculum highlights that flexibility in the provision of physical education is needed to provide inclusive education and to support diverse student abilities. BCs Curriculum identifies that technology has "opened the door for teachers and schools to approach the use of time and space in creative ways – ways that adapt to students' needs and interests" (Government of British Columbia, 2023g, para. 1). BC's Curriculum identifies four key considerations for physical education: 1) Alternative Delivery Policy – which indicates that families may choose a means of alternate delivery (alternate to in class with the teacher) for their child's physical and health education; 2) Inclusion, Equity, and Accessibility – teachers need to ensure the education provided addresses the needs of all students and shows respect for diversity; 3) Adapted Programs – the standard learning standards apply; however, adaptations are used as necessary, such as adapting the equipment; 4) Modified Programs – the learning standards are modified specifically to meet the student's needs. Digital technology is a means that can support these considerations; for example, digital technology supports connecting communities of learners - collaboration among students, teachers, parents, and content experts is facilitated via digital technology (Government of British Columbia, 2023b). In addition, digital technology provides access to a vast number of educational resources (Government of British Columbia, 2023b), such as video conferences with experts around the world and information on

strategies to adapt games for specific physical needs. In keeping with the success that teachers have found using digital technology to promote physical activity and in keeping with the significance of digital technology in today's world, Krause et al. (2020) put forth that training preservice teachers to use digital technology for physical education is an integral part of their education.

Despite the presence of digital technology in education and the beneficial findings regarding digital technology integration into education, education has been slower than other areas of society to fully embrace digital technology. There are obstacles to digital technology integration that slow its integration into education and reduce its effectiveness for achieving desired learning goals (Armour et al, 2017). Some of the obstacles to digital technology integration into physical education that have been identified are such things as: the association of digital technology with promoting sedentary behaviour (Pyle & Esslinger, 2014), teachers not being supported to have the time to learn how to effectively integrate digital technology to meet students' needs (Baek et al., 2018a), an overall lack of support to learn digital technology (Baek et al., 2018b; Krause et al., 2017), a lack of national standards to guide digital technology integration (T. Zakaria, personal communication, July 12, 2019), limited budgets (Baek et al., 2018b), and the need for preservice teachers to be prepared during their education on how to integrate digital technology effectively into their lessons (Hall, 2018).

2.3 Preservice Teachers need to be Prepared to Integrate Digital Technology into Physical Education

Learning to teach is complex and teaching others how to teach is challenging (Mjåtveit & Giske, 2020). Education programs in BC prepare elementary school teachers to teach in many subject areas and as such elementary school teachers are generalist teachers; in BC, elementary

teachers are responsible for teaching physical education to their students and helping them to establish physically active lifestyle behaviours (Truelove et al., 2021). Considering the varied scope of teachers' practice and the responsibility of teachers to integrate content, pedagogical and technological knowledge into their professional practice, teacher-educators have a challenging task in preparing preservice teachers (Mjåtveit & Giske, 2020). Hills et al. (2015) note that the importance of preservice teachers being prepared for physical education in the 21st century is enhanced by schools needing to adopt comprehensive school physical activity programs. BCs Curriculum also supports comprehensive school physical activity programs, exemplified through such aspects as identifying the importance of students understanding the significance of daily physical activity, as well as ensuring that students learn to identify various opportunities for physical activity throughout the day. Comprehensive school physical activity programs mean that all K-12 teachers need to be prepared to teach physical education and promote student physical activity throughout the school day; as such, education faculty need to be supported in preparing preservice teachers to teach physical education through effective means. Darling-Hammond (2017) highlight that teacher education is key in preparing effective teachers.

Additionally, in the 21st century teacher-educators have the added complexity of preparing teachers who will be effective in a digital world, where digital technology has become a routine component of learning and life (Armour et al., 2017; Scherer et al., 2019; Wyant & Baek, 2019). The Government of British Columbia (2023c) identified that all students must have regular opportunities in school to use technology to develop their skills. Ghavifekr and Rosdy (2015) suggest that in the 21st century incorporating educational technologies into education is a vital component of optimal teaching and learning.

2.4 Theoretical Foundations

In this section, the two theoretical frameworks that underpin this study, Mishra and Koehler's TPACK framework and Vygotsky's social constructivism, are presented. Mishra and Koehler's (2006) TPACK framework is considered foundational to this study because it describes the kinds of knowledge that preservice teachers (and their educators) need to understand if they are going to effectively integrate technology into their teaching (Koehler et al., 2014). Vygotsky's social constructivism provides foundational support to this study through drawing attention to the importance and influence of sociocultural context in education. Notably, Vygotsky's social constructivism "concentrates on the connections between individual functioning and development *and* the sociocultural practices in which individuals take part" (van Huizen et al., 2006, p. 271). Mishra and Koehler's (2006) TPACK framework is explored first and the importance of the relationship between pedagogical knowledge and technological knowledge is highlighted. Within the TPACK section there is an explanation of pedagogical integration that was informed by the work of Casey et al. (2017a) and Armour (2011). Next, Vygotsky's social constructivism is presented, and the significance of sociocultural context on education, social relevance and collaborative learning is explored.

2.4.1 Technological Pedagogical Content Knowledge

Mishra and Koehler (2006) identified that integrating technology into education is a complex process and as such developed the Technological Pedagogical Content Knowledge (TPACK) framework (see Fig. 1) in 2006 to guide the integration of digital technology into education (Casey et al., 2017a; Mishra & Koehler, 2006; Sargent, 2018). The TPACK framework continues to grow in popularity amongst researchers and is readily used by those investigating the integration of digital technology into education (Lee et al., 2022; Saubern et al.,

2020). Mishra & Koehler's 2006 publication was specifically selected to be used in this research study as this publication is their seminal work and has proven to be a valuable source of the TPACK framework. In fact, Mishra & Koehler's 2006 publication is the most cited work used in the study of technology integration into education; it has been used in more that 3,200 publications (Kessler & Phillips, 2019).

Mishra and Koehler (2006) state that a "conceptually based theoretical framework about the relationship between teaching and technology can transform the conceptualization and the practice of teacher education" (p. 1019), which is why they developed the TPACK framework. The TPACK framework was built upon the concept of pedagogical content knowledge introduced by Shulman in 1986. The various types of knowledge needed by teachers for effective teaching has been a significant area of research for quite some time. In the 1800s and early 1900s content knowledge was known as the main knowledge needed by teachers; by the mid-1980s, pedagogical knowledge had moved to the forefront as the knowledge needed by teachers (Halder, 2023). Then in 1986, Shulman identified that viewing pedagogical knowledge and content knowledge separately was not benefiting education and that understanding the intersect of these two types of knowledge was needed for effective teaching. Shulman put forth that a third type of knowledge, pedagogical content knowledge, created by the intersect of the two core knowledge types (content knowledge and pedagogical knowledge) should be recognized. As such, Shulman developed a framework that displayed the two core knowledge types, pedagogical knowledge and content knowledge, and the knowledge area, pedagogical-content knowledge, created by their intersect (Halder, 2023). Shulman (1986) describes pedagogical content knowledge as knowledge on the "most useful forms of representation" of content to "make it comprehensible to others" (p. 9).

Mishra and Koehler (2006) TPACK framework builds on Shulman's framework by including technological knowledge as a third core form of knowledge, as well as illustrates the complexity of the connection between pedagogical, content, and technological knowledge.

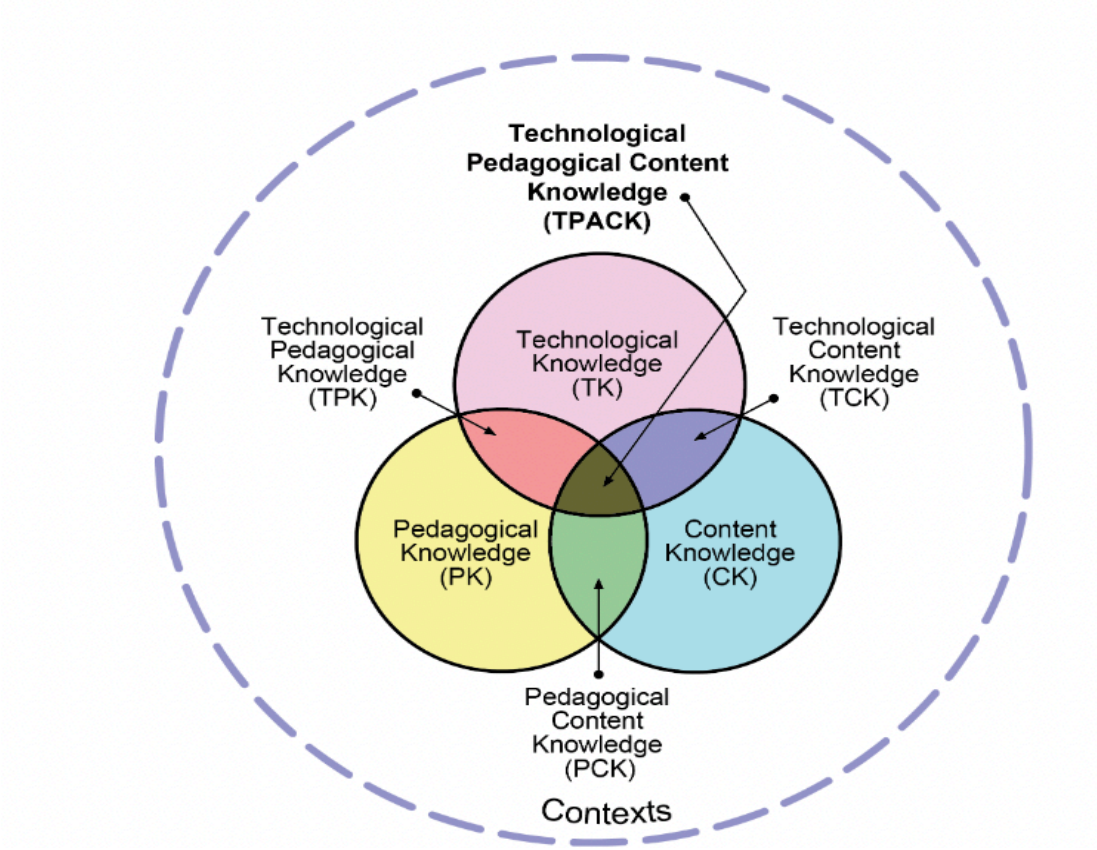

Figure 1. TPACK Framework created by Mishra & Koehler 2006:
"Reproduced by permission of the publisher, ©2012 by tpack.org" (Koehler, 2024).

First, I will describe the three core forms of knowledge (technological knowledge, pedagogical knowledge, & content knowledge) and then will describe the four intersecting points of knowledge, which are: technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and the central intersection of all three core knowledge types, technological pedagogical content knowledge.

The three core forms of knowledge are: 1) Technological knowledge - a dynamic state of knowledge that involves knowledge of various technologies and how to use them (Koehler &

Mishra, 2009; Koehler et al, 2013). Technological knowledge requires having a broad enough understanding of the digital technology in use that one is able to recognize when it is assisting or impeding the desired goal (Koehler et al., 2013). 2) Pedagogical knowledge - knowledge on the processes and practices of teaching and learning and includes such considerations as educational outcomes and how students learn (Koehler & Mishra, 2009; Koehler et al., 2013). 3) Content knowledge - knowledge about the subject matter (Koehler & Mishra, 2009; Koehler et al., 2013).

The types of knowledge formed from the knowledge intersections are: 1) Technological content knowledge, which is "an understanding of the manner in which technology and content influence and constrain one another" (Koehler et al., 2013, p. 16). 2) Pedagogical content knowledge, which is how someone interprets and understands the subject and then represents the material in a way that is conducive to student comprehension and assimilation (Koehler & Mishra, 2009; Koehler et al., 2013; Shulman, 1986). 3) Technological pedagogical knowledge is "an understanding of how teaching and learning can change when particular technologies are used in particular ways" (Koehler et al., 2013, p. 16). At the centre of the intersection of knowledge is 4) Technological pedagogical content knowledge, which is "an emergent form of knowledge that goes beyond all three "core" components (content, pedagogy, and technology); it is an understanding that emerges from interactions among content, pedagogy, and technology knowledge" (Koehler et al., 2013, p. 16). Willermark (2018) discusses the importance of understanding TPACK and highlights that increased understanding of this framework can be useful in assessing the practical implementation of digital technology and in determining whether the use of a specific digital technology is enhancing the teaching and learning of the subject to which it is being integrated.

Building technological pedagogical knowledge helps a person understand how technologies can fit into various learning contexts and how to effectively integrate them (Koehler et al. 2013). Harris et al. (2009) explain that they are building on the work of earlier authors in their work towards "pedagogically forward-thinking technology integration" (p. 395). For example, they cite the work of Means and Olsen (1997), who conducted a national study in the U.S. on the value of technology integration in supporting education reform which at that time focused on student-centered constructivist pedagogies. Further, Harris et al. (2009) put forth that the complex relationship of technology and pedagogy is often not being sufficiently considered when integrating technology into education and that integration is being done in a "pedagogically unsophisticated" way (p. 393). It is hoped that my study will aid in providing educators with information to enhance their understanding and ability to pedagogically integrate digital technology into physical education.

2.4.1.1 Pedagogical Integration.

"Merely introducing technology to the educational process is not enough."

(Mishra & Koehler, 2006, p. 1018)

For technology integration to be beneficial to learning, technology needs to be integrated into education with pedagogical awareness (Krause, et al., 2020; Mishra & Koehler, 2006). As mentioned, pedagogical integration of digital technology can be conceptualized as the process of integrating digital technology into education with a focus on pedagogy [conceptualized as learners' learning, teachers' teaching, and knowledge in context (Armour, 2011; Casey at al., 2017b)] in such a way that the integration of digital technology effectively addresses the desired learning outcomes.

Casey et al. (2017a) in their book, *Digital Technologies and Learning in Physical Education: Pedagogical Cases* use the pedagogical cases model developed by Armour (2014) to share the narrative accounts of learners from the perspective of physical educators, which is then followed by a pedagogical expert sharing an analysis of the narratives. This model highlights the importance of pedagogical integration of digital technology through illuminating how digital technology is being used practically by physical educators, how it is being received by the learner, the context within which it is being used, and how the learning outcomes are being addressed. The pedagogical cases model aligns well with Mishra and Koehler's (2006) perspective that research grounded in the real-life context of teaching practice is important for building understanding of digital technology integration into education.

Casey et al. (2017b) express that a focus on pedagogy is what has been missing in the discussion regarding digital technology and physical education, acknowledging that there is little evidence regarding *how* digital technologies are being used to promote physical activity. One consideration that has been brought to light is that perhaps what is hindering technology integration is educators trying to integrate digital technology into outdated pedagogies (Armour et al., 2017). Therefore, Armour et al. (2017) suggest a definition for pedagogies of technologies:

> Pedagogies of technology are critically aware and technically competent pedagogies that can be developed in practice to maximise the latent potential of technologies to accelerate learning in meaningful ways that meet the individual needs of diverse learners. The starting point for a pedagogy of technology is a desire to do things differently, rather than to do the same things using ‘flashy’ tools and gizmos. (p. 6)

The importance of *pedagogical* integration is highlighted through this definition’s focus on learners’ needs and meaningful learning.

In their article Casey et al. (2017b) offer responses to various arguments in the literature against the integration of digital technology into physical education. For example, Williamson (2015) voiced concerns over the impact of digital technologies that are designed to track various aspects of student' fitness, indicating that physical education may end up being governed by health tracking systems and focus on the corporeal development of the student rather than on the development of the whole person. Due to these concerns, Williamson cautions researchers to critically consider the use of digital technology in physical education. Additionally, Lupton (2014) advises that digital technology has the potential to contribute to negative health outcomes due to the potential for data to leave the hands of the individual and be used as surveillance by governing bodies; Lupton specifies that this potential exists if technology is used without critical planning. Both Williamson and Lupton comment on critical consideration being needed for digital technology integration; critical consideration of technology would be addressed by educators having an increased awareness of the pedagogies of technology and an understanding of pedagogical integration. Further, Gard (2014) also shared concern regarding the potential negative impact of tracking devices in physical education; he argues that the global goals of digital technologies are commerce, automating work, and the surveillance of people's behavior. Gard highlighted that because of the goals of digital technology, we need to be aware of its role and that rather than being beneficial to physical education, digital technology has the potential to cut teachers out of physical education altogether and promote physical activity as something that can be delivered by technology alone. Specifically, Gard stated that digital technology will support physical activity being viewed "as primarily technological problems matters rather than pedagogical ones" (p. 840). Gard concludes his article by inviting readers to consider what "pedagogically defensible" physical education might look like. Gard's views highlight the

importance of pedagogy and increasing awareness that technology and pedagogy are not dichotomous, but rather understanding the relationship between the two is vital for the integration of technology to enhance the achievement of learning outcomes and positively impact education. Overall, the cautions by Williamson, Lupton, and Gard emphasize the importance of further research being needed on the relationship between pedagogy and technology for physical education.

Developing a clear understanding of the pedagogical integration of digital technology has the potential to address the perceived negative impacts of digital technology that may be arising from a lack of pedagogical integration. Pedagogical integration not only has the potential to prevent digital technology from having a negative effect on physical education, but as Casey et al. (2017b) note technology integration done with pedagogical awareness can assist teachers to deliver education that is more efficient and engaging for digital age students. This section has highlighted that research on the pedagogical integration of digital technology is needed to reduce the potential negative impacts and optimize the benefits of digital technology. Exploring the perspectives of teacher-educators on how they are supporting preservice teachers to pedagogically integrate digital technology into physical education brings awareness to the significance of and contributes to the body of literature on the pedagogical integration of digital technology.

In this section the three core types of knowledge (technological, pedagogical, and content) of the TPACK framework and how these knowledge types are interrelated, has been described. The TPACK framework is foundational to this study on the ways teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into physical education. Also in this section, the importance of the work by Casey et al. (2017a), on

pedagogies of technology for integrating digital technology effectively into physical education has been highlighted.

The original publication by Mishra & Koehler (2006) describes context as being an important part of the TPACK framework; however, they acknowledge it was not included in the original TPACK figure until the *Handbook of Technological Pedagogical Content Knowledge for Educators* was written by Koehler & Mishra in 2008 (Rosenberg & Koehler, 2015). Rosenberg and Koehler (2015) mention that context is often missing from TPACK research and state "despite the growing and diverse research into many aspects of TPACK, it is clear that context remains an underdeveloped and under researched component of the framework" (p. 188). Further, Rosenberg and Koehler recommend that researchers investigate how contextual factors impact TPACK. The theoretical framework of Vygotsky's social constructivism provided insight to explore how sociocultural context impacts TPACK, as well as illuminated the significant role of sociocultural context and the Zone of Proximal Development within the pedagogical integration of digital technology. Vygotsky's social constructivism is presented in the next section.

2.4.2 Social Constructivism

Vygotsky's social constructivism maintains that learning is socially constructed through interactions with one's environment; as such, learning is impacted by cultural influences and social interactions (Bada & Olusegun, 2015; Luria & Vygotsky, 1992; McKinley, 2015; Sharkins et al., 2017; Vygotsky, 1978). Amineh and Asl (2015) share Vygotsky's perspective and state that learning "is mediated by community and culture" (p. 10). Digital technology's influence on current society continues to expand at an exponential rate (Jones et al., 2017); in fact, students born after 1980 are considered "digital natives" and have never known a world without the

internet (Kesharwani, 2020: Krause et al., 2017). The vast impact of digital technology on society and on social interactions makes it a significant consideration when exploring cultural and social influences on learning.

2.4.2.1 Zone of proximal development.

Vygotsky highlights the significance of social interaction on learning through the concept of the Zone of Proximal Development (ZDP). Vygotsky (1978) used the concept of ZPD for learning that goes beyond what one can learn independently. Vygotsky (1978) defined the ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Roth and Radford (2010) propose a more symmetrical interpretation of the ZPD; where just as the learner learns at the outer edge of their ZPD, the teacher learns also. "Far from constituting a sole opportunity for the student to learn (e.g., subject matter), the zone of proximal development constitutes an opportunity for the teacher to learn too (e.g., subject matter pedagogy)" (Roth and Radford, 2010, p. 304). Eun (2019) highlights that the learning that occurs within the ZPD is influenced by the societal and cultural settings within which the learner interacts. 21st century students spend a great deal of time interacting with and socializing through digital technology (Churcher et al., 2014); therefore, digital technology is influencing how 21st century student connect, collaborate, and construct knowledge.

2.4.2.2 Collaborative Learning & The Teacher's Role.

Social constructivism highlights that significant learning occurs through collaboration with others (Barak, 2017). Digital technology has increased socialization and opportunities for collaborative learning (Cicconi, 2014). Cicconi (2014) highlights that the internet is now "a

medium for social learning" and students are learning from each other through shared online spaces (p. 58). Further, Churcher et al. (2014) found that digital technology can be a relevant way for teachers to connect students and advance their learning.

With technology making it easier for students to find information and share knowledge, the role of the teacher is changing from being a disseminator of content to being a facilitator of learning (Churcher et al., 2014). Cicconi (2014) highlights the changing role of educators, noting that teachers are transforming from being sources of information that know how to deliver information for optimal assimilation to truly becoming facilitators of learning. Further fueling the transformation of educators' roles is the ability of digital technology to support student driven learning, and as students are increasingly able to independently find information the role of the teacher as a facilitator has increased in importance (Cicconi, 2014). The social constructivist perspective helps to increase understanding of the importance of teachers being facilitators of learning and fostering collaborative learning amongst their students (Barak, 2017). Sharkins et al. (2017) put forth that teachers can provide students with opportunities to share their perspectives and explain their understanding and thereby support students to socially construct knowledge. Cicconi (2014) notes that "technology allows for a new definition to be written, one that celebrates students driving their own instruction with masterful guidance from teachers" (p. 59).

It is important that teachers consider the cultural complexity of learners and how to provide an effective learning environment with consideration of cultural or societal influences. Shulman (1986) also identifies that consideration of the learner's context is a key component of good pedagogy and providing optimal education. In the 21st century, the way we communicate and share information has dramatically changed (Barak, 2017). Vygotsky 's social constructivism

encourages teachers to consider social and cultural influences that impact what and how students learn, such as the impact of digital technology on learning. Barak (2017) raises the concern that "student teachers are not sufficiently exposed to social constructivist approaches for promoting meaningful usage of advanced technologies" (p. 284). Barak goes on to highlight that "teacher educators can provide a pathway for transforming traditional practices to constructivists and social constructivists approaches" (p. 287). Kadri et al. (2017) further the understanding of Vygotsky's social constructivist approach and its potential to transform traditional teaching practices by highlighting that learning in the zone of proximal development occurs symmetrically.

2.6 Chapter Summary and Chapter 3 Preview

Chapter two presented the vital role of schools and teachers in motivating children to be physically active. The responsibility of teachers to integrate digital technology to promote physical activity and the need for preservice teachers to be prepared during their own education to integrate digital technology into the context of physical education was discussed. In addition, the two theoretical frameworks that provided insight and guidance for this research study were presented: First, Mishra and Koehler's TPACK framework in which the complexity of digital technology integration into education for specific learning purposes was highlighted, followed by insight provided by Casey et al. (2017a) through their focus on the importance of digital technology integration being guided by a pedagogical approach. Second, Vygotsky's social constructivism, was highlighted, as it presented the significance of the social and cultural influence on learning. In addition, Vygotsky's ZPD sheds light on collaborative learning, his social constructivist approach can guide teachers with how to facilitate student' learning in this digital era which provides vast information to students and supports "students driving their own

instruction" (Cicconi, 2014, p. 59); as well as forces all teachers to consider their pedagogical practices.

The social and cultural influence of digital technology on learning, combined with the dual responsibility placed on teachers to both pedagogically integrate digital technology and increase physical activity amongst digital age students affirms the need for this study on how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into physical education. This led to a case study research design, which explored teacher-educators' perspectives on navigating the complex social phenomena of supporting preservice teachers to pedagogically integrate digital technology into physical education. Chapter three presents the methodological rationale for why qualitative case study research design was selected. Also included in chapter three are descriptions of: the researcher's worldviews and role, contexts – participants and their classrooms, data collection procedures, data analysis and validity verification methods.

Chapter 3: Research Methodology

In this chapter, I describe the methodology of this study that explored how teacher-educators are supporting preservice elementary teachers to pedagogically integrate digital technology into physical education. This chapter begins with a reminder about the research problem, the purpose of this study, and the central research question. The chapter is then divided into two main sections: 1) methodological rationale and 2) research design. The first section on methodological rationale contains an overview of qualitative research, specifically CSR design, and why it was selected as the means of investigation for this study. The overall limitations of this study are included in the first section of this chapter and are connected to the limitations of CSR research design. The second section of this chapter contains details of the research design, which includes: delimitations of this study, participants and their contexts, data collection methods, data analysis procedures, and validity verification measures. This chapter culminates with a chapter summary and an introduction to chapter 4 in which the findings of this research study are presented.

The central question that guided this research study was, *How are teacher-educators supporting preservice elementary teachers to pedagogically integrate digital technology into physical education?* TPACK influenced the framing of this central question through highlighting that *pedagogical* uses of digital technology are needed to integrate technology effectively and that teachers need to conscientiously develop their technological pedagogical content knowledge to be able integrate technology meaningfully into their courses (Mishra & Koehler, 2006). Shulman (1986), and Mishra and Kohler (2006) include understanding learners' contexts as a key part of pedagogy. Vygotsky's social constructivism deepens the focus on learners' contexts through illuminating the significance of sociocultural influence on learning. Vygotsky's theory

highlights the need for teacher-educators to consider sociocultural changes, such as the societal permeation of digital technology, and how this may impact their pedagogical practices. Further, Vygotsky's zone of proximal development guides people to recognize the reciprocal influence of people in one's learning environment. The insight provided by these theoretical foundations, along with the vital need for elementary age students to develop lifelong physical activity behaviors, brought attention to the importance of understanding how preservice teachers are being supported during their education to develop their ability to pedagogically integrate digital technology into physical education. The next section of this chapter describes the methodological rationale that aided in determining the research design that was used to investigate this research query.

3.1 Methodological Rationale

The methodology of a study is informed by the research phenomenon under study, the researcher's worldview, the philosophical assumptions stemming from the researcher's worldview, and the specific research methods used by the researcher (Creswell & Poth, 2018). In this section, I explain why a qualitative CSR design was selected for this study and the role of the researcher in CSR design. Additionally, I share the importance of the researcher's worldview, which includes insight into the development of the theoretical framework (Fig. 2) that formed the foundation of this study.

3.1.1 A Qualitative CSR Design

Teachers must employ complex knowledge systems in complex learning environments (Koehler et al., 2013). The complexity of how preservice teachers are being supported to pedagogically integrate digital technology for physical education in their complex learning environments was well suited to be explored by a qualitative research design. Qualitative

research is to be used when planning to explore a phenomenon in-depth and when wanting to expand understanding of a situation's complexity (Creswell & Creswell, 2018; Denzin & Lincoln, 2024). In addition, qualitative research supports acquiring, "appreciating, and making sense of" multiple subjective perspectives (Patton, 2015, p. xiii). Therefore, a qualitative study, in which I used interviews and observations to collect data, was well suited to gaining an understanding of the perspectives of multiple teacher-educators on the complex topic of supporting preservice teachers to pedagogically integrate digital technology into the context of physical education. This study was conducted using a qualitative CSR design, which is described in the next section.

3.1.1.1 Case Study Research.

CSR is "an empirical method that investigates a contemporary phenomenon (the "case") in depth and within its real-world context" (Yin, 2018, p. 15). Delimiting the "case" and producing an in-depth description and analysis of a bounded system is a defining characteristic of CSR (Hancock & Algozzine, 2017; Merriam, 1998; Merriam & Tisdell, 2016; Yin, 2018). In fact, Hancock & Algozzine (2017) note that this is how CSR differs from other types of qualitative research in that CSR provides "intensive analyses and descriptions of a single unit or system bounded by space and time" (Kindle edition, location 335). The bounded system, the "case", in this study is how teacher-educators, in approved B.Ed. programs (that prepare elementary teachers for grades K–7) located in the province of British Columbia, are supporting preservice teachers to pedagogically integrate digital technology into the context of physical education. This clear identification of a bounded system supports deep analysis of context and understanding context assists in shedding light on complex phenomena. Yin (2018) furthers the capacity of CSR to address complexity and highlights that "The distinctive need for case studies

arises out of the desire to understand complex social phenomena" (p. 5). Education is a complex phenomenon; much of the complexity lies in the multiple intersecting items being addressed in any one classroom at any given time (Koehler & Mishra, 2009; Koehler et al., 2013). For example, teachers must employ complex knowledge structures to address the social needs of students while at same time try to integrate educational innovations, such as digital technology, into their learning environments (Koehler & Mishra, 2009; Koehler et al., 2013; Yurkofsky, 2022).

CSR's capacity to effectively explore educational innovations also stems from the CSR design's focus on providing a "detailed account of the phenomenon under study" (Merriam, 1998, p. 38). Detailed accounts of the phenomenon under study is enabled by CSR investigating phenomena in their real-life contexts; CSR theorists note that real-life contexts help to provide detailed accounts and enhance understanding (Merriam, 1998; Merriam & Tisdell, 2016; Stake 1995; Stake 2006; Yin, 2018). Mishra and Koehler (2006) illustrated the suitability of CSR to this study when they shared that research grounded in the real-life context of teaching practice is important for building understanding of digital technology integration into education. Therefore, a CSR design was determined to be well suited for this research study that explored the complex phenomenon on how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into the context of physical education.

In this section, CSR's strengths for this study were highlighted. CSR's strengths support it being a research approach that facilitates exploring a phenomenon in depth, providing holistic accounts, and developing comprehensive understanding of complex phenomena (Harrison et al., 2017; Merriam, 1998). All research designs also have limitations. CSR 's limitations and the overall limitations of this study are identified in the next section.

3.1.1.2 CSR Limitations Connected to the Limitations of this Study.

The strengths of CSR design also contribute to its limitations. For example, for successful CSR to be completed, the researcher must be able to establish a meaningful connection with participants to be able to understand and analyze their perspectives (Harrison et al., 2017; Patton, 2015) and this can entail a large time commitment. Conducting six interviews and four observations, while using an inductive approach to data analysis, was extremely time consuming.

In addition, access to context is extremely important in CSR and for this study access was restricted due to the COVID pandemic; instead of face-to-face observations and full submersion in the usual classroom context, observations were done online in Zoom (a video conferencing tool) supported classrooms. This context made it more challenging to assess the environment; however, this challenge was addressed by consciously focusing on the full environment, taking detailed notes, and having a preplanned observation guide (See Appendix G) to guide observations.

Another potential limitation of CSR is the experience of the researcher, as researchers have a main role in CSR data collection and analysis (Merriam & Tisdale, 2016), both of which are described in the next section, *Case Design*. As a researcher, I have experience reviewing relevant literature and collecting data for other research studies, including experience with assessment, interviews, and observations; these experiences assisted in being prepared for this study. However, a limitation for this study was that I am a novice researcher when it comes to CSR design; this was my first research study conducted using CSR and I found data analysis challenging. Yin (2018) acknowledges that data analysis of case studies is "the most difficult stage of doing case studies, and novice researchers are likely to have a troublesome experience" (p. 201). However, the challenges of CSR were ameliorated by in-depth preparation for CSR; for

example, literature written by main CSR theorists, such as Yin, Stake, Merriam & Tisdale were reviewed. Informed by CSR theorists' work, a CSR plan was set up ahead of time that detailed the research design and followed a clear methodological plan (Yin, 2018). The details of this plan are provided throughout this chapter. The research plan included such components as clearly articulated researcher worldview, interview protocol (See Appendix D) and observation protocol (See Appendix F). In addition, I had the support of a doctoral committee reviewing my work; for example, in CSR it is very important to limit the number of participants so that the researcher can increase the depth of research. My committee encouraged me to limit the number of participants to three and this aided in more manageable data analysis.

Highlighted within this section was how qualitative research is used to understand complex phenomena and how CSR focuses on identifying and investigating a bounded system with deep understanding of the real-life context. Also included in this section were the strengths and limitations of CSR connected to this study. Additionally, the researcher having a main role in CSR (Merriam & Tisdell, 2016) was introduced, the role of the researcher is described in the next section.

3.1.2 Role of the Researcher

Qualitative research is "a situated activity that locates the observer in the world" (Denzin & Lincoln, 2024, p. 128). This description of qualitative research highlights the researcher's role. The researcher is "an observer in the world" because the researcher not only has to observe the physical context in which the phenomenon is occurring but must also understand the context within the world and in consideration of peoples' worldviews. Denzin & Lincoln (2024) draw attention to understanding the social construction of context when they note that "qualitative researchers study things in their natural settings, which are socially constructed, attempting to

make sense of or interpret phenomena in terms of the meanings people bring to them" (p.129). Therefore, a qualitative research design, using interviews and classroom observations, was well suited to exploring how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into the context of physical education. Merriam and Tisdell (2016) describe the significance of the researcher in understanding context, saying that "Qualitative inquiry, which focuses on meaning in context, requires a data collection instrument that is sensitive to underlying meaning when gathering and interpreting data. Humans are best suited for this task" (Merriam & Tisdell, 2016, p. 2).

The depth of understanding of context needed for this study contributed to the specific selection of CSR as the qualitative research design. CSR theorists highlight the significance of the researcher in CSR, noting that the researcher is central in data collection and analysis (Campbell, 2015; Merriam & Tisdell, 2016; Patton, 2015; Stake, 2006; Yin, 2018). Yin (2018) identifies that good preparation for data collection begins with the researcher. Therefore, researchers showing how they understand the world and how this affects data analysis is integral to understanding any CSR study (Merriam & Tisdell, 2016; Patton, 2015; Yin, 2018;). Accordingly, CSR researchers need to ensure that they have reflected on their values and biases, and that this reflection needs to be included in the report (Yin, 2018). The next section, Researcher's Reflection, presents my worldview including associated assumptions and biases.

3.1.2.1 Researcher's Reflection.

It is important that researchers reflect on and make transparent their worldview, associated assumptions, and biases as these impact the lens with which the researcher views the world, and subsequently impacts how data is collected, perceived, and interpreted (Merriam & Tisdell, 2016; Saldaña, 2021). Worldview as described by Creswell (2018) is "a general

philosophical orientation about the world and the nature of research that a researcher brings to a study" (p. 5). Worldviews are the beliefs that researchers have formed throughout their lives and now form the lens through which they view the world (Creswell & Poth, 2018).

A researcher's worldview is impacted by their experience, my background is shared in chapter one under section *1.1 Researchers Background,* in which I share that I am a parent, a nurse, a teacher, a teacher-educator, and a coach – my experience in these areas has impacted the lens with which I view the world. In addition to a person's experience, literature has a reciprocal relationship with one's worldview - what one reads impacts their worldview and a person's worldview impacts what they read (Merriam & Tisdell, 2016). What a person reads also impacts the frameworks within which they choose to do their research. Merriam and Tisdell (2016) identify that theoretical frameworks are influenced by a researcher's worldview and are found within the literature. Vygotsky 's social constructivism theory and Mishra and Koehler's conceptual framework TPACK formed the theoretical framework of this study and are described in more detail in chapter two under *Theoretical Frameworks*; in addition, these works are discussed connected to the findings in chapter five. Merriam & Tisdell (2016) note that all research has a theoretical framework and that the theoretical framework should be articulated in every research study; they explain a theoretical framework of a study as the underlying structure that is derived from a researcher's worldview and from relevant literature. The theoretical framework of a study is the foundation from which the research problem emerges (Merriam & Tisdale, 2016). Miriam and Tisdale (2016) developed the model that is shown below, included within the framework is additional information to illustrate the theoretical framework that formed the foundation of this study.

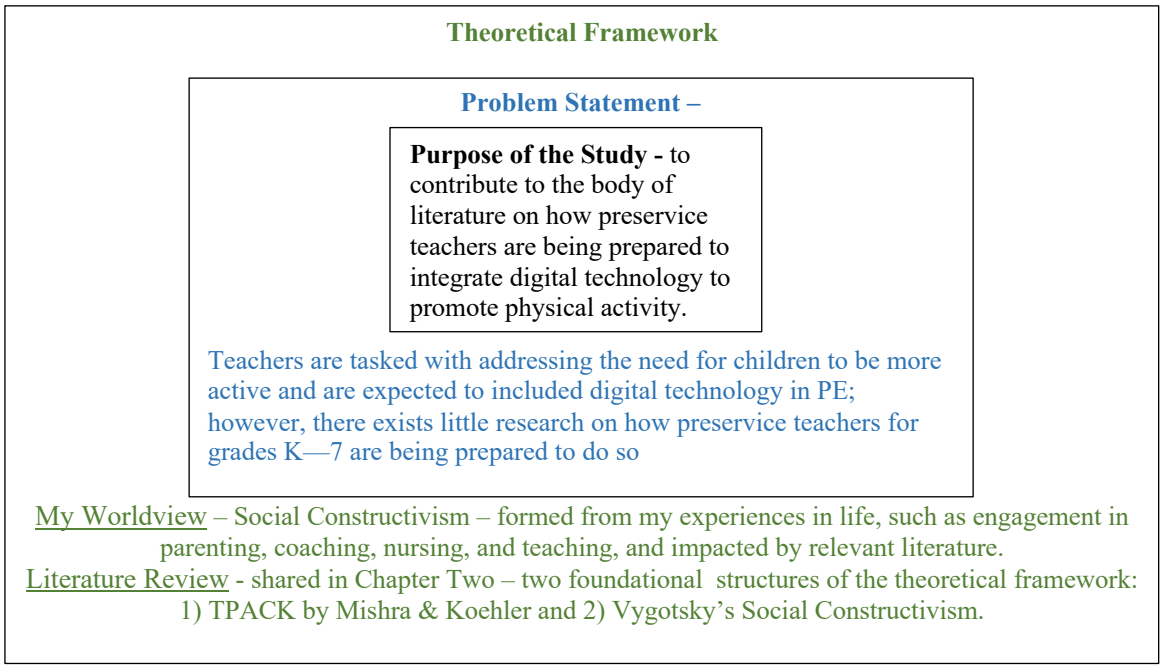

Figure 2. The Theoretical Framework [Merriam & Tisdell, 2016, p.87).
Legend - all bold font is part of Merriam & Tisdell's framework.
All font not bolded is specific to this study.

3.1.2.2 My Worldview - Social Constructivism.

The worldview that I hold is social constructivism. I share the perspective that "reality is not an objective entity; rather, there are multiple interpretations of reality" (Merriam, 1998, p. 22). I believe that reality is socially constructed and that there are multiple interpretations of a single event (Merriam & Tisdell, 2016; Stake, 2010). Stake (2010) states, "Many of us take a constructivist view that there is no true meaning of an event; there is only the event as experienced or interpreted by people" (p. 66). People with a constructivist worldview seek to understand the world around them through gathering multiple interpretations (Merriam & Tisdell, 2016); this worldview impacted my design decision to gain an understanding of this study's topic through gathering the perspectives and experiences of multiple teacher-educators. A researcher's worldview includes philosophical assumptions that provide the direction of a study and can be described under the classifications of 1. ontology, 2. epistemology, 3. axiology,

and 4. methodology (Creswell & Poth, 2018; Merriam & Tisdell, 2016). I will describe these four philosophical assumptions in relation to my worldview of constructivism and the selection of CSR design:

1. Ontology – "the nature of reality" (Creswell & Poth, 2018, p. 20) – in constructivism "individuals form their own realities" (Creswell, 2016, p. 41). My ontological belief that individuals form their own realities contributed to my selection of a CSR design to investigate teacher-educators' realities through using interviews to gain understanding of how teacher-educators were forming their reality of supporting preservice teachers to integrate digital technology into physical education.

2. Epistemology - "what counts as knowledge and how knowledge claims are justified" (Creswell & Poth, 2018, p. 20) – in constructivism "subjective participant views matter" (Creswell, 2016, p. 41). Merriam & Tisdell (2016) describe epistemology as the construction of knowledge. As a social constructivist, I believe that knowledge is constructed continuously by people as they make meaning of their experiences through a lens built on previous experiences. My epistemological belief illustrates how CSR design was suitable for this study, as CSR design explored how teacher-educators are making meaning of their experience of supporting preservice teachers to integrate digital technology into physical education.

3. Axiology - "the role of values in research" (Creswell & Poth, 2018, p. 20) – in constructivism "values of researcher are made explicit" (Creswell, 2016, p. 41). The axiological belief that the values of researchers should be made explicit is supported by CSR. My detailed methodological plan makes transparent my worldview and my potential biases (Creswell, 2016).

4. Methodology - "the process of research" (Creswell & Poth, 2018, p. 20) – in constructivism it is "inductive research starting with participant views" (p. 41). An important part of CSR research

is that it is an inductive process, which means the researcher builds concepts from the data, rather than deductively testing a hypothesis (Merriam & Tisdell, 2016). I began with participants' views, which were coded throughout the study using constant comparative analysis. In the constant comparative method developed by Glaser and Strauss in 1967, researchers use inductive coding strategy starting with open codes and continually comparing data from which categories and themes emerge (Merriam & Tisdale, 2016). The constant comparative analysis process was used to support organic emergence of themes; this process is explained in more detail in the next section of this chapter, *Research Design*.

The articulation of my constructivist assumptions highlight that constructivists believe people actively construct knowledge through their experiences and through interactions with others (Bada & Olusegun, 2015; Churcher et al., 2014; Sharkins et al., 2017); this belief strongly influenced the selection of CSR design. Yin (2018) acknowledges that case study researchers "might pursue a constructivist approach in designing and conducting … case study - attempting to capture the perspectives of different participants and focusing on how their different meanings illuminate" the study (p. 16). Worldviews are not without bias and the potential biases that could stem from my worldview are explained in the next section.

3.1.2.2.1 Researcher Bias.

With researchers having a specific worldview and being the main instrument of data collection and analysis, researchers' biases must be made explicit (Yin, 2018). The biases I hold are linked to my worldview of social constructivism. With my belief that knowledge is socially constructed comes the bias that there is no single one truth and that understanding comes from exploring multiple perspectives. The impact of this bias on the selection of research design was explained in the previous section.

A personal bias that I have identified is that I believe digital technology is a significant part of an optimal physical education program. This bias is informed by the knowledge of directives from the provincial and federal governments to integrate digital technology into all aspects of learning (Government of British Columbia, 2023b); and by literature that identifies the motivational aspects and success of digital technology in promoting physical activity (Lewis et al., 2017; Parker et al., 2017; Wyant & Baek, 2019). Consequently, my bias could impact my collection and interpretation of data, as I may naturally focus on data that confirms my belief. To ameliorate the potential for this bias I recorded interviews, had preplanned observation charts that guided my observations, and had participants review the data collected and themes that emerged. In addition, interview protocol (See Appendix D) and observation protocol (See Appendix F) were developed that guided data collection. Yin (2018) shares that using participants' words helps to minimize bias; therefore, I included quotations from the participants and context descriptions from observation to show how findings emerged. To further substantiate that the potential for bias was addressed, I used triangulation between data sources and between data collection methods. Another bias that should be mentioned, as it is common in CSR, is recall bias (Yin, 2018), recording interviews and the use of observational collection charts assisted in minimizing this bias.

Openly examining bias and including steps to address bias in the research design are key in limiting bias in research studies (Merriam & Tisdale, 2016; Yin, 2018). Therefore, the transparency of including my worldview, assumptions, and biases in this study helped to limit bias. As well, a clear and well-articulated research design helps to limit bias. My research design is presented in the next section.

3.2 Research Design

The research design for this study, as explained in the methodological rationale section of this chapter, is a qualitative CSR design. It is important in qualitative CSR research to have a clear research plan (Yin, 2018). Yin (2018) describes a research plan as "a logical plan for getting from here to there, where here may be defined as the set of questions to be addressed, and there is some set of conclusions about these questions" (p. 26). The guiding research questions for this study are identified in chapter one in the section *1.3 Research Questions* and the central research query, along with the research problem and purpose, were reiterated in the introduction of this chapter. The conclusions or findings of this study are presented in chapter four and discussed with connections made to relevant literature in chapter five.

This section of chapter three is divided into seven sections that delineate the research plan. This first section provides the role of a research plan and outlines the chapter. Sections two through six are presented in the following order: delimitations of the study, recruitment procedures, participants and their contexts, data collection methods, and data analysis procedures. Section seven summarizes chapter three and introduces chapter four.

3.2.1 Delimitations

The specific CSR design for this study is a multi-case descriptive CSR design. Yin (2018) identifies that one case study can cover multiple cases and that the researcher, through cross case analysis, can draw a single set of themes from multiple cases. In addition, this case study is a descriptive case study. Descriptive CSR designs are used to describe phenomena in-depth, with attention to context (Hancock & Algozzine, 2017). The purpose of a descriptive CSR design "is to describe a phenomenon (the 'case') in its real-world context" (Yin, 2018, p. 286). As a reminder, "the single most defining characteristic of case study research lies in delimiting

the object of study: the case" (Merriam & Tisdell, 2016, p. 38). It is extremely important in CSR to set "bounds to the case" (Yin, 2018, p. 24).

The phenomenon or bounded unit that was studied with this multi-case descriptive case study was how teacher-educators, in approved B.Ed. programs (which prepare elementary generalist teachers for grades K–7) located in the province of British Columbia, are supporting preservice teachers to pedagogically integrate digital technology into the context of physical education. The procedures used for recruiting participants are described in the next section.

3.2.2 Recruitment Procedures

To begin the process of recruiting participants, I started with obtaining ethics approval from UVic's Human Research Ethics Board; this was a harmonized approval, which means the ethics application for this study was reviewed and approved by four BC universities (See Appendix A). Once approved, I began contacting potential participants. At the time of this study there were nine universities in the province of British Columbia that had approved B.Ed. programs. Based on a review of these programs and based on the universities' geographical locations, five of the nine potential participants were contacted. Potential participants were contacted via an initial introduction e-mail (See Appendix B) with a consent form (See Appendix C) attached. Four potential participants agreed to be a part of this study; the first three participants that agreed were accepted into the study. The number was limited to three participants upon recommendation from my doctoral committee that fewer participants would support more in-depth exploration of the cases. In addition, the fourth participant would not have been able to participate until after the intended data collection window. Therefore, to keep the research plan on its designated timeline for data collection, this participant was not included. The participants, and their contexts, who were included are described in the next section.

3.2.3 Participants & Their Contexts

The participants included in the study were teacher-educators who taught PE courses (or course equivalents) in approved K–7 B.Ed. programs in the province of British Columbia. Participants were randomly assigned pseudonyms of common names that could easily be remembered and that would ensure that the participants' identities remained confidential. The first participant was given the pseudonym "Peter", the second participant was given "Pat", and the third participant was given "Paul". The descriptions of the participants and their contexts came from class observations and interviews, both of which were strongly impacted by the COVID pandemic, as all courses were mandatorily being delivered online (via video conferencing) and interviews also had to be conducted online.

Included in this section is a chart that presents an overview of the participants and their courses (see Table 1). The chart includes: the "point in career" of each participant, participants' self-analysis of their experience with digital technology, number of classes per week, the overall course' focus, the focus of the individual classes that were observed, and the class delivery mode, which includes a description of the teacher-educators' physical background during course delivery. After the participant chart, this section contains written descriptions of the participants contexts, which present more in-depth descriptions of the classroom contexts. Examples of the teacher-educators' uses of digital technology are touched upon in these written descriptions to provide deeper insight into their contexts; in chapter four uses of digital technology are further expanded upon as examples for various findings. In addition, there are some participants' words used in this section to help establish a richer understanding of the teacher-educators' contexts. The Observation Comparison Chart (See Appendix J) contains the notes taken during observations and provides further insight into the participants and their contexts.

Participant Pseudonym	Peter	Pat	Paul
Point in Career	Professor - One year from retirement	Long-time professor	New instructor working as a sessional
Participant Self-analysis of experience with digital technology	"I haven't explored that area [digital technology] as much as I might possibly have done. There seems to be a continuum of where people fall on the technology spectrum from very little to a whole lot. And I would probably place myself in the center."	"not an experienced user of digital technology" "a computer dinosaur [when it comes to digital technology] because I really do not embrace technology at maybe the level that I should."	When asked if he uses digital technology in the courses he teaches, the answer was – "absolutely, all the time." He also provided examples of use, such as "different types of video analysis with everyone on the cell phone. Now, it's very easy to do this."
Classes/Week	Full semester course **2 classes/week** 1.25-hour Lecture AND 1.25-hour Lab	Full semester course **2 classes/week** 2-hour Lecture AND 2-hour Lab	Full semester course **2 classes/week** Both are 1 hour 20 min classes - a mix of Lecture & Lab
Course Focus (specific course name withheld to maintain confidentiality)	Gain knowledge & pedagogical skills for teaching quality PE. Lesson planning to encourage movement & physical activity for life.	Pedagogical understanding of developmentally appropriate physical activity. Teaching games for understanding & inclusivity.	Knowledge and pedagogical development for teaching PE. Increase understanding and ability to develop inclusive plans to encourage physical activity for life.
Focus of Observed Classes	Creative Movement – focus on engagement and long-term physical activity promotion	Fielding & Striking Games – how to teach for progressive development & inclusive engagement	Gymnastics – focus on increasing elementary students understanding of balance -inclusive and motivational engagement in physical activity
Participant Context (Full context in Appendix J: Observation Comparison Chart)	Via Zoom Video Conferencing Background - an unembellished wall with a window that had blinds down for the preservice teachers to be able to see the teacher-educator clearly	Via Zoom Video Conferencing Background - image of pool with people swimming	Via Zoom Video Conferencing Background - a large classroom that had tables, chairs (pushed to the side of the classroom) with one gymnastics mat central in the room. A computer, keyboard, coloured beanbags on a table and pictures of people being physically active on a board were all within the camera view.

Table 1: Participants Chart. All participants (at the time of data collection) taught a physical education course in an approved B.Ed. program in BC, Canada.

3.2.3.1 Participant 1 – "Peter".

Peter's physical education course for preservice teachers had two 1.25-hour classes/week with a lecture on Monday and lab on Wednesday for the full winter semester. Peter incorporated planned interactive activities during the lectures that reinforced the day's topic. On the days I

observed the topic was creative movement. All classes were delivered synchronously online via Zoom. Nineteen students were enrolled in this course. I observed two classes, a Monday and a Wednesday class of the same week - 14 students attended on the first day with 12 having their cameras on and 15 students attended on the second day with 13 students having their cameras on. Peter's background online was a wall with a window that had blinds down for the preservice teachers to be able to see him clearly.

Peter was online early both days and as students arrived for class, he greeted many by name following with a social check-in such as "How is everybody?" and "Did anyone do anything exciting over reading break?" The students engaged in discussion and a friendly interactive tone was set for learning. Peter's following statements regarding his own digital technology ability reflected acknowledgement of his digital technology integration efforts, as well as a desire to expand digital technology integration in this physical education course. Peter stated,

> I haven't explored that area [digital technology] as much as I might possibly have done. There, there seems to be a continuum of where people fall on the technology spectrum from very little to a whole lot. And I would probably place myself in the center.

Peter further explained that "certainly in my teaching and in my lectures and my delivery of my courses, I use technology, but there's areas where I could certainly enhance." Peter's use of digital technology for content delivery was apparent during the lectures, PowerPoint slides were used to display key text and images were used that represented lesson concepts. Physical activity promotion digital technology was used through video being embedded in the lecture that showed examples of creative movement. This increased engagement and understanding of the topic. In addition, the music in the videos promoted a positive atmosphere and encouraged movement.

Video was also used and role modelled as an effective means of feedback, which is further described in chapter four. Throughout his lecture, Peter asked if any students had questions or needed clarification. Online breakout rooms were used for the students to work in small break out groups and create their own creative movement lesson plan to share with the larger group when the students reconvened later in the class. Peter had emailed a handout to all students so that they all had the creative lesson plan guide to assist their learning. Each preservice teacher was required to contribute to the lesson. I was able to observe the breakout rooms, and all students appeared to have their videos on, be engaged, and were actively engaging in developing the lesson with the rest of the group. The videos of creative movement and the lesson plan guides appeared to provide the students direction and engage the students in the activity. When the preservice teachers reconvened to their full class, Peter enthusiastically welcomed the students back to the main online class area. Students shared their creative movement lesson ideas and most included that they would use video, such as YouTube videos to engage their future students in creative movement and to help them start developing their own ideas.

3.2.3.2 Participant 2 – "Pat".

Pat's physical education course for preservice teachers was composed of a two-hour lecture and a two-hour lab each week. Both the lecture and the lab occurred on the same day, the lecture was from 10:30 am to 12:30 pm and the lab from 2:00 pm to 4:00 pm. Both components were delivered synchronously online via Zoom. Thirty-three students attended the lecture. Pat was online early for her classes and started the class with a welcome and by letting all students know the agenda for the day. Pat provided the option of students having their cameras on during the lecture; however, most students elected to have their cameras off. A background of physical activity (such as a swimming pool) was displayed behind Pat as the classes commenced.

Pat described herself as “not an experienced user of digital technology” but revealed her openness to digital technology when she said that “I believe digital technology is fabulous. Mr. Google is a fabulous tool.” Pat demonstrated using digital technology for delivering class online and sharing content; in addition, Pat mentioned using video to promote physical activity and to assess physical movement; she said, “I play videos” and then “we answer questions about the videos.” Throughout the lecture, Pat shared a live feed of herself and had lecture slides displayed on screen at the same time. Pat checked in regularly with the students to see whether they had any questions or needed anything clarified. Interactive learning was encouraged during the lecture through specific questions posed by Pat throughout the lesson. In addition, an open question time was provided for the students at the end of the lecture to ask any remaining questions; most students turned on their cameras to ask questions. The chat function was used by three students to ask questions during the lecture and Pat responded orally.

The lab component happened later the same day as the lecture. Students were split into groups of five or six and were divided into three online rooms; their assignment was to create a lesson plan for a striking/fielding game activity and to include in the lesson plan how cognitive, psychomotor, and affective domains of learning would be addressed. Students used Google docs to develop their assignment. I was able to drop into the various online rooms. Four of the rooms were actively engaged in discussion that appeared to have input from all group members. Two of the online rooms were quieter. However, in one of two rooms, some of the students were trying to encourage interaction by stating their thoughts on the lesson plan and asking for feedback. The students regrouped as a whole class after approximately 35 minutes and were given 10 – 12 minutes to present their lesson plans to the class. To encourage participation, each member of each group was required to present a portion of their group’s lesson. Although the lessons

planned for the elementary students did not include digital technology within the lesson as a direct motivator of physical activity, the preservice teachers did become more familiar with how digital technology can be used for communication and planning, such as Zoom and Google docs, and were effective in using digital technology to develop lessons that would encourage their future student to engage in physical activity. Pat was the least experienced with digital technology of the three participants in this study; her contributions to this study were meaningful as Pat brought the perspective of an experienced educator, who had knowledge of her limited experience with digital technology but was pushing through "to continue to be an effective facilitator of education."

3.2.3.3 Participant 3 – "Paul".

Paul's physical education classes were a mix of lecture and physical activity; the course was delivered synchronously via Zoom in two 1 hour 20-minute classes/week. The psychomotor focus of the class I observed was designed to assist preservice teachers to teach gymnastics with specific psychomotor focus on the importance of training elementary students about balance. Paul started by arriving early and setting up. Paul used Spotify (a free digital music service) to play music that would be playing as the students arrived at class. He greeted the first few students that entered the online space by name as they signed in and then once the class started to fill, he greeted everyone with a "good morning everyone". To encourage an open atmosphere for learning, Paul made a point of connecting with the students through noticing things in the students' backgrounds and engaging the preservice teachers in discussion prior to class commencing. Paul taught from a large classroom that had tables, chairs (pushed to the side of the classroom) with one gymnastics mat central in the room, so that the preservice teachers could see Paul when he was demonstrating physical activities. Paul was large on the screen and the student

images were small, which appeared to make the preservice teachers feel comfortable being on screen. In view on Paul's screen was a computer, keyboard, coloured beanbags on a table, and pictures of people being physically active on a board; this created a welcoming educational space.

Paul had the most experience integrating digital technology into physical education for physical activity promotion. Paul credited this experience to having a mentor who offers continuous support and is well versed in digital technology integration for physical activity promotion. Throughout the lessons, Paul conscientiously role-modelled for the students what was expected of them and deliberately thought out loud to ensure students recognized the various teaching strategies being used. For example, Paul articulated to preservice teachers that one of his main reasons for using music in classes is the ability of music to set the tone of a classroom and encourage engagement.

An overview for the lesson was shared with the students and Paul shared his screen during the overview so that students could see the outline while they reviewed it together. Paul did a check in for questions and then started the lesson. Paul reviewed the peer teaching assignment that would be coming up later in the class and reminded the preservice teachers that the class would involve everyone being physically active. The students were encouraged to use whatever space was available to them, which ranged from one student in a full gymnastics centre to many students being in small rooms with yoga mats laid out. All students were strongly encouraged to turn cameras on and take part in physical activity together. The physical activities began with Paul demonstrating to the class a few balance poses, and, to role model, Paul taught as though he was leading a class of elementary students and had the preservice teachers do the movements simultaneously online. After showing three balance poses and having everyone try

them together. Paul played a “freeze” game of balance poses – the preservice teachers moved through the three poses to music and when the music stopped, the preservice teachers were to hold whatever pose they were in. If preservice teachers were not able to “freeze” in time, then they engaged in an additional activity like five jumping jacks. Paul continued with a class that supported engagement and promoted physical activity using digital technology.

3.2.3.4 Participant & Context Summary.

Due to the COVID pandemic, all courses were delivered online via Zoom video conferencing. Teacher-educator participants offered two classes per week varying in length between one to two hours; courses included a mix of labs and lectures. All teacher-educator participants set positive educational environments through welcoming preservice teachers to class in a positive manner and through encouraging questions and the sharing of perspectives. The teacher-educator participants had varying levels of experience with digital technology; however, all used digital technology in their physical education courses to teach preservice teachers how to promote physical activity. For example, all the teacher-educators used PowerPoint, videos, and breakout rooms. Their varied experience with digital technology added richness to this study, as the data collected reflects a good sampling of diverse experience with digital technology. Data collection methods used to collect data for this study are described in more detail in the next section of this chapter.

3.2.4 Data Collection Methods

As mentioned, researchers use CSR design when wanting to understand a complex social phenomenon within its real-world context (Yin, 2018). With the goal of CSR being to understand complex social phenomenon, certain data collection methods are recommended. Yin (2018) highlights that case study evidence can come via at least six different methods: documents,

archival records, interviews, direct observations, participant observation, and physical artifacts. CSR researchers are encouraged to use two or more methods of data collection to establish validity (Merriam & Tisdell, 2016; Yin, 2018). Interviews and observation in real-life settings are effective means for exploring individuals' realities and multiple subjective views (Yin, 2018). These data collection methods are well suited to this study, in which I used semi-structured interviews and observations to collect data on how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into the context of physical education.

In addition to multiple methods of data collection (interviews, observations) being used to establish validity, multiple sources (interviews with different people and data collection at multiple times) can also be used to further validate findings (Merriam & Tisdell, 2016). Yin (2018) identifies that multiple interviews with the same participant can serve as multiple sources. Multiple sources were used in this study; I interviewed each of the three participants twice and collected data at eleven different times. For this study, data was collected through a total of 6 interviews and five class observations. There were two interviews and one or two class observations with each participant (see Table 2). Due to the COVID pandemic, all interviews were conducted via video conferencing. The web-based video conferencing tool Bluejeans was used for interviews, as Bluejeans is a Canadian hosted conferencing tool and therefore provides better security of information. First interviews were conducted in the fall of 2020, class observations occurred in the winter of 2021, and second interviews were conducted in the spring of 2021. A data collection timetable is presented in Table 2; this timetable includes the benefits of interviews and observations, as well as displays the sequence of data collection events.

Interview – An essential means of data collection in CSR; interviews provide insight into the participants' perspectives and how they are making meaning of the situation (Yin, 2018; Merriam & Tisdell, 2016). In addition, interviews are beneficial as they can be focused specifically on the case (Yin, 2018).	**Direct Observation** – The phenomenon of interest being observed in real time, provides greater depth of understanding of the phenomenon' context and thus of the phenomenon on the whole (Yin, 2018; Merriam & Tisdell, 2016).
First Interview	
Nov. 19th , 2020	Peter
Dec. 7th , 2020	Paul
Dec. 15th , 2020	Pat
Class Observation	
Jan. 28th, 2021	Paul
Feb. 2nd , 2021	Pat
Feb. 22nd & Feb. 24th , 2021	Peter
Second Interview	
May 4th, 2021	Pat
May 7th, 2021	Paul
May 12th, 2021	Peter

Table 2: Data Collection Timetable. Data was collected between November 2020 and May 2021.

3.2.4.1 Interviews.

Interviews are an essential means of data collection in CSR (Yin, 2018). Some of the benefits of interviews are that they provide insight into participants perspectives, increase understanding of how people are making meaning, and allow for clarification of meaning (Merriam & Tisdell, 2016; Patton, 2015; Stake, 1995; Yin, 2018). In addition, interviews allow researchers to collect targeted information and focus on the phenomenon being explored (Yin, 2018). Interviews were used in this study to collect data that focused on exploring how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into physical education. The use of interviews provided a means to gain insight into teacher-educators' perspectives on their role in supporting preservice teachers to integrate digital technology. Also interviews allowed the teacher-educators' voices to be heard directly;

participant quotes are used in chapter 4 to substantiate the findings and show how themes emerged.

The specific type of interview used in this study was semi-structured interview. Semi-structured interviews consist of guided questions that are designed to guide conversations on the phenomenon (Yin, 2018); they are a flexible type of interview that permit the interviewer to respond to information provided during the interview and to ask questions that are reflexive to the answers being provided by the interviewees (Merriam & Tisdell, 2016; Yin, 2018). This flexibility also can be a downfall of CSR design as the interviewer may diverge too far from the line of questioning and not remain focused on the phenomenon being investigated (Yin, 2018). To keep the interviews on topic, interview guides with guiding questions were created for first and second interviews.

3.2.4.1.1 The Development of Interview Guide One

The interview guide created for interview one (See Appendix E) was created before interviews commenced. This interview guide was formed with insight provided from the TPACK framework. The TPACK framework brings to light that experience with and an understanding of digital technology and its reciprocally intertwined influence with content and pedagogy is needed to effectively integrate digital technology into education. The TPACK framework illuminates technological pedagogical content knowledge as a knowledge area that teachers need to consciously develop to deliver optimal education in the 21st century (Mishra & Koehler, 2006; Mishra & Koehler, 2009). The guide created for interview one collected data on teacher-educators' current: 1) experience with digital technology, 2) comprehension of digital technology, and 3) supports/obstacles for developing technological pedagogical content knowledge. For example, question two asks teacher-educators their opinion on digital technology

use in schools and how digital technology fits within school curriculum; this question was designed to gather data on teacher-educators' technological pedagogical knowledge, which is knowledge of the existence and capabilities of various technologies and how they may assist with meeting specific curriculum goals. Questions three asks teacher-educators about their use of digital technology in their courses; this question ascertains teacher-educators' technological pedagogical content knowledge, by exploring how they are using specific technological tools to facilitate students learning course content (Mishra & Koehler, 2006; Koehler & Mishra, 2009; Koehler et al, 2013). Question three goes on to inquire about the supports teacher-educators are receiving to integrate digital technology in their courses. Mishra and Koehler (2006) highlight that supports are key in technology integration into education and note that a lack of supports for technology integration can be a major factor impacting if and how teachers integrate digital technology. Questions four and five further investigate supports available and obstacles experienced by teacher-educators when preparing preservice teachers to integrate digital technology into physical education. Question six inquires as to how teacher-educators view the relationship between digital technology and physical activity and ascertains their opinion on supporting preservice teachers to integrate digital technology into physical education. This question is designed to gather data that provides a deeper understanding of teacher-educators' beliefs about digital technology integration into physical education, which helps to shed light on the importance current teacher-educators are placing on technological pedagogical content knowledge.

This interview guide was also influenced by Vygotsky's' Social Constructivism, which is shown through bringing attention to the sociocultural influence of digital technology and the need to research how preservice teachers are being supported to develop their pedagogical

practice to integrate digital technology into education. Additionally, in many of the questions in interview one, teacher-educators are asked their opinion; the decision to ask teacher-educators their opinion was influenced by Vygotsky's social constructivism highlighting the strong influence of sociocultural environment and personal experience on the development of one's perspective.

3.2.4.1.2 The Development of Interview Guide Two

The guide for interview two (See Appendix H) was created after data collection and analysis of interview one and observations. This allowed the second set of questions to address gaps in or new insight on the research topic. For instance, another downfall of CSR can be that interviewees do not stay on topic or misunderstand a question; the interviewer may need to ask clarifying questions or re-ask the same question (Yin, 2018). For example, after reviewing interview one, I realized that I let one participant veer away from digital technology for physical activity promotion and focus on digital technology for remote learning (an influence of COVID); in interview two, I was able to re-ask participants to describe their strategies for supporting preservice teachers to integrate digital technology into physical education with the goal of physical activity promotion and keep answers on topic. An additional benefit of interview two in this study was that I could focus on insight from interview one and observations. For example, teacher-educators responses highlighted the significance of *pedagogical* integration, which then was further investigated during second interviews.

The questions in the guide for interview two (See Appendix H) were designed to garner a deeper understanding of how teacher-educators are supporting preservice teachers to integrate digital technology into physical education with a focus on pedagogical integration. This focus on pedagogical integration led to the development of questions designed to ascertain technological

pedagogical content knowledge. Technological pedagogical content knowledge is demonstrated through teachers using technology in constructive ways to facilitate the assimilation of content knowledge; Mishra and Koehler (2006) highlight that applying technological pedagogical content knowledge in education requires an understanding of the relationship between these three knowledge areas and then using this understanding to develop strategies and representations to assist students to assimilate course content and ultimately achieve learning outcomes. For example, question two asks specifically about the strategies that teacher-educators are using to support preservice teachers to integrate digital technology into physical education to achieve the goal of promoting physical activity. In addition, supports or lack thereof are a key aspect of being able to develop technological pedagogical content knowledge and pedagogically integrate technology into education (Mishra & Koehler, 2006). Questions three and four ask about factors supporting and impeding teacher- educators facilitating preservice teachers to develop their understanding of how to pedagogically integrate digital technology into their courses. Further, the TPACK framework highlights that teachers need to be aware to consider technology, content, and pedagogy when determining how to effectively integrate technology into education. Question five specifically asks teacher-educators how they are supporting preservice teachers to integrate digital technology to meet specific learning objectives such as facilitating fundamental movement competence in their future students.

Vygotsky's social constructivism was also key in the development of interview guide two. The social constructivist perspective helps to increase understanding of the educational importance of teachers being facilitators, collaborative learning, and the sociocultural setting within which leaners interact (Barak, 2017; Cicconi, 2014; Eun, 2019). In addition, Vygotsky's (1978) zone of proximal development illuminates that people learning in collaboration with peers

goes beyond what a person can learn independently and that teachers can facilitate learning by providing environments that support the sharing of perspectives and the social construction of knowledge (Sharkins et al., 2017). Roth and Radford (2010) bring attention the zone of proximal development being interpreted by many in more of a unidirectional way than Vygotsky potentially intended, and highlight that consideration should be given to that learning within the zone of proximal development is reciprocal. This insight from Vygotsky's social constructivism influenced the wording of interview questions; such as the choice to use the words "support" or "supporting" in every question in interview guide two. For example, in question number two, "How would you, as a teacher educator, describe the strategies you are incorporating to support preservice teachers to be prepared to integrate digital technology into lessons to promote physical activity?" This phrasing with the use of "support" ascertains the perspective of teachers being facilitators of learning. The significance of considering one's environment is also shown in question three, which asks about factors that impede preservice teachers learning about technology integration, and question four asks about supports available/needed for teacher-educators and for preservice teachers to integrate digital technology; factors and supports are environmental influences. Question six culminates the directed questions with bringing the interview back around to how teacher-educators are viewing their roles in supporting preservice teachers to integrate digital technology into physical education. This question was designed to gain an understanding of teacher-educators perspectives now that they have been through the reflective process of participating in two interviews that inquire about their role supporting preservice teachers to integrate digital technology into physical education; understanding how teacher-educators view their roles provides insight to their perspectives on collaborative learning and on teachers being facilitators of knowledge development.

Another potential downfall of interviews can be poor recall on the part of the interviewer (Yin, 2018). To address this potential issue and to ensure interview data was preserved (Merriam & Tisdell, 2016), all interviews were audio recorded and then I, using NVivo Transcription, transcribed the interviews myself. To ensure that participants were asked for their consent to audio record interviews, and to ensure that participants were provided with similar understandings of the interview process, an interview protocol (see Appendix D) was developed and followed for every interview. In addition to interviews, the data collection method of observation was used to gain deeper insight into how teacher-educators are supporting preservice teachers to integrate digital technology into the context of physical education. I used multiple data collection methods to strengthen the validity of this study (Patton, 2015).

3.2.4.2 Observations.

Observations are the act of noting and recording phenomenon (Hancock & Algozzine, 2017). They provide additional information beyond the selective perceptions of others and allow the researcher to observe the phenomenon under study in context and in real time, which facilitates deeper understanding of the phenomenon (Patton, 2015; Yin, 2018). I used the method of direct observation and was a passive observer - I did not assume any role in the setting being observed. Observations occurred between January 28th, 2021 and February 24th, 2021 (See Table 2 for the observation schedule); in each class, I observed teacher-educators' in B.Ed. PE courses in which they facilitated preservice teachers' learning regarding how to encourage students in K–7 to be physically active. At the time of observations, due to the COVID pandemic, teacher-educators were delivering their courses via Zoom; therefore, all observations were completed via Zoom. I observed Pat and Peter for two classes each as their lectures and labs were delivered in

separate classes; Paul chose to have one class observed as he combined his classes to be both lecture and lab in each class.

To aid in keeping consistency between observations and to assist in setting guidelines for the observations, I developed an observational protocol (See Appendix F) to guide the observations. Yin (2018) notes that it is important to have well planned observational protocol in CSR and highlights that having protocol established is especially important in multi-case case studies as an effective way to increase reliability of the study. The observational protocol for this multi-case case study was reviewed and accepted by my doctoral committee and by an Ethics board prior to the commencement of data collection.

It is important to be aware of the influence an observer can have on those being observed; the presence of an observer can cause people to act differently and influence the data being collected (Merriam & Tisdell, 2016; Yin, 2018). To address this possibility, the observation protocol for this study outlined that preservice teachers would be made aware ahead of time that I would be observing their classes and that they would have opportunity to let their teacher-educator know if they were uncomfortable with being observed. In addition, preservice teachers were made aware that their identity would remain completely confidential, and that no data would be collected specifically on them as individuals. Further, teacher-educators were provided with an optional guiding script for my introduction that reminded preservice teachers of my role, the confidentiality of the study, and that they could let their teacher-educators know if they had any concerns. At the start of classes, teacher-educators did use the guiding script provided to them and introduced me to the preservice teachers, reminded them of my role, and that they could privately contact the teacher-educator and let them know if they had any concerns.

In addition to an observational protocol, researchers should create an observation guide (See Appendix G) for observations; this is "a list of features to be addressed during a particular observation" (Hancock & Algozzine, 2017, loc 1102). This list includes information about the observation, such as the date, the context, and the activities observed (Hancock & Algozzine, 2017; Merriam & Tisdell, 2016). The preplanned observation guide was developed with insight from TPACK. The TPACK framework highlights how knowledge of technology and understanding how technology can influence the learning environment are key aspects of technology integration; this influenced and supported the inclusion of focused observations on the environment and on what digital technologies were being used within that environment. Vygotsky's theory of social constructivism and its focus on environmental influence also aided the development of the observation guide. Vygotsky writes of the "re-arming" of humans and how one's environment and one's response or adaptation to environmental interactions impacts the development of peoples' ability (Luria & Vygotsky, 1992); therefore, many aspects of the environment were focused on during observation, as noted by the columns in the Preplanned Observation Guide (see Appendix G). These columns being: Physical Description, Social Description, Participants & Positioning, Activities and which digital tools were observed being used. The preplanned observation guide (see Appendix G) was used to collect data in all classes observed and after each class the information collected was transferred to a master document, the Observation Comparison Chart (See Appendix J). Entering the data into the Observation Comparison Chart facilitated cross-case comparison and enhanced validity of the study. Validity was enhanced by the inclusion of observations as an adjunct means of data collection in addition to interviews, as this facilitated triangulation through the comparison of data from multiple collection methods. Validity is discussed in the section, *3.2.6 Validity.*

3.2.5 Data Analysis

Data was analyzed using thematic analysis. Theming the data "provides descriptive detail about the patterns observed and constructed by the analyst. Rather than using a short code or category label, a theme expands on the major ideas through the use of an extended phrase" (Saldaña, 2021, p. 369). The approach to theming that I used was categorical theming, in which themes emerged from the general "ideas suggested by the data" (Saldaña, 2021, p. 259). The ideas suggested from the data became apparent through using first and second cycle coding. First cycle coding was used to analyze what was present in the data and second cycle coding synthesized the initial determinations into new understandings (Saldaña & OMasta, 2018). In this chapter, my coding process is explained in somewhat of a linear fashion; however, my coding process was cyclical. I continually cycled through the data, recoding and recategorizing with new understanding as I progressed through the processes of data analysis. Saldaña (2021) highlights the cyclical aspect of coding and highlights the "reverberative nature of coding—comparing data to data, data to code, code to code, code to category, category to category, category back to data, etc." (p. 88). When collecting data in CSR you must constantly be analyzing the data, as well as keeping in mind the data you have already collected (Merriam & Tisdell, 2016).

Data analysis was deliberately completed using solely inductive thematic analysis (Patton, 2015) to have the codes, categories, and themes emerge directly from the data. However, to inform and facilitate category development, I kept reviewing relevant literature and reminding myself of the research questions. Researcher immersion in these two theories influenced the researcher's analytical lens; thereby, emerging themes, although inductively formed from data, were informed by the theoretical foundations of this study. During interview analysis, clear connections to theoretical foundations were apparent; for example, see Figure 3 on page 76, there

is a clear connection to technology and the concept of social relevance. Also, in connection with TPACK, in Figure 3 the teacher-educator refers to technology he discusses technology as a tool to add to "their toolbox". Identifying technology as a current societal tool shows a further connection to Vygotsky's social constructivism; Vygotsky observed that the tools present in one's environment impacts a person's development and noted that humans adapt to use the tools in their environment to achieve specific goals. Luria and Vygotsky (1992) highlight that humans have "complex mutual relationships with the objects of the external world" and humans understanding that these "*tools*, can be used for a specific purpose" is a key part of learning (p. 114). Explicit connection to theoretical frameworks and relevant literature is completed in chapter five, the discussion chapter.

3.2.5.1 First Cycle Coding.

Data analysis began with recording and analyzing the first interview. The data collection timeline (see Table 2) shows the order and timing of data collection. All interviews were recorded with consent from participants. Immediately after every interview, I listened to the interview recording and checked for clarity as well as started to familiarize myself with the data. Merriam & Tisdale (2016) note that researchers being a part of the transcription phase of data analysis is beneficial for data analysis, as then the researcher is already analyzing the data during transcription and noting potential themes. After the first listen through of each interview, I used Nvivo transcription to transcribe each interview. Immediately after transcription, I relistened to each interview and made all necessary corrections to the transcription document. Listening to the interviews repeatedly and being able to hear the participants' intonation allowed me to gain deeper understanding of the intended meanings of their words and gain insight into their perspectives.

Initially I spent a great deal of time learning how to use Nvivo software as I had considered using Nvivo to store and organize data; however, I did not find using research software to be conducive for familiarizing myself with the data and or for fully immersing my mind in the data to facilitate depth of understanding and fully informed synthesis. Therefore, I used Nvivo only for transcription and decided to do all coding manually. Through manual coding I found I could see the full picture and was able to reorganize the codes continually as new understandings developed. In addition, the new understandings were situated in the whole of the data rather than being siloed in computer assisted qualitative data analysis software (CAQDAS) program. Saldaña (2021) notes that being a beginner researcher and trying to learn CAQDAS can be overwhelming. Manually coding and analyzing qualitative data on hard copies gives the researcher "more control over and ownership of the work" (Saldaña, 2021, p. 45).

After interviews were transcribed, I listened to the interview recordings and reviewed the transcriptions many times, initially highlighting notable comments in yellow and making notes in blue font in the margins to indicate potential codes that were emerging from the data (See Fig. 3). Saldaña (2021) states that when "something in the data appears to stand out, apply it as a code" (p. 140). As I went through this coding process, I kept analytic memos in red font by the data segments (see Fig. 3); I found keeping my evolving thoughts in memos by the relevant data helped with determining and organizing codes. Analytic memos are notes to the researcher about what they were thinking about the data; the notes reflect the researcher's thinking (Saldaña, 2021). There is no need for analytic memos to be academic writings, a researcher can just plainly write what is going their mind (Saldaña, 2021). Good thinking through analytic memo writing combined with the coding process can lead to well established and meaningful themes (Saldaña, 2021).

After the transcripts were initially reviewed and the data that stood out was highlighted in yellow, I began more focused first cycle coding. I used three kinds of first cycle coding methods: 1) In vivo coding, 2) concept coding, and 3) descriptive coding (Saldaña, 2021). In vivo coding (using the participants' words) was used to facilitate the voices of the participants being heard and assist in presenting an understanding of the participants' perspectives (Saldaña, 2021; Charmaz, 2014). Concept coding, which is "a word or short phrase that symbolically represents a suggested meaning broader than a single item or action" was used to identify concepts emerging from the data (p.152). Descriptive coding was used to identify "noun-based" units of data, this helped with identifying basic topics (Saldaña, 2021). There was so much data that I decided to colour code the different types of coding to help keep the data organized and went through the interviews multiple times highlighting with the colour relevant to the type of code. I used pink highlighter for potential In vivo codes, blue highlighter for potential descriptive codes, and green highlighter for potential conceptual codes (see Table 3: Coding Legend). See Figure 3 for an example of first cycle coding. Throughout this process analytic memos continued to be added and adapted.

Coding	**Indicator**
Notable Comment – potential code	Yellow highlighter
Comments/Potential codes	Blue font
Memo	Red font
InVivo Code (Potential)	Pink highlighter
Descriptive Code (Potential)	Blue highlighter
Conceptual Code (Potential)	Green highlighter

Table 3: Coding Legend – displays data coding indicators.

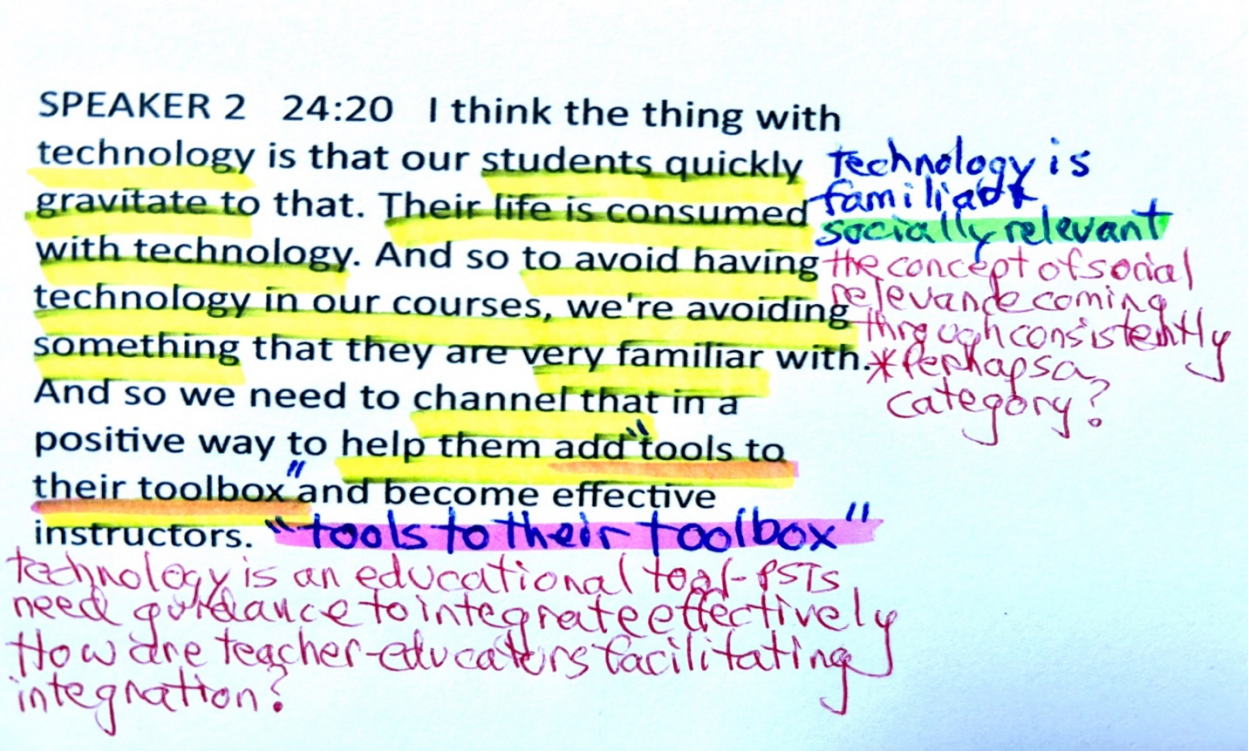

Figure 3: Example of first cycle coding. See Table 3 for Coding Legend.

Once I had reviewed each transcription multiple times and initial coding was well underway, I organized the transcriptions on my walls to be able to see the data and initial codes within the whole picture (See Fig. 4). At the top of this sorting process, to guide analysis and keep it focused, I placed five pieces of paper with large printing. One paper displayed the purpose of the study and on each of the other four papers was one of the four research questions - the central question and the three sub-questions. After the first three interviews were coded, I started to focus more on second cycle coding.

Figure 4: Coding Data.

3.2.5.2 Second Cycle Coding.

Second cycle coding synthesizes the data into new understandings (Saldaña & Omasta, 2018). “The primary goal during second cycle coding is to develop a sense of categorical, thematic, conceptual, and/or theoretical organization from your array of first cycle codes” (Saldaña, 2021, p. 297). Categories developing “is largely an intuitive process but is also systematic and informed by the study’s purpose, the investigator’s orientation and knowledge, and the meanings made explicit by the participants” (Merriam, 1998, p. 179); during this intuitive process, I kept the study’s purpose, my orientation, relevant literature, and the participants’ perspectives in mind during contemplative processing (Merriam, 1998). I used the

inductive constant comparative method of data analysis (developed by Glaser and Strauss, 1967) to continually compare data during the collection and analysis phases. Using the constant comparative method to determine similarities and differences helped to generate categories reflective of the data (Hancock & Algozzine, 2017; Merriam & Tisdell, 2016), as well as helped to establish validity as constantly being aware of the similarities and differences a holistic picture representative of all the data. In addition, the manual tabletop method of sorting data was used for second cycle coding (Merriam & Tisdale, 2016).

The manual method of tabletop sorting is "faster and more flexible than" computer assisted analysis software (Saldaña, 2021, p. 295). The tabletop method facilitated organizing and reorganizing the data as new understandings emerged and while being able to visually take in the "big picture" that the data was presenting. For me personally, the tabletop method (See Fig. 5) facilitated patterns emerging through being able to see the full picture and feel fully immersed in the data, rather than only being able to see silos of information at one time. Through this process I was able to see repetitive codes and code groupings. When I would see a potential category emerge, I would write that on a piece of paper and put it by a group of similar codes. This process is called pattern coding, which is the second cycle coding method that I used for this study. Pattern coding is the process of grouping codes into related and more meaningful analytic units (Miles et al, 2020). Coding data and finding patterns and themes from within the data is inductive analysis (Patton, 2015). During second cycle coding, codes became solidified, categories evolved, and themes emerged (See Appendix I: Thematic Map). Validation processes are presented in the next section, *Validity.*

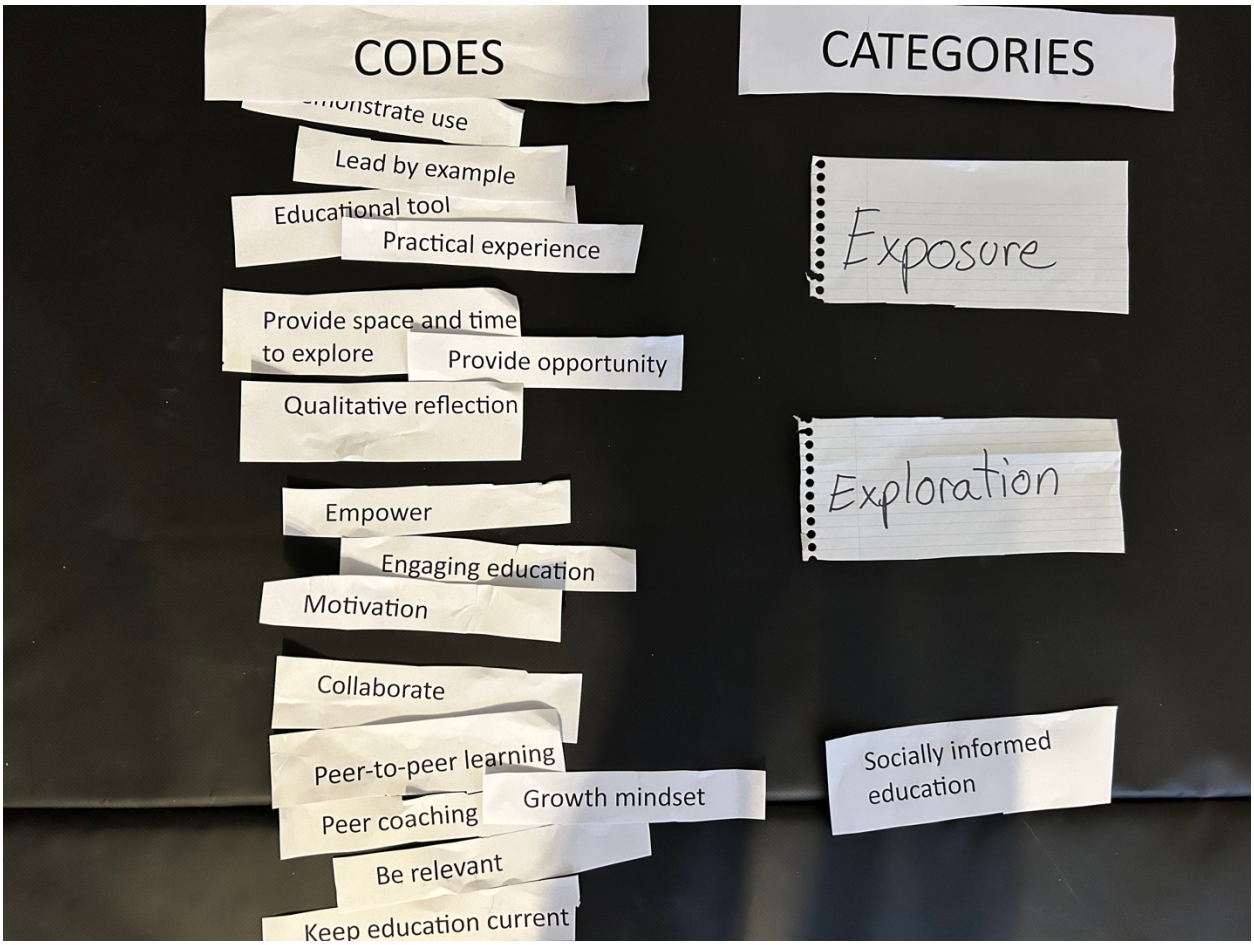

Figure 5. Tabletop method used during second cycle coding.

3.2.6 Validity

A well-planned research design is foundational in establishing the validity of a qualitative study (Merriam & Tisdell, 2016). The research design for this study was comprehensively planned and then clearly articulated in this chapter. Another significant strategy used to establish the validity of a CSR study is that of researchers being transparent with their worldviews and biases (Merriam & Tisdell, 2016). In this chapter, transparency of the researcher was included in the methodological rationale section, in which I openly shared my worldview, associated assumptions, and biases. The additional validity measures planned into this study are described next, they are: 1) Using a multi-case design, 2) Triangulation of data, 3) Adequate engagement

with time for consideration of disconfirming evidence, 4) Rich, thick description, and 5) Members checks and peer examination.

3.2.6.1 Using a Multi-case Design.

A multi-case design results in stronger validation of findings (Befani, 2013; Yin, 2018); this study was intentionally planned as a multi-case design to strengthen the trustworthiness of the findings. Being able to use cross case analysis and compare data from different contexts and between various perspectives enhanced the validity of this research study through increasing the diversity of the data collected (Merriam & Tisdell, 2016; Stake, 2006; Yin, 2018). Additionally, having multiple sources and using multiple collection methods facilitated further validity methods such as triangulation and consideration of disconfirming evidence (Stake, 2006).

3.2.6.2 Triangulation of Data.

Triangulation can be done through triangulating data from multiple sources or from triangulating data from multiple methods or a combination of both (Patton, 2015; Yin; 2018). Triangulation can occur from one source if data is gathered at multiple times; Yin notes that "the same participant several times or on several occasions-which would then serve in its own way as a set of 'multiple' sources" (Yin, 2018, p. 129). The process of triangulating from various sources and by various means helps to ensure correct interpretations (Stake, 2006). I triangulated findings between the collection methods of interviews and observations, as well as triangulated data between cases. With my strong constructivist worldview and desire to support the voices of the participants being heard, my findings relied heavily upon the data collected from interviews and the comparison of perspectives. Patton (2015) acknowledges that some research studies do rely more on interviews than on other methods of data collection.

3.2.6.3 Adequate Engagement with Time for Consideration of Disconfirming Evidence.

Adequate engagement with data during the data collection phase is a means of establishing validity and is unique each study (Merriam & Tisdell, 2016). Spending time in the setting observing the context can be done in one long visit or multiple visits (Merriam & Tisdell, 2016). I observed two classes of Pat and of Peter's courses, one lecture class and one lab class of each. I observed one class of Paul's as he combined lecture and lab into each class. In addition, I spent time with the participants conducting two interviews with each of them to gain an in-depth understanding of their perspectives. Conducting two interviews with each participant provided me time for careful consideration and comparison of data from first interviews and observations; then I was able to engage in second interviews with a deeper understanding of the participants' perspectives and of the phenomenon under study. Adequate engagement also provided opportunity for disconfirming evidence to be considered, which is another method of establishing validity (Patton, 2015). I paused during collection and analysis to contemplate the data and whether the whole story was being reflected in how the data was being presented; this is important to do when progressing through data analysis and identifying patterns (Merriam, 1998). The study design was planned in a way that provided opportunity for disconfirming evidence to be collected; for example, the study was planned to compare multiple cases from various universities in BC. In addition, the participants themselves represented diverse experience in education, as well as represented various stages of digital technology experience. This provided varied perspectives regarding digital technology and its integration in education to be heard and compared. As I compared and analyzed the data from the various collection methods and sources, I consciously remained open to and considered if any disconfirming evidence was being presented.

3.2.6.4 Rich, Thick Description.

Rich, thick description is useful in establishing validity in CSR (Merriam & Tisdell, 2016). To be able to provide rich, thick description and to enable transferability, I developed protocol and guides for both the interviews and the observations (See appendices D, E, F, & G), which guided data collection and facilitates more accurate comparison with other studies (Merriam & Tisdell, 2016; Miles et al., 2020). In addition, rich, thick description assists the perspectives of the participants to be heard more directly and presents the context in detail (Patton, 2015); this supports readers being able to analyze the data themselves and determine if the findings agree with their personal analysis (Merriam, 1998).

3.2.6.5 Member Checks & Peer Examination.

Gaining feedback from others that are invested in the research, such as through member checks and peer examination, helps to facilitate the validity of a research study (Merriam & Tisdell, 2016; Patton, 2015). Member checking can be used to validate various aspects of a study, such as to verify data or to provide feedback on components of the study - findings, themes, descriptions, and so on (Creswell & Creswell, 2018; Patton, 2015). The participants in this study were invited to provide feedback on data summaries, which gave them the opportunity to clarify the data included in the study and to determine if they agreed with the themes that emerged from data analysis. In addition, peer examination by my doctoral committee of the final report helped to establish the validity of this study and ensure that findings addressed the research questions.

3.3 Chapter Summary and Chapter 4 Preview

In this chapter, the methodological rationale and research design of this study were presented. Particulars included in the methodological rationale section were the reasons CSR

design was selected for this study, the limitations of this study, the role of the researcher, the researcher's worldview and biases, and philosophical assumptions. Information included in the research design section was the delimitations of the study, participants' and their context, data collection & analysis methods, and validity verification measures. Chapter four presents the findings on how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology to meet physical education goals.

Chapter 4: Findings

In this chapter, I share the findings from this case study that address the central research question, *How are teacher-educators supporting preservice elementary teachers to pedagogically integrate digital technology into physical education?* The findings of this case study came from three teacher-educator participants and were generated from the inductive thematic analysis (Patton, 2015) of six teacher-educator interviews (two with each participant) and five teacher-educator classroom observations (one participant with one classroom observation and two participants with two classroom observations) (See Appendix J for the Observation Comparison Chart). During thematic analysis, three themes, with two categories each, emerged from the fourteen final codes. These three themes - each listed here with their two categories are: 1) Recognizing Factors Impacting Digital Technology Integration – categories: External Factors and Internal Factors; 2) Fostering Pedagogical Digital Technology Integration – categories: Exposure and Exploration; and 3) Growing with Evolving Education – categories: Beyond the Walls of the Classroom and Social Relevance. Figure 6 displays a thematic map that shows the relationship of these themes and their associated categories (see Fig. 6). These themes and categories form the organizational structure under which the findings of this study are presented. In addition, under the themes and categories, quotations from teacher-educator interviews and descriptions from class observations are included to illuminate the inductive thematic analysis and provide evidence to support the findings. This chapter is focused on solely presenting the findings from inductive analysis. In chapter five, these findings are discussed in connection to this study's theoretical frameworks and situated within relevant literature.

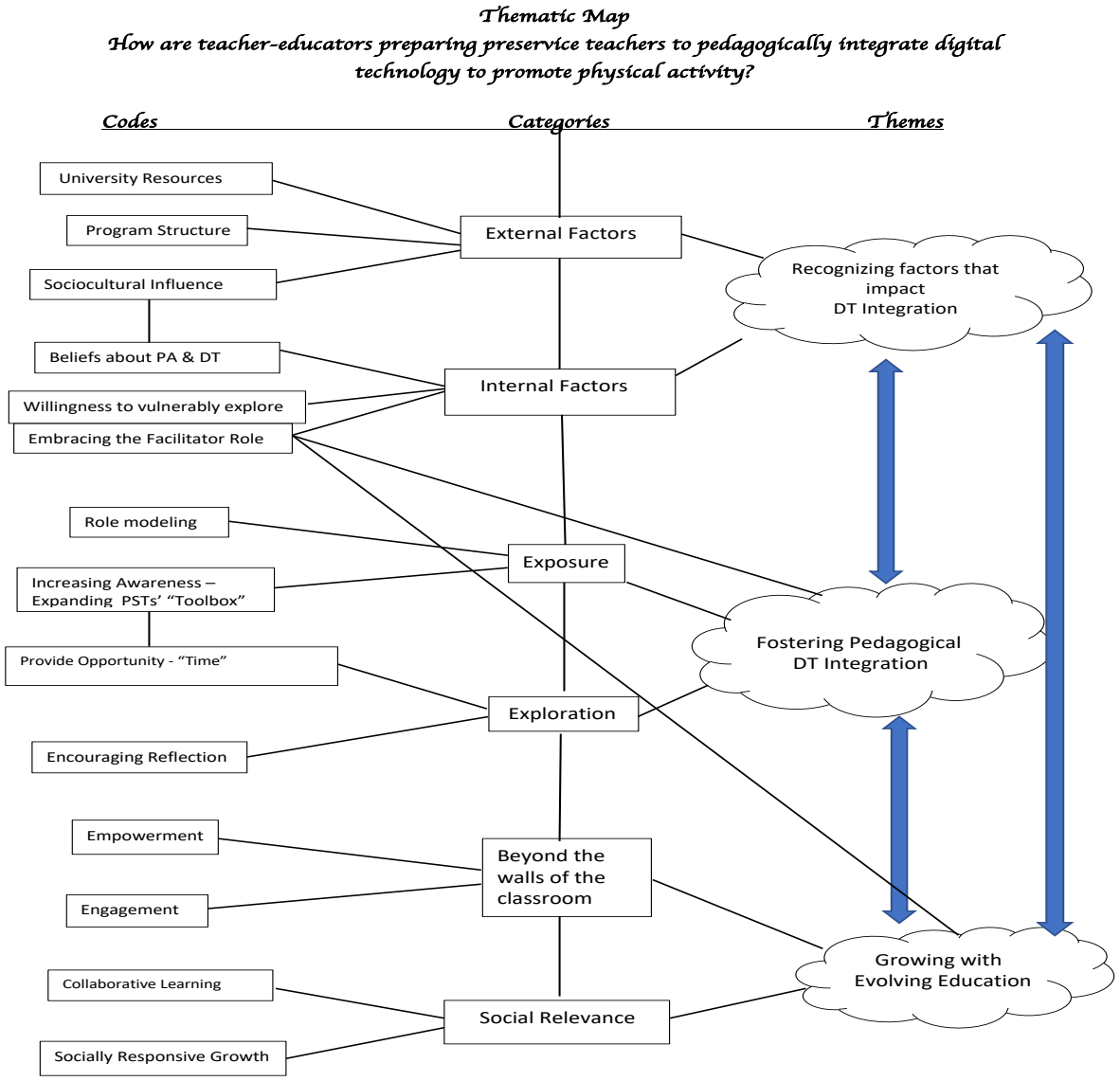

Figure 6. Thematic Map showing the codes, categories and themes that emerged during analysis.

Before delving into the findings of this study, I would like to note that data collection occurred during the COVID pandemic, which had digital technology in education come to the forefront as a means of educational delivery (Williamson et al., 2020). Overall, I believe this added to the richness of the data as teacher-educators were forced to become more familiar with digital technology uses for education, and as such their insight and experience with various

digital technologies was expanding greatly during this time. In reference to the rapid and unplanned engagement with digital technology, Peter commented that educators are "Going to be incredibly different and better instructors as a result of the kind of work they've had to go through to connect and engage students through technology in their courses." The forced online delivery that occurred during COVID dramatically impacted the teacher-educators teaching and subsequently complicated data collection, as teacher-educators were naturally wanting to answer questions with a focus on digital technology for distance delivery; however, this study remained focused on how teacher-educators are supporting preservice teachers to pedagogically integrate digital technology into physical education.

4.1 Theme 1: Recognizing Factors Impacting Digital Technology Integration

The first theme, recognizing factors that impact digital technology integration, emerged from teacher-educators sharing insight on the various factors that impact their ability to facilitate preservice teachers integrating digital technology into physical education. These factors formed two main categories – external factors and internal factors. External factors are elements that come from outside of the body and effect an event, decision, or situation (Collins, 2022). The external factors that emerged in this study are described in the next section. Internal factors are the beliefs, thoughts, and feelings that come from within people and influence their decision making (Martinez & Shaker, 2018). The internal factors findings are presented in this chapter under the section, *Internal Factors.*

4.1.1 External Factors

As mentioned, external factors are influences that come from outside of the body and effect decision-making and situational occurrences (Collins, 2022). The external factors that emerged in this study as impacting teacher-educators ability to support preservice teachers to

integrate digital technology into physical education were university resources, program structure, and sociocultural influence. These external factors form the organizational headings for this section.

4.1.1.1 University Resources.

University resources include such items as funding, digital technology apps and equipment, services, physical structures, and human resources (Friel et al., 2009; Kelchen et al., 2021; Liefner, 2003; UBC, 2023). Teacher-educators identified the university resources of funding, digital technology resources (equipment and apps), and human resources as key items that impact their ability to prepare preservice teachers to integrate digital technology into physical education. The findings for funding and digital technology resources are presented together in the next section as participants talked about these university resources in a closely connected manner.

4.1.1.1.1 Funding and Digital Technology Resources.

Funding and digital technology resources were highlighted by the participants as foundational external factors that influence their ability to prepare preservice teachers to integrate digital technology into physical education. Teacher-educators talked about limited digital technology resources being supplied by the university and that universities often count on students supplying their own digital technology. Peter stated that there are “issues around having enough equipment for students to effectively use it [digital technology] within the preservice courses.” Paul commented specifically on the current reliance for preservice teachers to have their own devices and stated that the “majority of students have cell phones at this time” and added “I'm lucky because every single person who comes into my class has a cell phone and knows how to use it quite well.” Teacher-educators shared concern over the potential for

students to have limited access due to this reliance on personal devices. Pat commented that "if we're going to use the technology and we're going to say it should be part of it [physical education], we, I think, we have to give the options for those individuals that don't have access due to financial limitations and resource limitations." In addition to teacher-educators commenting on schools needing to direct funding towards digital technology resources, teacher-educators recognized that they could help support equitable student access. For example, Peter brought up that there is a need for teacher-educators and PE educators in general to advocate for funding and digital technology resources, stating:

> as physical educators, we have to advocate for sufficient budgets to provide equipment and resources for our courses and make sure that funds are provided so that we can continually advance our courses in those directions [digital technology advancement] by adding more equipment, or more technology.

Teacher-educators highlighted that because universities often rely on preservice teachers to have their own digital technology device that teacher-educators need to help preservice teachers become aware of and plan for equitable digital technology access for their future students. Pat commented "I think that pre-service teachers today use technology because it's part of the education process, especially at the university" and then continued with "I think that they have to be made aware that not all students are going to … have access, equitable access to resources." When talking about funds needing to be directed toward equitable access, teacher-educators also identified that PE courses have specific digital technology needs such as funding being directed toward applicable digital technology equipment and PE resources, such as fitness apps. Paul emphasised the need in PE for access to portable digital technology devices like iPads with appropriate apps already downloaded. He stated that what is needed is "having technology

accessible to students in a way that teachers are able to use in the physical education setting." Pat also commented on the need for school support for accessible portable devices, "I think that the school system has to provide the resources, just like they provide a textbook, they have to provide some sort of a tablet or something that the students can then use so that there's an equal playing field." Paul went on to highlight the lack of funding for such digital technology as fitness apps, he stated that "the applications on the device … is something that costs money. Right. And so, for things like that, it takes some time to get those. And I think that might be a barrier for some." Paul mentioned that if the university increased the support provided for access to apps, then instructors could reduce the time that they currently have to spend finding relevant apps. Paul recounted a lesson where he "scoured the internet forever to try and find something that was open source, easy for everyone to have. And it was really difficult to find one [an app] that was decent." The lack of university support for digital technology equipment such as mobile digital technology devices and digital technology resources such as apps specific to PE was reflected in observations. During class observations, no fitness apps (Strava, Super Stretch Yoga, Fitness Kids, FitQuest Lite, etc.) were used. In fact, it was noted during classroom observations that no advanced fitness digital technology equipment such as fitness trackers, movement analysis apps, movement-based gaming technologies, video analysis software or applications were used, which backs up the comments by teacher-educators that their universities are not allocating funding to such technologies for their classes.

In this section, teacher-educators expressed that funding and digital technology resources, specifically appropriate digital technology equipment and app access, were identified as external factors impacting teacher-educators ability to integrate digital technology into physical education. The next section shares findings on the human resources needed for teacher-educators

themselves to be supported, and for them to be able to support preservice teachers, with the pedagogical integration of digital technology into physical education.

4.1.1.1.2 Human Resources.

When speaking of digital technology support, participants explained that there are university supplied human resources for classroom digital technology set up support [aka IT support], but that this IT support is focused on classroom digital technology, such as supporting instructors to use the university selected learning management system (LMS) for organization and course delivery. The teacher-educators found that their university supplied digital technology support does not include help with the pedagogical integration of digital technology for achieving learning outcomes. Paul commented that "we do have some digital supports or service from the technology supports … but largely that's looked like how to build your course in 'Brightspace' [an LMS]" and he mentioned that it would be helpful if universities provided instructors with "a quick way of how it [digital technology] can be implemented or just a little bit of a tutorial on this and how you can get started with it [digital technology]." During class observations the main digital technology used by teacher-educators was LMS. Teacher-educators at various times directed their students to refer to the class communications on either Brightspace, Canvas, or Moodle. When referring to digital technology used in physical education courses for preservice teachers, Pat said that there was not "anything particular for preservice teachers… but that they [preservice teachers] have access to the same digital technology that everyone does" on campus. During class observations, digital technology being used in these courses to support preservice teachers integrating digital technology into physical education was similar to that used in the majority of university classrooms. The digital technology resources that Pat, Peter, and Paul used to support physical education were LMS', Google docs, videos,

PowerPoint, images, and video conferencing. Physical activity was encouraged in their courses through such means as displaying images and showing videos of people being active, as well as by leading simultaneous physical activity via video conferencing.

Teacher-educators identified that organized and planned university support for digital technology integration into their courses and how to support students to further their ability with digital technology integration is not strongly supported. Pat brought attention to the support needed for teacher-educators to be able prepare preservice teachers to use specific PE apps in their future classrooms. Pat said that it would be helpful if someone would let teacher-educators know "you're going to need this particular app" and then "you're going to need to go on here and learn how to use that app." Instead, teacher-educators commented that digital technology integration is left up to the individual or faculty members who can form support groups on their own. The added workload of integrating digital technology into courses, without having organized human resource support designated to assist classroom integration for digital technology, can be an energy drain on instructors. Paul stated:

> right now, I feel it's largely more or less the individual instructors going forward and trying to find their own [way], which is great, that's awesome. But with everything going on, a lot of the instructors are also very busy with their own research, with other jobs. And so, it can be difficult to front load all of that yourself.

However, teacher-educators did find valuable support through collaboration with their colleagues. When discussing the need for universities to provide more IT support for course integration of various digital technology, Paul talked about how most of the support for course integration of digital technology for the goal of achieving course outcomes, such as encouraging physical activity, has come from colleagues, "Most of the support that I've had has really been

interacting with colleagues". Peter also indicated that support for pedagogical digital technology integration came from his colleagues,

> … collaboration with other instructors is really important in this [digital technology integration] aspect. And over the last five, 10 years or so of me teaching my course, I've had numerous discussions with a couple of other colleagues regarding teaching pedagogy and the use of technology.

In addition, teacher-educators commented on how collegial support was key in their being able to support preservice teachers to integrate digital technology to meet physical education goals. Peter highlighted that his faculty had "meetings as a department on how we could learn from one another and what were the best [digital technology] tools available" and that his faculty were able to "assist one another with drawing on each other's backgrounds and experience in technology and sharing that and helping one another navigate the new future." Peter added that his colleague's "strong response to incorporating technology" has made the instructors better able "to connect and engage students through technology in their courses."

Collaboration with colleagues being key to facilitating the integration of digital technology into physical education was expressed many times by Paul throughout the interview process. For example, Paul stated that "the collaboration with my colleagues. I've found it's really been the most valuable kind of technological support that we've had throughout how to integrate it [digital technology] successfully and meaningfully in our classes." Paul also specifically identified that he is exceptionally lucky to be able to collaborate with a mentor who is well-versed in integrating digital technology into physical education.

The importance of universities supporting faculty collaboration and how university supported collaboration could assist faculty in being able to integrate digital technology into

preservice teacher physical education was also commented on by Paul. Paul stated that it would be beneficial for universities to plan "pro D days for the instructors in the faculty of Education where someone who has gathered all of these tools simply exposes it to everybody in the faculty" then instructors could "look at how individuals can use it [digital technology] differently." Paul highlighted that, "the more people that we expose it [digital technology] to, the cooler, different ways, creative integrations into the course content we can find." University supplied human resources and the human resource of faculty collaboration were key supports mentioned by teacher-educators as a means of assisting teacher-educators to increase digital technology integration into their courses and increase their ability to prepare preservice teachers to integrate digital technology for physical activity promotion in their future classes. Program structure also influences how teacher-educators support preservice teachers to integrate digital technology into the context of physical education; program structure is discussed in the next section.

4.1.1.2 Program Structure.

One of the main external factors impacting teacher-educators preparation of preservice teachers to integrate digital technology into physical education was the knowledge of another course or courses within their B.Ed. program that were designed to be the "technology course." Paul mentioned that there was a separate "teacher technology course" in their program. Peter also commented on a separate digital technology course in their program, "we have a whole course dedicated to technological applications" and "within that course, students are exposed to a whole variety of current software programs that are designed to enhance and measure physical activity in all kinds of different settings." Reviewing the programs at all three universities backed up what the teacher-educators said about separate courses for digital technology integration, as all three programs had separate digital technology courses as part of their curriculum. As noted

by the teacher-educators, having a separate digital technology course can be beneficial in programs as it allows the focus of that course to be learning about various digital technologies. However, having a separate course for digital technology combined with instructors having limited experience with digital technology integration could lead to teacher-educators relying on students learning digital technology integration in the one course designated as the digital technology course and this would not role model digital technology integration being woven throughout the curriculum. In addition, universities lacking organized human resource support for teacher-educators to integrate digital technology into their courses further promotes teacher-educators reliance on the specifically designated digital technology courses in their programs to teach the preservice teachers how to integrate digital technology. Peter specifically identified his reliance on there being separate digital technology courses offered in his program:

> Now, as I have said from my personal perspective, I have not used a lot of technology in terms of engagement with the students in that manner [physical activity promotion]. However, in our program, we have other courses that really promote the use of technology and . . . how technology can be applied to various areas of our program.

The influence that program structure has on digital technology integration emerged as an external factor impacting teacher-educators ability to prepare preservice teachers to integrate digital technology into physical education. Sociocultural influence was also revealed as impactful and the data for this finding is presented in the next section.

4.1.1.3 Sociocultural Influence.

The teacher-educator participants shared that the vast integration of digital technology into society influences their preparation of preservice teachers and puts pressure on teacher-educators to integrate digital technology. Peter stated that “Digital technology is here. It has been

here for a while, it's with us, it is what our students … entering kindergarten and early primary grades are coming to our schools being familiar with." Teacher-educators also shared that the vast integration of digital technology into society combined with the presumed familiarity of students with digital technology makes them feel pressure to stay up to date with the most current technologies. Paul commented regarding 21st century students that "the students moving forward are also going to be interacting with newer and newer technologies. So, if you're [teacher-educators] behind the times in that realm, you're not actually serving your students the best of your abilities." The acceptance of digital technology in society was evident in the classes observed. During class observations, teacher-educators expectations that preservice teachers would have their own personal devices and be able to search necessary information were met.

Societal pressure to stay up to date with digital technology can be a source of intimidation, as Peter observed:

> technology has come such a long way, and it is so rapidly changing. I think this is one of the difficulties with technology is trying to keep up with it. And as instructors, we are faced with so many other demands and we're pulled in so many other directions that it can be easy to not stay current from a technological perspective.

Pat shared the impact of trying to keep up with digital technology advances, acknowledging that she was "struggling with all of the things [digital technologies] that are out there." During class observations Pat acknowledged that the students may be more familiar with some of the digital technology being used and commented to the students "that you students know this better than me." During Peter 's class, a video was proving to be challenging to share on a particular device; Peter welcomed insight from his students and was then able to address the situation. Teacher-educators and teachers in general have a strong commitment to advancing education in keeping

with societal and cultural needs. This serves as a motivator for teacher-educators to engage with digital technology and prepare preservice teachers to integrate digital technology to facilitate various physical education goals, including promoting physical activity. However, at the same time, the fast pace of digital technology advancements can cause teacher-educators to feel intimidated by digital technology and without proper university support and program structure, this pressure can lead to a lack of confidence in teacher-educators feeling prepared to facilitate preservice teachers to integrate digital technology into physical education. The lack of confidence experienced by some teacher-educators and additional internal factors are discussed in the next section.

4.1.2 Internal Factors

As noted in the introduction for this theme, internal factors are the thoughts and feelings that arise within people from their personal beliefs and influence the decisions they make (Martinez & Shaker, 2018). In this case, the internal factors that emerged from the data as being influential on teacher-educators' preparation of preservice teachers to integrate digital technology into physical education were the teacher-educators' beliefs about digital technology and physical activity, and the teacher-educators' willingness to vulnerably explore digital technology with their students & the teacher-educators' ability to fully embrace the facilitator role. These internal factors form the organizational headings for this section. The data for the teacher-educators willingness to vulnerably explore and their ability to embrace a facilitator role are so closely intertwined that the data is presented together under one heading. What it means to vulnerably explore digital technology is explained in section 4.1.2.2.

4.1.2.1 Beliefs about Physical Activity & Digital Technology.

The teacher-educator participants' beliefs about physical activity and digital technology are foundational factors that impact their preparation of preservice teachers to integrate digital technology to meet physical education goals. Teachers' beliefs affect what and how subjects are taught in their classes; therefore, teacher-educators' beliefs about the significance of physical activity affect how it is taught to preservice teachers (Baek et al. 2018b; Kakazu & Chow, 2023; Wyant & Baek, 2019). Regarding physical activity, Pat said that having students actively engage in physical activity "is very important to create those lifelong literacy skills." Lifelong literacy is conceptualized as literacy learning that develops over a lifetime (Hanemann, 2015). Pat was referring to physical literacy being something that continues to develop over a lifetime. In addition, Pat commented on the benefits of physical activity being done in classes at schools, such as giving students the opportunity to "develop leadership skills together" and to recognize that different people have "different levels of ability and capacity." Pat further observed that schools offering planned physical activity "provides children with more diverse opportunity" to engage in various types of physical activity because they can engage in "game type activities, as well as the individual type of activities." Peter also shared his belief of physical activity promotion in schools, stating "I think physical activity should be definitely promoted in elementary and secondary schools. It is essential to the health and well-being of students." Paul's beliefs regarding physical activity promotion in schools aligned with Pat's and Peter's, he noted that "I absolutely think that the educators should be promoting physical activity." The belief of teacher-educators in the importance of preservice teachers effectively promoting physical activity in their future classes positively impacted their preparation of preservice teachers to promote physical activity; this belief motivates teacher-educators to stay current with the most

effective ways of promoting physical activity and fuels their desire to grow this knowledge with the next generations of teachers. Teacher-educators' beliefs in the importance of preservice teachers promoting physical activity were reflected in class observations. Teacher-educators delivered class content that emphasized the importance of effectively engaging elementary students in physical activity. For example, Pat highlighted to preservice teachers the importance that elementary students should feel successful when engaging in physical activity and suggested that when preservice teachers are assisting elementary students to improve in a particular physical activity that preservice teachers should ensure the suggestions provided are attainable so that elementary students retain positive feelings towards physical activity. During Peter's class observations, he provided preservice teachers with strategies to instil a love of physical activity in elementary students, such as providing elementary students with activities that support autonomous decision-making, which promotes engagement in physical activity. Alley (2019) highlights that providing students with autonomy promotes students' motivation and engagement. One example Peter shared to support student' autonomy and foster engagement was encouraging elementary students to choose a creative movement pattern that reflected their personal interests. The enthusiasm and positive energy with which all teacher-educators delivered their course content showed that they valued and strongly believed in the importance of physical activity.

The teacher-educator participants also shared their beliefs about digital technology. Peter articulated his thoughts regarding integrating digital technology into physical education,

> I do believe it's very important because, as I said, our world has become a digital world and whether that be with our computers, or our gaming, or our phones, or the way that we interact with technology, it's just happening to a greater degree.

Peter went on to say that “it's [digital technology] a tool that can be used to in many helpful ways. I believe it can encourage movement and learning of skills.” Peter expressed his perspective stating that “technology can be our friend and we need to embrace it.” Paul shared a similar sentiment when asked about supporting preservice teachers to integrate digital technology for physical education: “absolutely I think it [digital technology] should be [used in physical education to promote physical activity]…that's where the world's going. To try to avoid it….is limiting your potential, I think, as an educator.” Pat agreed with digital technology being beneficial, commenting that “I believe digital technology is fabulous”. Teacher-educators acceptance and support of digital technology being used to promote physical activity was observed in their classes. All three teacher-educators used PowerPoint, online images, videos, and LMS to promote physical activity. Paul also used Spotify to create a positive atmosphere and motivate movement through energizing music.

Overall teacher-educators in this study viewed digital technology as having the capacity to be a positive influence in physical education, as exemplified by Paul’s comment that digital technology “can absolutely be used to our advantage in physical education.” However, concerns regarding digital technology integration into education were mentioned. Such as when Pat queried the following “but does it [digital technology] take away then because of the other things like that constant distraction” and “Is it [digital technology] taking away from the other parts of learning that we all had to go through before the digital age? I don't know. I think it's a question that we have to consider.” Pat’s comments highlight an important aspect of digital technology, that of *pedagogical* integration. Even though digital technology was agreed upon by the teacher-educators to have beneficial uses in physical education, Pat’s voiced concerns regarding digital

technology integration and the possibility that digital technology could take away from a lesson reinforces the need for digital technology integration to be done pedagogically.

The importance of pedagogical integration of digital technology was shared by all the teacher-educator participants involved in this study. Peter commented on the importance of meaningful integration of digital technology; for example, when talking about integrating digital technology pedagogically, Peter gave an example of an approach he had learned for pedagogical lesson planning of first identifying learning outcomes, then determining what resources to use for assessments, and then deciding which activities will help students to reach the "learning targets" of the lesson. This approach assists preservice teachers to determine if certain tools and technologies will be useful in achieving a lesson's designated learning outcomes. Paul also commented on the importance of pedagogical integration, "I feel like the best thing I can do for preservice teachers moving forward is just showing them examples of how it [digital technology] can potentially be implemented….and then linking it [digital technology] to the pedagogical theory." Paul also noted the importance of good pedagogy by saying that he tells his students that "it [digital technology] should be something that helps you and not something that over complicates your lesson, which I think some [lessons] can go that way [overcomplicated] if people don't implement it [digital technology] correctly." Paul added that he reinforces with preservice teachers the need for them to know "why am I doing what I am doing right now?" Paul reminds preservice teachers in his class that "we [teachers] have a very small window where we are able to convey some of the skills. And so make sure that you are packing in really as much meaningful instruction" as you can. The teacher-educator participants all strongly shared the belief of preparing preservice teachers to promote physical activity regularly and effectively with students.

As well, all three teacher-educators believed in the potential of digital technology to be an effective motivator of physical activity. However, Peter and Paul placed a higher level of importance on digital technology being integrated into physical education and keeping up with our "digital world" and Pat shared more concern over the possible negative impacts of digital technology integration and its potential to take away from learning. As mentioned, Paul has the most experience with digital technology, Peter has a moderate level of experience, and Pat, although a very experienced educator, acknowledged that she is "a computer dinosaur [when it comes to digital technology] because I really do not embrace technology at maybe the level that I should." The amount of experience was reflected in class observations. As was described in context descriptions in chapter three, all three teacher-educators used digital technology in physical education; however, Paul (with the most experience using digital technology) integrated digital technology to promote physical activity most fully into his class, through successfully having the preservice teachers engage in a physically active lesson during class time, as well as create mini-lessons in which they had their fellow classmates be active.

Although the teacher-educator participants had varying levels of digital technology experience, they all shared a growth mindset approach to the advancement of education, which was apparent when Pat commented that she uses "technology because it's part of the education process" and that she has a "desire to continue to be an effective facilitator of education." One of the main ways that teacher-educators supported preservice teachers to integrate digital technology into the context of physical education was the willingness they demonstrated to vulnerably explore digital technology with their students and their openness to truly embracing a facilitator role, which is discussed in the next section.

4.1.2.2 Willingness to Vulnerably Explore & Embrace the Facilitator Role.

Vulnerability as defined by Brown (2017) is "uncertainty, risk, and emotional exposure" (p. 154). Vulnerability experienced by the teacher-educators came from uncertainty in their ability with digital technology combined with the extensive sociocultural integration of digital technology and the subsequent pressure they felt to be knowledgeable on the various types of digital technology. The teacher-educators' feelings of uncertainty were impacted by their level of experience with digital technology combined with the amount of human support that was available to them for guidance. Peter commented on "the instructor's knowledge and expertise with new technology" as being a personal barrier and identified "each individual instructors' motivation or familiarity or comfort level in exploring more technological tools" as an obstacle. Pat commented that "I actually expect students [preservice teachers] to be better at this stuff [digital technology] than I am" and commented that she was "a little bit anxious about it [digital technology integration]." Peter commented on what he felt was an area that could improve in his course, "a weakness in my course at this present time is that I have not adopted a lot of other technological aspects." During class observations, Pat and Peter revealed their lack of familiarity with some aspects of digital technology and their openness to being vulnerable by asking for digital technology assistance from preservice teachers during class. Preparing preservice teachers to integrate digital technology while still feeling as though they have much to learn about digital technology required the teacher-educators to take on a level of uncertainty and risk.

Paul expressed less uncertainty with integrating digital technology into his courses and with preparing preservice teachers to integrate digital technology into physical education. However, Paul still was willingly vulnerable in his courses, experiencing uncertainty and taking risks by trying new digital technology and new approaches with his students. This was noted

when Paul said that “a lot of it [digital technology integration] has been trial and error on my end” and “obviously you'll try new things and it might not always work. And that's totally fine.” During class observations, before class started, Paul was experimenting with how Spotify would play music through his digital devices and was also checking how his leading certain physical actions through video conferencing were being perceived; this exemplified his confidence and his subsequent approach of trying “new things”. Paul had less uncertainty with taking risks because he had more experience, which afforded him more confidence in his ability to use digital technology in physical education. He gave a great amount of credit for his experience and confidence to having an accessible mentor who was well versed in digital technology integration into physical education. Many times, Paul commented on the support from his mentor, having access to his mentor’s resources, and being able to work closely with his mentor as they explored various digital technology together as being extremely beneficial. When talking about the support he has had to prepare preservice teachers to integrate digital technology, Paul commented that “it’s largely been resources that I’ve gained from [my mentor] or that [my mentor] and I have kind of developed together.” Having support reduces the level of vulnerability; however, there is a level of vulnerability experienced by all teacher-educators when using digital technology in their classes and assisting preservice teachers to become more familiar with how to integrate digital technology.

The willingness to vulnerably explore digital technology in their courses was a stepping stone on the path of teacher-educators embracing their roles as a facilitators of digital technology integration. Teacher-educators are used to being confident, often feeling as though they are the expert, in what they are introducing to preservice teachers and in the case of digital technology (due to the number of technologies and the rate of change of digital technology) their role is one

in which they are less likely to feel as though they are an expert in the digital technology being introduced, but rather their role is that of a facilitator assisting preservice teachers to explore pedagogical digital technology integration. The teacher-educators in this study recognized their roles as facilitators. For example, when Pat was talking about teacher-educators' responsibilities as preservice teacher educators, she referred to the role of teacher-educators "as facilitators at the university level for teachers." Paul's response when asked how he viewed his role in preparing preservice teachers to integrate digital technology for physical activity promotion was as "a facilitator for them to develop their own ideas." Peter expressed that "it comes back to this is point of ownership of giving students more ownership over their learning and the teacher being a facilitator." In the past educational technologies (chalkboard, overhead projectors, stop watches, video, etc.) advanced more slowly and teacher-educators had more time to get well versed in the various technologies that they were introducing to preservice teachers, so the role of facilitator came with more experience and more confidence. And although teacher-educators recognized their role as facilitators of digital technology integration, being facilitators of educational tools that they are still learning themselves and will be learning as they explore with the students takes a great deal of vulnerability and courage.

External and internal factors emerged as impactful on teacher-educators' ability to support preservice teachers to integrate digital technology into the context of physical education. Within external factors university resources, program structure, and social cultural influence were found to be the most prevalent. The internal factors that became apparent as significant were teacher-educators' beliefs about physical activity & digital technology, their willingness to vulnerably explore digital technology, and their openness to embracing a facilitator role. These findings are discussed with perspective from relevant literature in chapter five. The second theme

that emerged from the data as to how teacher-educators are supporting preservice teachers to integrate digital technology was that of teacher-educators fostering preservice teachers to pedagogically integrate digital technology into their courses; this theme is described in the next section.

4.2 Theme 2: Fostering Pedagogical Digital Technology Integration

The second theme that emerged was that teacher-educators are supporting preservice teachers to integrate digital technology into physical education through fostering pedagogical digital technology integration. Exposure and exploration are the categories that formed the foundation for this theme. Exposure emerged from the significance that teacher-educators placed on role modeling and on increasing awareness of digital technology - expanding the preservice teachers "toolbox" as indicated by Peter. The category of exploration developed from the importance teacher-educators placed on providing opportunity for preservice teachers to familiarize themselves with digital technology integration into physical education through personal use of digital technology and through using qualitative reflection to analyze the effectiveness of their digital technology integration. Pedagogical integration is conceptualized in this study as integrating resources, in this case the resource of digital technology, into education in ways that take pedagogy [the connection between learners' learning, teacher's teaching, and learning in context (Armour, 2011)] into consideration in such a way that intended learning outcomes, such as increased physical activity, are achieved.

4.2.1 Exposure

Exposing preservice teachers to digital technology or making digital technology "known" to preservice teachers was identified by all teacher-educators as a main way in which they are preparing preservice teachers to integrate digital technology in their future classes. Positive

socialization and preparation with digital technology prior to teaching significantly influences preservice teachers' ability to effectively integrate digital technology into courses (Gawrisch et al., 2020). Digital technology is an educational tool that must be implemented in the same way as other educational tools with knowledge of why and how this specific tool is going to assist students in meeting their educational goals.

4.2.1.1 Role Modelling.

A role model is "a person whose behaviour, example or success is or can be emulated by others" (Collins, 2022). Teacher-educator participants in this study highlighted role modeling as a significant means that they use to advance preservice teachers understanding of digital technology integration and to prepare preservice teachers for digital technology integration into physical education.

Role modeling was identified by all teacher-educators as a key means of exposing preservice teachers to various digital technology that facilitates meeting physical education goals. Paul stated that "showing them [preservice teachers] examples of how it [digital technology] can potentially be implemented. I think that that's really the best way to show the potential … exposing them to tools and saying, look at what this tool can do." Pat shared the same sentiment, stating that one of the main ways teacher-educators can help preservice teachers to integrate digital technology is through "setting an example … using it[digital technology] and showing the capacity." One of Peter's comments highlighted the importance of role modelling as a foundational aspect of teaching "there is the word teach in teaching physical education. And that means that we are instructing we're teaching, modeling, providing examples of opportunities." Peter went on to say that preservice teachers and the students they will be teaching:

> … are growing up in a world with technology, they've grown up with phones, smart phones and computers from day one, but it does take some learning and proficiency for preservice teachers to become familiar with what's available and what's out there and how to use it. There's … all these wonderful tools. But if they don't get exposure, how to use these programs or applications, then they're likely not to incorporate them.

Teacher-educators exposed preservice teachers to digital technology use in physical education through role modelling digital technology integration in the delivery of their own courses. Peter role-modelled digital technology integration by using digital technology to show preservice teachers various relevant images of creative dance and videos showing creative movement in which their future elementary students could engage. The videos provided ideas to preservice teachers as to how to encourage their students to be motivated to move; for example, the videos presented ideas such as having elementary students create movement themes related to their individual interests such as sports, superheroes, or favourite tv shows. One of Peter's examples involved showing the preservice teachers the Harlem Globetrotters, analyzing the Globetrotters movements, and then having a discussion with the preservice teachers as to how their future students could analyze videos of basketball movements and mimic the motions for their creative movement designs. In addition, Peter helped preservice teachers understand the benefit of elementary students using an imaginary ball in the basketball dance. An imaginary ball allows elementary students to create dances in which they can be "professional" basketball players and have all their basketball moves be successful. After Peter's role-modeling, during class discussion the preservice teachers were encouraged to talk about showing videos to their future classes and plan how to incorporate music into their lessons.

Pat role modelled the use of digital technology promoting physical activity through using images and videos of students engaging in various sports. Pat talked specifically about using videos to teach preservice teachers how to teach Fundamental Movement Skills (FMS). Pat said that showing "a video of a fundamental movement skill" and then playing that video in slow motion for analysis of movement is an excellent way to help preservice teachers "cognitively understand that information [motor skill patterns] and then have the confidence to effectively be able to teach it." During class observations, Pat also role-modelled the use of digital technology for promoting critical reflection of physical activity content. To increase preservice teachers' understanding of teaching FMS, Pat had preservice teachers complete reflective questions in Canvas [an educational software] and had the students identify what level of skill acquisition they are at themselves, having them choose between the three stages of skill learning – cognitive (understanding what to do), associative (doing the movement with analysis of how to improve), or autonomous (automatically doing the movement correctly) (Huber, 2013). This use of digital technology helped the preservice teachers to understand how their own level of competence with a specific physical activity may influence their approach to teaching that activity to their future students. Pat identified that sometimes elementary teachers do not feel confident in their ability to teach certain skills in physical education and that this is a time when digital technology can be very useful. Rather than teachers avoiding certain skills or physical activity, they can show videos of the skills to their students. Pat added that this has the additional benefit of teachers being able to choose videos of people that their students can relate to, which further increases student' motivation.

During class observations, Paul role modelled integrating digital technology into physical education through using Spotify (a digital music streaming service) for music, images of physical

activity and physical activity equipment, and Zoom (a video conferencing service) to demonstrate activities. Paul demonstrated all physical activity skills himself prior to having the preservice teachers engage in the physical activity game that he had designed in which students move around to music and then freeze in specific balances when the music stops. Through having the students engage simultaneously in this online activity, with their computer cameras on, Paul promoted collaboration and socialization. This approach of participating in physical education together in a game format motivated the preservice teachers to engage in physical activity. As well the game format promoted a positive association with digital technology for physical activity promotion. Paul ran the class as though the preservice teachers were in an elementary class so that he was role modelling how preservice teachers could engage with students in their future classes. For example, he used Google forms to have students engage in self-reflection regarding how the class went for them; the form asked preservice teachers questions on such things as to how they were feeling before being physically active, how they were feeling after being physically active, what was the easiest balance, and what was the most challenging balance. Paul mentioned to the students that Google forms can be completed anonymously or with knowing who has filled out the form; their selected approach will depend upon their goals. Students in Paul's class also connected in online breakout rooms and created slide shows that they then shared with the class. During the student slide shows, preservice teachers were once again encouraged to be active and try out the poses that their peers had designed. Everyone was required to have their cameras on and engage in physical activity together. In addition, Paul had assigned the preservice teachers to groups (which were referred to as "teams" and the preservice teachers created fun team names) for the semester and Paul had set up a blog site for the "teams" to connect with each other, this further enhanced socialization

during class observations and further established a positive association with using digital technology in the physical education context.

In addition to role modelling the practical application of integrating digital technology into physical education in their courses, teacher-educators exposed preservice teachers to digital technology by talking with them about pedagogical integration. For example, teacher-educators identified the importance of ensuring that preservice teachers are not only aware of and understand that digital technology is a tool but that like all other educational tools, for digital technology to be useful, it must be integrated meaningfully, keeping learning outcomes in mind. The digital technology tools for physical education that the teacher-educators discussed and the importance of knowing how to use the right tool for the job (that is, the learning outcomes) are described in the next section.

4.2.1.2 Increasing Awareness – Expanding Preservice Teachers "Toolbox."

As mentioned, teacher-educator participants in this study shared the perspective that digital technology is a tool that can be used to enhance learning. Pat stated that digital technology is "good as one of the tools out there"; Paul said that digital technology for physical activity promotion can be "a valuable tool"; and Peter shared that he thinks digital technology is "a tool that can be used in many helpful ways. It [digital technology], I believe, it can encourage movement and learning of skills." As exemplified by Peter's statement, the teacher-educators in this study believed that digital technology can be used to encourage people to move; however, teacher-educators were also aware that the opposite happens, and that digital technology has been linked to contributing to sedentary behaviour. Pat commented that digital technology can be used in two main ways; one way promotes a "seated position" and "the other one [use] is movement". When teacher-educators were asked about the common perception that digital

technology should not be used in physical education for physical activity promotion because of its association with sedentary behaviour, teacher-educators said the key is to be knowledgeable about the digital technology you are using and how it relates to your educational goals. Paul shared his thoughts on digital technology promoting sedentary behaviour or motivating movement:

> I believe that people believe that it [digital technology] increases sedentary behavior because that's what it's been more or less designed to do previously. We're playing video games where we're sitting down and we're completing it, but we use technology to take different aims. As far as like even if you look at some of the fitness apps that we have to use at home, fitness apps right now are absolutely blowing up where it's walking you through proper form, how to execute the skills effectively, what you're looking for, where you should be feeling it, so on and so forth. So, it really just depends on what we're targeting. I believe that this the initial wave of technology was look at what you can do while sitting… But if we target it differently, I think they [digital technology] can absolutely be a valuable tool. I think it just comes down to how we use it.

The importance of becoming aware of the various types of digital technology and understanding how to integrate the "tool" of digital technology for educational goals emerged as important in preparing preservice teachers to integrate digital technology into physical education. Peter commented that digital technology is "a very powerful tool and I think it's something that certainly can assist educators in accomplishing significant student learning outcomes for their courses." Teacher-educator spoke about two main learning outcomes in which digital technology is helpful in motivating movement that of skill development and tracking progress combined with goal setting.

4.2.1.2.1 Skill Development.

According to the teacher-educators, skill development was enhanced by using digital technology because of its ability to provide timely feedback on how students are executing movements. Paul indicated digital technology could be used very effectively for "immediate feedback for our students". During class observations, Paul had preservice teachers complete balance poses in their small groups and had them take photos on their own cell phones of the poses to share with the larger class during their preservice teacher led lesson. This activity gave preservice teachers the autonomy to select which poses they wanted to use, while at the same time had the preservice teachers reviewing the photos of themselves completing balance poses and analyzing how well they completed the specific balance. Pat described using videos to show students proper physical skill execution. In addition, Pat talked about digital technology being easy to use for recording and commented on how the instantaneous visual feedback can increase students' understanding of skill execution and thereby their skill competency. Pat identified the visual feedback on correct movement can help children develop FMS, which can increase their overall confidence and motivate students to be physically active. Paul also commented on the value of the timely feedback that digital technology provides, saying "So I think the speed of feedback is something that is absolutely very valuable about technology. And then also we're able to kind of open up some new doors that we didn't necessarily have access to before." The new doors Paul is referring to are the immediate visual feedback for students and their increased understanding on how to improve their movement skills. Paul stated that without digital technology:

> … it's very difficult sometimes to assess where you're at without actually being able to see how you perform a skill. It is very easy to think that you are doing exceptionally well when you can never actually get any of that visual feedback.

Peter also highlighted the benefits to skill development of using digital technology. He said that digital technology was helpful for students in terms of learning "accuracy, velocity and distance, in terms of striking objects and such." Peter further noted that digital technology is an "incredibly empowering tool for students because they get immediate feedback" and that "a student can look at a video of themselves and instantly, with some instruction, change and improve a movement pattern that they wouldn't have recognized before." Paul supposed a student might analyze their own skill in the following way,

> I took a pause here or this was my overall time for that move. And so, you're able to look at your performance and think critically about it…You've got tons of opportunity to say, oh, I didn't throw that last one to feel as strong as my previous ones. What happened?

The lifelong impact of the efficiency of digital technology to help students analyze and improve their FMS was commented on by Peter:

> … then as students get older to be able to perfect those skills in many areas, that will enable them to then find activities that they love and enjoy and will hopefully help them carry on with those activities in their future. Late teen to adult years to keep them physically active and healthy.

4.2.1.2.2 Tracking Progress combined with Goal Setting.

Another learning outcome, highlighted by teacher-educators, is that digital technology integrated into physical education can help students track their progress and set physical activity goals. Peter said "one [digital technology] that I'm most familiar with is fitness trackers and the

ability to record activity." He commented that "smartphones and smartwatches, for example, are an amazing tool that motivate people and kids to movement". Paul shared that tracking progress with the use of digital technology can help students recognize:

> … this is where I am. I can be here eventually, or this is my goal. How can I get there? And then it helps you kind of identify some of those goals, whether or not they're attainable, what they look like. You can track your progress over time and see, oh, I've improved so much.

Peter also articulated the benefit of the tracking capacity of digital technology for students:

> … technology has such an impact on that [giving students more responsibility for their learning] because it's very precise, it's very quick to give students feedback, and it allows them to track their progress over a period of time as well, so they can see improvement and so they can track and record that progress very easily with the use of technology.

Additionally, Peter commented on the social aspect of digital technology and talked about people being able to choose whether they want to compare themselves to others or to themselves. He said that a lot of people use digital technology to set goals and then are either individually motivated by a digital technology reminder of their goals or motivated by comparing with friends and family.

Paul shared an example of how he integrates the tracking ability of digital technology in a social way into courses to promote physical activity:

> the tracking aspect of digital technology is a really good one and then having fun. I think that the video analysis game is one of the funnest days when people have such a good time and they're able to see and I usually do a little bit of like a competition where it's like

fastest throw or I can actually track the ball and do some physics on it and how fast it's going. Right. And so, and I print off certificates and all of that for my students.

Paul role models for preservice teachers how to incorporate the tracking ability of digital technology to help students both understand and celebrate their skill level. Paul's development of a "fun" day and incorporating certificates to recognize students' achievements provides preservice teachers with an idea of how digital technology can be integrated into physical education in a positive and beneficial way to promote physical activity and motivate movement.

Paul further highlighted the social aspect of digital technology as potentially motivating for students "Instagram and Snapchat as probably the two biggest ones [popular digital technology] where people are actually showing what they're doing and how they're portraying the different activities that they're doing." Paul then mentioned that with social media and digital technology, preservice teachers need insight into how to use digital technology responsibly and that their future students will also need guidance on responsible digital technology use. Peter also commented on the importance of teaching students to use digital technology responsibly stating that "we need to incorporate it [digital technology] into our educational experience for children to help guide them in making good choices and to always use technology wisely."

The importance of instructing preservice teachers and students in general to use digital technology "wisely" was stressed by all the teacher-educators. In addition, teacher-educators made clear the importance of teaching preservice teachers about meaningful integration and planning ahead for potential challenges. Peter, for instance, highlighted the vast number of digital technologies and the importance of assisting preservice teachers in understanding how to meaningfully integrate digital technology into physical education stating that "there's quite an array of different things [digital technology] available now, and it's a matter of one becoming

aware of what's available and *how* [emphasis added] they [technologies] can then be implemented in their physical education lessons." Paul acknowledged that teacher-educators "should be teaching them [preservice teachers] strategies on how to interact with technology. When is it appropriate to be using the technology? Do we always need it? … I absolutely think that incorporating some separation is huge." Paul was referring to the fact that part of integrating digital technology meaningfully into health and physical education is determining when the digital technology is of benefit, when it is not, and when it is a detriment. Paul said that teacher-educators should ensure that preservice teachers are aware to deliberately include breaks from digital technology for their students as well. When speaking of digital technology integration, Paul acknowledged that

> in physical health education, part of what we teach are wellbeing and health strategies for life. So having brain breaks from your phone is something that we should be instructing in physical education class. … I think that that's something that we should be instructing and teaching our teachers.

Paul indicated that the grade the preservice teachers will be teaching needs to be considered when determining how or if digital technology is going to be integrated. Paul said that he has found with younger students that "incorporating a bit of a break from it[digital technology] is often advantageous for the students." Paul said that with younger students he finds that using digital technology more often "in a teacher centered way" is more beneficial and then explained that he has found it more effective if the teacher is the one in control of the digital technology with younger students. He identified that this is so the younger students are not individually on their phones and so that the teacher is interacting with the whole class of students simultaneously.

Another challenge that teacher-educators prepare preservice teachers for with digital technology is that of knowing the policies of the school they will be working at regarding taking photos/videos of students. Paul said, “one of the important things that we do need to cover and that we do for a little bit in our teacher education classes, is the idea of taking pictures and videos with your students and what that looks like. And so having them [preservice teachers] confident, going in on what they can and cannot do, and how they can find out what is specific to each school, if they've got specific policies.” Paul said he knows that some schools are making that easier by having the policy that parents must opt out of photos/videos, rather than opt in. Paul stressed that preservice teachers should be made aware of the importance of knowing their school’s policy before they are using digital technology to take photos or videos of students.

Teacher-educators identified that a key strategy they tell preservice teachers to help them be ready for the challenges they may face while integrating digital technology is to plan for challenges and be well prepared. Peter said “excessive planning” is a strategy that he drives home with his preservice teachers to prepare for the potential challenges. Pat said she makes sure preservice teachers know that they should “have a backup plan and a backup plan to the backup plan.” Paul shared that “we try and prepare students for a variety of scenarios. So, we really drive home the idea of over planning.” The significance of the role of teacher-educators in preparing preservice teachers to integrate digital technology through addressing the aforementioned considerations of meaningful integration for specific learning outcomes, the appropriate use of digital technology, knowing school policies, and planning for potential challenges, was highlighted by Peter when he surmised:

> … my role is crucial … because students look to their teachers, professors as people that they want to trust and want to emulate and want to know that they're getting the best and

most current information in order to help them establish their career and become proficient.

Peter went on to say that it is the responsibility of teacher-educators "to help them [preservice teachers] add tools to their toolbox and become effective instructors." In addition to preparing preservice teachers to integrate digital technology into physical education through role modeling and expanding their toolbox, teacher-educators found it crucial to provide preservice teachers with time and opportunity to explore digital technology themselves. The strategy of exploration is described in the next section.

4.2.2 Exploration

Teacher-educators identified personal exploration with digital technology to be an integral component of preservice teachers being prepared to pedagogically integrate digital technology into physical education. Teacher-educators identified two main overarching strategies that they use to support preservice teachers' exploration of digital technology: 1) providing opportunity – "time" and 2) qualitative reflection.

4.2.2.1 Providing Opportunity – "Time".

Teacher-educators felt that providing preservice teachers with time to explore digital technology was key to learning. Peter thought it was important that preservice teachers "are exposed [to] and given the tools and the information and are allowed to *explore* [emphasis added] what's currently on the market in terms of technological advances." Pat talked about the importance of all students having "time to absorb" what they are learning. Paul said that he works at providing opportunity for preservice teachers to be able to understand and use technology, then added "that's what I try to facilitate, as well as the idea of exploring into your own sort of ideas." Paul went on to explain his statement, saying that once preservice teachers

are provided with information then they need time and opportunity to experience digital technology themselves to build their practical knowledge and come up with their own ideas for integration. Peter highlighted the importance of preservice teachers having time with digital technology to be able to incorporate digital technology meaningfully into their future classes; he commented that "it does take some learning and proficiency from our preservice teachers to become familiar with what's available and what's out there and how to use it." He surmised that "if they don't get exposure, how to use these programs or applications, then they're likely not to incorporate them" into their future classes.

Teacher-educator participants agreed that providing adequate time for preservice teachers to personally use digital technology for physical education purposes was key to preparing preservice teachers to be able to integrate digital technology into physical education. Providing preservice teachers with practical experience integrating digital technology to meet the physical education goal of promoting physical activity was mainly done through recording movement skills and then critically analyzing those movements. Peter provided preservice teachers with time to use digital technology for physical activity promotion by planning activities that had preservice teachers use digital technology to record and analyze Fundamental Movement Skills (FMS). Peter gave the specific example of having preservice teachers digitally record elementary-age children completing the FMS of throwing and kicking. The preservice teachers were instructed to guide the students on how to do the FMS correctly, record the children completing the skills, and then watch the recordings and analyze the children's movements. After video analysis the preservice teachers were required to provide ideas of how the children could improve their FMS. Peter said this helped preservice teachers be "aware of what the correct teaching and instructional steps are for teaching those kinds of skills … and helping

students advance in those skills." Peter specified that by using digital technology to improve preservice teachers' analysis "they [preservice teachers] could easily make suggestions that would almost make instantaneous improvement" in their students' FMS. He further added that this helps the elementary students to "develop competency and confidence in their ability with movement" and indicated that the students' whose skill confidence increases are more motivated to engage in physical activity.

As mentioned earlier, Peter also uses video and online images to teach preservice teachers how to engage children in creative movement. The specific example Peter provided was that of how to engage children with different interests in creative movement. In this case, Peter used the example of children that may not be interested in creative movement but are interested in team sports. During the class I observed, Peter shared with the preservice teachers a creative movement routine that was focused on basketball movements and showed how this approach could engage students who like ball sports in creative movement. Peter's sharing was followed by Peter providing opportunity for the preservice teachers to take time to reflect on "sport" inspired creative movement and share their ideas with each other. The preservice teachers extended Peter's idea and talked about using video clips from the popular basketball themed movie "Highschool musical" such as showing elementary students the song and dance "Get Your Head in The Game" to motivate students and get them excited about creative movement.

Also communicated previously was that Paul found his classroom/gym set up to be excellent for teaching preservice teachers how to teach PE; the preservice teachers could go straight from the classroom to the gym and actively apply what they had just been learning. Paul found that having preservice teachers use digital technology to record and analyze movement, as well as analyze their own ability to teach physical education, was beneficial for preparing

preservice teachers to integrate digital technology into physical education. Paul said that "we did a lot of video editing this semester." Paul gave the example of an activity that he has the preservice teachers do in which they record themselves teaching their friends how to play a game and then they analyze the recordings. During the observation of Paul's class, he had the students develop slide show balance routines that demonstrated them doing various balance poses; the students were then asked to share these slide shows with their class remotely via Zoom. The last slide of each presentation was a 'puzzle pose' that each of the preservice teachers tried to guess what the pose was, do the pose at their own location, and see if they guessed the pose correctly. All students were required to have their cameras on so that each person could see the other preservice teachers attempting the puzzle poses, this was to foster engagement through shared activity.

Pat also talked of having the students critically analyze FMS by watching videos and then analyzing proper skill execution. In addition, during class observations, Pat had the preservice teachers use digital technology to form groups in online break out rooms and work together to prepare lessons for striking and fielding games. The importance of teacher-educators providing preservice teachers with the experience of using digital technology themselves was voiced by Pat, she said that for teacher-educators:

> It's not just what you're teaching, it's how you're teaching and how it's affecting the preservice teachers *to use it* [emphasis added] is, I think, a really important sort of perspective. And then in turn, they [preservice teachers] are either motivated to use that [digital technology] or not based on *their experience* [emphasis added]

Pat furthered that thought, saying that preservice teachers "will use the things that they found worked for them and were a positive experience." In addition to providing preservice teachers

with time and opportunity to use digital technology in physical education, teacher-educators emphasized the importance of qualitative reflection being a part of exploration. The significance of reflection and meaningful digital technology integration is described in the next section.

4.2.2.2 Encouraging Reflection.

Reflection can be described as critical analysis of what a person is doing or processing with consideration of how their context and beliefs are impacting the development of their understanding (Kelchtermans, 2019; Kelchtermans, 2009). Teacher-educators in this study demonstrated three main ways of using reflection as a strategy for meaningful integration of digital technology. One way is by having preservice teachers encourage their students to use reflection, along with the quantitative feedback provided by fitness trackers, to assess how they felt during physical activity and add meaning to the quantitative data the digital technology provided. The second way is using digital technology as the reflection tool; this engages 'digital age' students in completing reflections on physical activity and provides preservice teachers with student feedback data that can be easily organized and tracked to further insight as to how the day's physical activity affected their students. The third way teacher-educators mentioned to use reflection was to have preservice teachers reflect on their use of digital technology in class, asking themselves such questions as was it meaningfully integrated and how did the integration the physical education provided.

The first example of reflection comes from Pat who talked about the importance of qualitatively analyzing the quantitative information provided by digital technology. Pat commented on tracking devices and how they provide a quantitative value and that to have that quantitative value provide meaning for students, the students need to include a qualitative assessment of their experience. Pat explained this by saying "So if we're going to use that

[iPhone] as a tracking device … I think we have to also integrate the qualitative value by asking for some sort of a reflection on the qualitative experience of it." Pat then provided the example of preservice teachers using digital tracking devices with elementary students and that preservice teachers need to consider the following:

> if we [teachers] say that our goal for the day is ten thousand steps, which is the quantitative value … we have to integrate - Who did you do it with? How did it feel? How would you do it differently next time to make it feel better? …so that there's still the reflection aspect.

This statement from Pat shows how teacher-educators are assisting preservice teachers to integrate digital technology in a meaningful way by helping students realize and understand how physical activity is impacting their lives. Pat surmised that a "combination of the two [quantitative and qualitative]" could be "the best of both worlds because it asks the students to make it more than just obtaining a quantitative value." During class observations, Pat used digital technology for the reflective purpose of helping preservice teachers deepen their understanding of their own learning experience with physical activity. Pat had preservice teachers answer reflective questions in Canvas; such as, "identify a sport or recreation activity that you consider yourself to be at the autonomous stage and how long it has taken you (in years) to get to this stage." This example shows how Pat used digital technology in a way that assisted preservice teachers to deepen their understanding of their own physical activity development.

Paul commented on reflection being key in promoting student understanding of the importance of physical activity and identified that digital technology can be a tool that engages 'digital age' students to qualitatively reflect. He said that reflection:

> … is something that the technology can really, really help with. And even little things like, for example, exit tickets leaving the classroom, you can have an iPad as everybody's leaving. And then they put in a little bit of score, a score into a Google sheet or something like that. So immediately recorded, time stamped and then you're able to reflect back on what were their good days, and were their bad days?

Paul used this example to demonstrate how digital technology can be used to help students identify the emotions they have connected to physical activity. During class observations, Paul had preservice teachers fill out surveys, which gave the preservice teachers the opportunity to reflect on their emotions connected to a class in which digital technology was incorporated to record movement. This survey also provided useful information to assess the impact of the lesson and resources used. Paul said that teachers can easily analyze reflections entered on iPads due to the flexibility of analysis that digital technology affords, such as grouping data in various ways for increased understanding. For example, Paul said the teachers may group responses that indicated student opinion on competitive games and determine "Well, they didn't like the competitive aspect of this game … maybe I can tailor it to be a little more cooperative to begin with and then we'll kind of work our way forward." Paul's statement indicated encouraging the preservice teachers to use their students' reflections to inform and adjust class physical activity responsively in ways that will encourage more students to be active and enhance future physical education. Paul added that this type of reflective feedback has the dual purpose of being helpful to teachers in assessing if their integration of digital technology was beneficial; he highlighted the self-reflection piece, saying that the teachers themselves can use digital technology to show "some of that self-reflection as far as why am I doing what I am doing right now?" Paul said he prompts preservice teachers to think about "What are some other ways that you could see this

[digital technology] working" and that he encourages preservice teachers to discuss how the digital technology was used and could be used in the future. He has preservice teachers "go out with partners and implement it [digital technology] in a different way or represent this however you like, and then they can come back and share with the group. Oh, you did this and I did this. My plan was a really great idea. And then have a bit of a reflective conversation" to deepen learning. Pat also talked about the importance of preservice teachers reflecting on the tools they are using. She said that she has preservice teachers "really reflect on their experiences so that they know what's their default" and that teachers can have a "tendency to really be in that comfort zone." But that as "leaders, they may need to come out of their comfort zone so that they can effectively create an optimal learning environment for everyone."

Teacher-educators are using reflection as a main strategy to assist preservice teachers with digital technology integration into physical education. Teacher-educators highlighted that reflection is needed to help students meaningfully understand the quantitative data provided by fitness trackers. In addition, using digital technology as the tool for entering reflections engages 'digital age' students and provides data that can be easily grouped in different ways by preservice teachers to deepen their understanding of the student's reflections on physical activity. Further, preservice teachers are being taught to reflect on their own use of digital technology to ensure digital technology is being integrated meaningfully and is adding to a positive learning environment. Using reflection to further understand digital technology integration helps teachers to grow with an education system that is evolving rapidly in this digital age. Growing with Evolving Education is the third and final theme.

4.3 Theme 3: Growing with Evolving Education

Beyond the walls of the classroom and social relevance are the categories that formed from the data and from which the third theme, Growing with Evolving Education, emerged. Teacher-educators identified that helping preservice teachers consider the importance of how their future students' education will impact them beyond the walls of the classroom and facilitating preservice teachers' understanding of the significance of providing a socially relevant education, to be both vital components of supporting preservice teachers to integrate digital technology effectively into physical education and to grow with an ever-evolving education system.

4.3.1 Beyond the Walls of the Classroom

The category of Beyond the Walls of the Classroom emerged from the codes of Empowerment and Engagement. Teacher-educators highlighted that preservice teachers using digital technology to engage students in physical activity during school hours can empower students to take more responsibility for their own physical activity and be more engaged in physical activity both during class time and beyond school hours.

4.3.1.1 Empowerment & Engagement.

Teacher-educators described student empowerment and student engagement concurrently, as such the data for empowerment and engagement are presented together in this section. In this study, the conceptualization of empowerment that will be used is the act or action of helping someone feel like they are capable agents and have some control over what occurs (Avelino et al., 2019); in addition, empowerment includes people being able to set goals and take responsibility towards achieving those goals (Cattaneo & Chapman, 2010). Teacher-educators found empowerment and engagement to be closely connected and determined that empowering

students fosters student engagement. The description for engagement that is going to be used for this study is that engagement includes both getting and holding someone's attention and inducing participation (Merriam-Webster, 2022). Teacher-educators described how digital technology can empower students to take responsibility for their own physical activity and can engage students in physical activity both in the classroom and beyond the walls of the classroom.

Peter shared the following thoughts on how digital technology can empower students to take more responsibility for their own physical activity:

> … a lot of technological advancements have given us opportunity, especially to measure cardio capability. And that is a significant measure of fitness, also other aspects of strength, endurance, flexibility. Those things can also be measured with technological adaptations. And so those things can quickly, again give students feedback as to where they stand and what they need to do to improve. And like I alluded to earlier, the piece about giving the student, empowering the student with information and then the student using that information to set personal goals and adapt their movement skill to improve their performance is really critical.

Peter went on to say that empowering students by giving students control of their information increases their engagement. Peter stated that "all of a sudden, students are more empowered about their learning and they realize the why they're doing something and the value of what they're doing. And so it increases their engagement."

Paul shared an example of students being empowered and engaged by digital technology, "the idea of having students track on Strava, like the school run that you're doing, instead of you [teachers] there with the stopwatch, can be a really cool initiative …And then they [the students]can track their performance of different segments and gives them a much better idea of

how they're performing over time." Paul also described how digital technology empowers students to analyze their own physical movement, and commented that students analyzing video of their own physical movement can help "them identify autonomously what they're going to be looking for and what happened. So that's something that I think digital technology does exceptionally well."

In addition, teacher-educators identified that digital technology further empowers and engages students by allowing them to connect with course content outside of class time and facilitates learning beyond the walls of the classroom. For example, Paul talked about preservice teachers being able to connect with PE course content outside of the class through using a PE Instagram page:

> I think, again, that [having a PE Instagram page] would just be a cool way to reinforce some of what's covered in physical education class . . . you run into a situation where in class you go in, you do your thing and then you leave, and you never think about it until the next time that you're in class. So, there isn't much homework that a lot of people give. So if you're able to reinforce that in any way, any type of multimedia, then chances are students are going to be more primed to perform when they come back in.

Peter stated that "[digital technology] improves engagement levels" and made the following comment on how digital technology can engage students in physical activity beyond school:

> And I think technology definitely is a method that can be utilized to capitalize on involving students to a significant degree. One of the things with technology is that it can be it can be used in a classroom, but it can also be used to connect away from classrooms like we were talking earlier. And so students can go out into the community, into their

> own environment. They can use it [technology] as part of their own personal activity involvement away from school.

Further, Pat highlighted how digital technology can empower and engage students in physical activity beyond the classroom by allowing them to compare themselves with their own performance and not be compared to others in the class. Pat identified that preservice teachers can encourage "[physical activity] outside of the classroom, if that is the case, can be done digitally…if we're encouraging regular activity then that also needs to be done outside of the classroom, and, you know, here [digital technology] is a way that students could track and watch their own progress." Pat highlighted the additional benefit of students being able to "watch themselves progress and improve based on their performance as opposed to someone else's performance. Now we are having them take responsibility for their own engagement in the activity."

Teacher-educators made it clear that digital technology can support physical activity empowerment and engagement outside of the classroom and that educating students to engage in physical activity daily and in various environments is the point of physical education. Paul said that "in my opinion, I would say that the elementary school physical education needs to be reformed a little bit moving forward and just have a … a little bit more availability." Paul commented that "the whole goal of physical education is to create individuals who are wanting to sustain that exercise, who are wanting to continuously exercise." Peter also highlighted the importance of PE fostering lifelong engagement in physical activity, Peter stated that the goal of physical education is

> Not only to encourage physical activity three or four times a week in physical education classes… but to encourage kids to be involved in movement all the time, seven days a

> week with their families, with their friends out in nature and out in the environment. And so I think a very effective and astute instructor can have tools at their disposal to engage students beyond the walls of the classroom.

During class observations, teacher-educators used digital technology to enhance engagement with physical activity course content; for example, teacher-educators provided preservice teachers more with responsibility through having course content and additional resources flexibly available on the course LMS. As mentioned earlier, during class observations, teacher-educators also provided preservice teachers with online breakout rooms, where the preservice teachers could go as a small group, converse together, access the resources online and develop lesson plans to promote physical activity. Having resources available through digital technology also meant PE course materials were available outside of class time; this empowered students by giving students control over how and when they accessed and assimilated course content. In addition, during class observations, teacher-educators used digital technology such as videos, images, and music to foster preservice teachers' engagement with and understanding of promoting physical activity. Teacher-educators revealed during interviews that when classes are delivered face-to-face, they have preservice teachers record other students' movements and are then able to assess FMS and use digital technology to provide feedback to students on correct movement patterns. During class observations, Peter used video found on YouTube to show students varying abilities/levels and approaches to creative movement, which increased preservice teacher understanding and engagement. The students were encouraged to actively engage in discussion and share ideas for their lessons. Pat displayed images of people engaging in physical activities throughout the duration of her lecture to encourage physical activity. In addition, Pat used google docs in student assignments so that preservice teachers could connect

collaboratively at any time to plan their physical activity lessons. Paul used digital technology during his class to have the students take photos of themselves, analyze their balance poses, and share these poses with the rest of the class; this helped preservice teachers to analyze how well they were executing poses and normalized the various levels of physical ability, which appeared to empower preservice teachers through increased confidence.

Teacher-educators identified that digital technology could empower and engage students by supporting them to connect with course content beyond the walls of the classroom. In addition, teacher-educators noted that digital technology can empower students to take more responsibility for their own physical activity through providing feedback on their individual physical performances and through providing students with guidance on how to develop their physical abilities. Teacher-educators also identified that for education to continue to grow and evolve with societal expectations, educators need to make a point of staying socially relevant; social relevance is discussed in the next section.

4.3.2 Social Relevance

Helping preservice teachers to understand the importance of keeping education socially relevant was identified by teacher-educators as a significant component of supporting preservice teachers to integrate digital technology into physical education. Teacher-educators highlighted that students will connect better with their education if they feel it is socially relevant. Pat noted that it is the responsibility of teachers to ensure their students connect; Pat commented that “it's on you as the as the leader, as the educator, you know, you've got to figure out a way to connect.” Teacher-educators described collaborative learning and socially responsive growth as ways to keep education socially relevant.

4.3.2.1 Collaborative Learning.

Teacher-educators talked about the importance of preservice teachers learning from and with each other in this fast-paced technological world. Collaborative learning in the form of peer-to-peer learning was identified as an effective strategy to help students efficiently increase their understanding of digital technology through the synergy of shared learning. Paul highlighted using peer-to-peer learning when he said, “we can't realistically expose them [preservice teachers] to … every single type of tool that's out there, we can expose them to some of the things that we used in the past and then brainstorm as a group.” Paul also mentioned collaborative learning when he said, “I think the best way to actually show that [digital technology being beneficial in physical education] to the teacher or to the future teachers in the classroom would be just show them examples of what we can possibly achieve there [with digital technology], even if it's a small example, and then *chat about it* [Emphasis added].”

In addition to collaborative peer-to-peer learning occurring through observation of digital technology and subsequent group discussion of how it can be used, teacher-educators also identified peer teaching as a means of effective learning. Pat identified peer teaching as advantageous because “Instead of being top down, having more of a peer-to-peer type of instruction may hit that intrinsic motivation button.” Teacher-educators used video analysis as a way to provide preservice teachers more experience with digital technology as well as a means to support collaborative learning by having preservice teachers assess their own and their peers’ teaching styles. For example, Peter described an activity in which he has preservice teachers teach one another FMS, which is then videotaped for the preservice teachers to critique their own learning and their peers. Peter said the preservice teachers “take turns teaching their peers and

going through all the steps of executing and delivering an effective lesson plan that has learning objectives."

This use of digital technology assists preservice teachers to hone their teaching skills that facilitate physical education and provide preservice teachers with an example of how digital technology can be used by students for self and peer analysis.

Paul also commented on the benefit of using digital technology (specifically video analysis of how preservice teachers are teaching movement) for peer learning:

> … it's a peer coaching, peer teaching opportunity because you have to have someone else there and then you can brainstorm what you're looking at. And so that's something that I've used in the past. And I use it in my pre-service teaching courses.

Peter further emphasized peer learning being beneficial when he stated that "teamwork and peer assessment from one student to the next is a powerful learning tool." Overall, teacher-educators found that having preservice teachers engage in peer-to-peer learning was an effective social approach that synergistically exposed them to various digital technologies and supported social relevance through the sharing of multiple and diverse perspectives. During class observations, teacher-educators had the preservice teachers work in groups to brainstorm ideas and plan lessons together.

Collaborative learning emerged as a means of keeping education socially relevant. Teacher-educators found that peer-to-peer learning supported preservice teachers to stimulate learning through exposing them to various perspectives and ideas. Socially responsive growth was also found to be significant in keeping education socially relevant and is described in the next section.

4.3.2.2 Socially Responsive Growth.

Teacher-educators highlighted that integrating digital technology into education is a complex and somewhat daunting task. Teacher-educators also noted that digital technology is fully integrated into society and that digital technology integration in education is necessary to keep education relevant. Peter articulated this perspective when he stated that "it [digital technology] is such a huge part of our world, and we need to incorporate it into our educational experience for children" and that "we're [educators] often slow to change and the world around us isn't slow to change. It's changing so rapidly and we need to be renewing our content of our courses more regularly to keep them relevant."

Teacher-educators acknowledged that integrating digital technology will come with challenges, but that to keep the education they provide to preservice teachers, and subsequently the education preservice teachers provide to their future students, most effective, teacher-educators will have to brave the challenges that come with digital technology integration. Pat commented on teachers tending to want to stay in their comfort zone and how important it is to break out of that comfort zone and evolve with education. She highlighted that "Outside comfort lies great opportunity." Paul shared his thoughts on integrating digital technology stating that "breaking that [digital technology] barrier is really important for us as educators because, you know, you're going to have to deal with it eventually. That's where everything is going." And Peter concluded:

> … as instructors, we need to champion methods that will help our students get there … I think the thing with technology is that our students quickly gravitate to that. Their life is consumed with technology. And so, to avoid having technology in our courses, we're avoiding something that they are very familiar with.

Paul noted that taking on the challenge of integrating digital technology into education will "open up some new doors that we didn't necessarily have access to before." However, the vast amount of digital technology and how rapidly digital technology changes causes digital technology integration into education programs to be viewed with trepidation. Peter acknowledged this and suggested a planned approach to integration. Peter stated that "having a planned approach to having a technological component to physical education, I think that is a wise thing for preservice programs to consider." Then Peter went on to acknowledge that he finds integrating digital technology into PE challenging and even though he had started to integrate digital technology into preservice teacher education he found that he would like to adopt digital technology more fully. Peter stated that "a weakness in my course at this present time is that I have not adopted a lot of other technological aspects." Peter went on to say that

> ideally going forward, as a result of participating in your study, the use of technology in education could be a lecture topic on its own to be added into the course. And so, I can clearly see the value of that being a part of the course on teaching physical education is that instructors would have a section, or assignments related to the use of technology.

Teacher-educators commented that preservice teachers and Education programs need to respond to the prevalence of digital technology in society and be open to integrating digital technology into education. Paul said that teacher-educators need to instill with preservice teachers the passion "to grow and to develop an understanding that teaching is absolutely something that you're going to continue developing for your life" and that "they're [preservice teachers] going to have so many different realms and areas where they can implement technology effectively." Peter noted that regarding "the importance that technology can play in the educational environment" that the "mark of a master teacher is that they explore all kinds of

different methods and ways to work with students, to engage learning, to motivate students to make application practical and relevant."

Responding to and growing with evolving education was determined as significant by all teacher-educators, both for their own growth as preservice teacher educators and as role models to encourage responsive growth in preservice teachers. Peter concluded that "it's easy to keep the contents of your course similar from year to year, and it's important to expand one's horizons, to include more relevant topics that meet the needs and demands of education today."

Teacher-educators highlighted that responding to what is occurring in society helps to keep education relevant. Further, teacher-educators noted that digital technology is fully integrated into society and that this needs to be reflected in education to keep education relevant. This means that teacher-educators need to actively work at being comfortable with integrating digital technology into their courses and assisting preservice teachers to do the same.

4.4 Chapter Summary and Chapter 5 Preview

Chapter four presented the findings from this case study exploring how teacher-educators are supporting preservice elementary teachers to pedagogically integrate digital technology into physical education. The chapter was organized according to the three themes that emerged from data analysis, which were: recognizing factors impacting digital technology integration; fostering pedagogical digital technology integration; and growing with evolving education. The findings from this case study are discussed in connection with relevant literature in chapter five. In addition, chapter five shares some implications of these findings for both practice and theory. As well, recommendations that support the preparation of preservice teachers to integrate digital technology are shared and potential future research ideas are put forth that could add meaningful

empirical data to further increase understanding of how to pedagogically integrate digital technology to achieve specific learning outcomes.

Chapter 5: Discussion

This study explored the perspectives of teacher-educators on how they're supporting preservice elementary teachers to pedagogically integrate digital technology into physical education. The themes elucidated through inductive thematic analysis have been presented in chapter 4. In this chapter, these themes are discussed in relation to the theoretical foundations of the study and the literature presented in chapter two.

The theoretical foundations for this research study rest with Mishra and Koehler's Technological Pedagogical Content Knowledge (TPACK) framework (2006) and social constructivism (Vygotsky, 1978). The findings from this study build upon these foundations. In this section the ways that this study built upon these foundations will be explored. It is important to note that Mishra and Koehler explain TPACK as existing in a state of dynamic equilibrium and changes in any one knowledge area effects the other two, but for the purpose of analysis the knowledge areas can be considered separately.

This study provides empirical evidence for the TPACK framework (Mishra & Koehler, 2006) in that teacher-educators repeatedly expressed their need for support both from their universities and through the structure of their education programs to develop their technological knowledge (TK), technological content knowledge (TCK), and their technological pedagogical knowledge (TPK). These needs are indicated in theme 1a of the findings that focuses on the external factors that impact digital technology integration, discussed in detail in section 5.1.1 of this chapter (p.141).

The need to focus on pedagogy emerged as a key consideration of this study. Data analysis revealed that teacher-educators believe fostering pedagogical integration (Theme 2) is an important part of preparing preservice teachers to integrate digital technology into physical

education. Looking through the lens of TPACK, this focus aligns with the need for technological pedagogical knowledge. In addition, it aligns with Casey et al.'s (2017b) vision to develop "theory-grounded and practice relevant pedagogies of technology to inform the ways" teachers use technology in physical education (p. 2), and goes further to conceptualize integration itself as pedagogical in the concept "pedagogical integration of digital technology"; this conceptual phrase is used to indicate the process of digital technology being integrated into education with consideration of the learners' learning, the teachers' teaching, and the sociocultural context in such a way that the integration of digital technology effectively addresses the desired learning outcomes (as discussed in section 5.2, p. 151, of this chapter).

From the Vygotskian perspective, teacher-educators and their preservice students construct learning together through social interactions (Vygotsky, 1978). Teacher-educators facilitate preservice teachers' learning by designing learning opportunities at the outer edge of their zone of proximal development (ZPD) scaffolding them to extend their learning. More recent interpretations view Vygotsky's (ZPD) as symmetrical, just as students learn, teachers can also learn (Roth & Radford, 2010). Fostering pedagogical integration (Theme 2) is supported by teacher-educators having the willingness to vulnerably explore digital technology integration alongside their preservice teacher students as facilitators of learning rather than experts in a top-down approach. This changing role of teacher-educator from content expert to facilitator was a key finding of this study. In the 21st century, with the internet being the main keeper of information, the role of the teacher is changing from content keeper to that of facilitator (Churcher et al., 2014). It was found that teacher-educators would benefit from learning to vulnerably embrace a facilitator rule and introduce digital technologies with even a limited understanding of the technology. In other words, teacher-educators could let go of that ingrained

feeling of needing to be the content expert when it comes to technology, as knowing the specific details and all the in's-and-outs of various technologies is not needed and is intimidating due to the rapid rate of change of technologies. This is aligned with more recent interpretations of Vygotsky's Zone of Proximal Development that sees learners learning alongside teachers. Kadri et al. (2017) discuss how their case study found that learning occurs for both participants in the relation between the preservice teacher and the teacher-educator; both learn through their interactions.

The feeling that teacher-educators may have, of needing to be an expert in technology may impede the introduction of digital technologies into teacher education. Rather, teacher-educators can learn to embrace the social constructivist approach and foster collaborative learning amongst the students (Barak, 2017) through embracing the facilitator role and exploring pedagogically integrating digital technology together. This perspective may be different from the TPACK perspective which would envision technological knowledge as a requirement.

Finally, and perhaps most importantly this research study emphasizes the sociocultural context of learning (Vygotksy, 1978). Koehler et al. (2014) indicated that there was a need to focus on the social context of the TPACK model. This research study emphasizes this need by highlighting that teacher-educators and their preservice teachers' students must constantly grow and evolve their practices of digital technology integration into education (Theme 3b, Social Relevance), to remain socially relevant in this ever-changing digital age.

The next section of chapter five further discusses the three themes of chapter four in relation to the literature discussed in chapter two.

5.1 Theme 1: Recognizing Factors Impacting Digital Technology Integration

External and internal factors were identified by teacher-educators as influencing their ability to prepare preservice teachers to pedagogically integrate digital technology into physical education. This is congruent with the study conducted by Wyant et al. (2015) in which first order (external) and second order (internal) factors were found as having a significant impact on the integration of digital technology into physical education.

5.1.1 External Factors

University resources were a key external factor that teacher-educators identified as impacting their ability to support preservice teachers being prepared to pedagogically integrate digital technology. The university resources that the teacher-educators highlighted as specifically impactful on technology integration were funding for digital technology [both hardware (equipment) and software (such as apps)] and subsequent potential access inequities, and support being available for digital technology integration into courses to meet student' needs and achieve course goals.

Teacher-educators bringing forth that funding can be a barrier to digital technology integration is consistent with Baek et al. (2018b) who noted that limited budgets are a barrier to teachers integrating technology. Having adequate access to resources is a significant factor in preservice teachers being prepared to use digital technology in their future classes (Tondeur et al., 2012; Tondeur et al., 2019). In this study, teacher-educators highlighted that due to restricted budgets preservice students are expected to have their own technological devices for use within courses. With limited budgets for technology and therefore limited access to technology being a concern, it is important to highlight that teacher-educators found that the majority of their students do have mobile devices and are competent using their devices as part of their learning.

This is consistent with Krause at al. (2020) discussing the ease of mobile device use within preservice education, who found that the "functionality, familiarity, and connectivity of mobile devices lend themselves to easily integrate across a wide range of preservice teacher learning experiences" (p. 250). It is also important to note that mobile devices are becoming more common place with younger students, Austys et al. (2020) found that an increasing number of elementary students are using cell phones. Therefore, the dependence on students to bring their own devices (BYOD) is starting to become an accepted and expected part of education.

However, it was highlighted by teacher-educators that despite most students having their own devices, there are still issues at times around having enough digital technology in their courses for preservice teachers to learn how to use digital technology effectively. Further, teacher-educators noted that because preparing preservice teachers to use digital technology is now a mandated part of their education (Government of British Columbia, 2023a), teacher-educators must advocate for all of their students to have equitable access to digital technology. This aligns with Foulger at al. (2017) identifying that it is the responsibility of teacher-educators to provide their students with equitable technology experiences. Teachers-educators agreed that advocating for sufficient budgets was necessary even if students have their own devices so that they can continue to advance digital technology integration in their classes and provide optimal education for their students.

In addition to adequate budget being needed for technological hardware such as digital technology equipment, teacher-educators noted that funding for software, such as access to relevant apps, is significant for 21st century teacher preparation. This is consistent with Mishra & Koehler (2006) who found that teachers need to have access to hardware and software to effectively integrate digital technology for building their technological knowledge (TK) and

technological content knowledge (TCK). Teacher-educators noted that in all levels of education having technology equipment available with support for how to use relevant apps is needed. Gal et al. (2018) stress the benefits of apps and note that advancements in physical activity apps have created new opportunities to increase physical activity and have been associated with increased motivation and engagement in physical activity.

Teacher-educators indicated that apps were expensive, and this was a potential barrier to integration. Although, as indicated by Wyant and Baek (2019), there are many free and low cost apps available. Teacher-educators shared that they need to be aware of the low-cost options and frame digital technology integration as budget-friendly in order to garner support from programs. However, even with low cost options being available, it takes time to find and integrate appropriate apps; in this study, teacher-educators indicated that it takes a great deal of time to find apps that are open source and relevant and that the time involved to find appropriate apps can be a barrier. Polly et al. (2010) suggested that program structure can provide support to minimize such barriers. This can be achieved through funding and integration support by making technology integration a priority for the Education program as a whole and taking a team approach to integration rather than structuring programs so that technology integration is the responsibility of each individual teacher-educator (Polly et al., 2010).

Teacher-educators in this study noted that currently integration at their universities is left up to the individual or faculty members forming groups on their own; they shared that more support being provided from their universities on *how* to integrate technology into their courses would be helpful. As Paul stated, “right now, I feel it's largely more or less the individual instructors going forward and trying to find their own [way]” (p. 86). Teacher-educators acknowledged that there is IT help at their universities with how to use LMS in their courses;

however, there is not support for pedagogically integrating digital technology into their courses, such as identifying which apps are relevant, and how to integrate technology and specific apps into their courses to meet students' needs and achieve course goals. This aligns with findings from other studies that identified that there is technological support provided for teacher productivity such as management of course content, but that support was lacking when it came to integrating technology with a focus on student' learning (Baek et al., 2018b; Krause et al., 2017). Baek et al. (2018b) highlight that within teacher education programs the focus tends to be technocentric (functions and operations of the technology) rather than a focus on pedagogical integration. Successful technology integration needs to have support for both technical and instructional purposes (Tondeur et al., 2012).

Although teacher educators in this study found university support could be strengthened, they did find meaningful support through collaboration with their colleagues and found this collaboration to be extremely helpful. Prior studies have indicated that colleague collaboration is an important part of successful technology integration (Tondeur et al., 2019; Uerz et al., 2018; Wyant & Baek, 2019). In this study, teacher-educators noted that collaborating with colleagues can significantly help teacher-educators understand how various technologies can be relevant to their teaching. For example, Peter indicated that "collaboration with other instructors is really important… I've had numerous discussions with a couple of other colleagues regarding teaching pedagogy and the use of technology" (Findings chpt. p. 87). and Paul shared that "collaboration with my colleagues" to be "the most valuable kind of technological support" (Findings chpt. p. 87). This is consistent with Uerz et al. (2018) who found that teacher-educators who had help from colleagues felt more comfortable with using digital technology and had a better understanding of how digital technology fit into their "pedagogical context."

Teacher educators highlighted whole departmental support to be important with technology integration. For example, Peter noted that his faculty had "meetings as a department on how we could learn from one another" (Findings chpt. p. 87) and that his faculty was able to "assist one another with drawing on each other's backgrounds and experience in technology" (Findings chpt. p. 87). Paul emphasized the benefits of educational institutions planning departmental professional development days so that the instructors can learn from each other and share their understandings. Paul commented that "the more people that we expose it [digital technology] to, the cooler, different ways, creative integrations into the course content we can find" (Findings chpt. p. 88). This is consistent with Krause et al. (2020) highlighting that programs are not providing enough support for discipline specific technology integration and that professional development is a needed and meaningful way universities can provide support for technology integration. Tondeur et al. (2012) conducted a meta-ethnography study that reviewed 19 articles and found that teacher-educators find support through activities in which they can consult with one another and share information. Although this study by Tondeur et al. was completed in 2012, it remains relevant to more recent contexts, as indicated by its citation in over 650 publications since 2020.

Having a departmental team approach to technology integration can be a beneficial part of the program structure (Tondeur et al., 2012); a departmental approach helps programs to weave technology throughout the curriculum. However, many programs do not take a departmental approach and instead offer one course that focuses on technology integration. The study conducted by Wyant et al. (2015) found that a stand-alone technology course did help preservice teachers to build technological knowledge. However, Bakir (2016) found that the stand-alone course approach does not provide enough support for preservice teachers to learn

how to integrate technology throughout their courses in teaching methods in different subject areas. Further, Krause et al. (2020) found the reliance of Education programs on an isolated digital technology course does not work and encourages teacher-educators to rely on that course rather than include a focus in their own courses on digital technology integration preparation. This aligns with the findings of this study as when teacher-educators were asked about technology integration in their courses they highlighted how students are supported to integrate digital technology in their program's focused digital technology course.

Another external factor that was found in this study to impact teacher-educators supporting preservice teachers to integrate digital technology was sociocultural influence. With the prevalence of digital technology in society, there is an expectation that teacher-educators will prepare preservice teachers to integrate digital technology into their future classrooms, so that K-12 teachers will be able to effectively prepare their future students to learn and work in the 21st century (ISTE, 2023). In addition, ISTE (2023) puts forth that it is the expectation of teachers that they will be preparing their students to contribute and participate meaningfully in our digital world. Teacher-educators in this study shared feeling pressure to keep up with rapidly changing technology and be able to prepare their students to teach in the 21st century. For example, Paul commented that preservice teachers are going to be expected to have a certain level of technological competence; therefore, if teacher-educators are "behind the times in that realm, you're not actually serving your students to the best of your abilities" (Findings chpt. p. 90). Peter shared that technology is changing rapidly and teacher-educators are "faced with so many other demands and we're pulled in so many other directions that it can be easy to not stay current from a technological perspective" (Findings chpt. p. 91). Teacher-educators in this study identifying feeling pressure to keep up with technology and needing more university support is

consistent with current research. The Tondeur et al. (2012) meta-ethnography found that educational institutions play a main role in setting the necessary conditions for teachers to be able to support the preparation of preservice teachers to integrate digital technology; the importance of institutional support is also highlighted by Tondeur et al. (2019) who note that institutional level factors, such as "access to resources" and "technology planning" need to be acknowledged to support teacher-educators in their task of preparing preservice teachers to integrate technology. Further, O'Neil and Krause (2019) found that universities need to provide support for teacher-educators because teacher-educators "must be the focus for changing the landscape of educational technology knowledge and skill construction and future implementation in K-12 schools" (p. 1292). With teacher-educators being identified as foundational to digital technology integration into education, the factors that impact their ability to do so must be addressed. In this section, external factors found in this study were discussed within the literature. In the next section, the internal factors that teacher-educators identified will be contributed to the discussion on teacher-educators' role in preparing preservice teachers to integrate technology.

5.1.2 Internal Factors

The internal factors identified in this study as impacting teacher-educators' preparation of preservice teachers to integrate digital technology were teacher educators' beliefs about physical activity and digital technology, their willingness to vulnerably explore digital technology and their ability to embrace the facilitator role. As discussed at the beginning of this chapter, recent interpretations of Vygotsky's Zone of Proximal Development see learners learning alongside teachers, both at the outer edge of their zones of proximal development (Kadri et al., 2017).

Internal factors impacting technology integration also align with TPACK. The findings from the Wyant et al. (2015) study in which the internal factors of beliefs and confidence were found to impact technological knowledge (TK) and therefore digital technology integration. The finding of personal beliefs impacting teachers' integration of technology is also consistent with a study by Baek et al. (2018b) in which they found that personal beliefs such as self-efficacy play a significant role in technology integration and can be a barrier to technology integration. They discuss this in relation to TPACK explaining that personal beliefs can be "second-order barriers" to developing technological knowledge TK and integrating digital technology (Baek et al., 2018b).

Teacher-educators in this study were all physical education teacher-educators and shared the belief that preparing preservice elementary teachers to promote physical activity is of utmost importance. This belief fostered a desire within them to optimally prepare preservice teachers to promote physical activity with their future students. In addition, the teacher-educators' in this study were found to hold the perspective that digital technology is the way of the future and is an effective tool in physical education. For example, Peter stated, "our world has become a digital world" and technology is a "tool that can be used in many helpful ways. It [digital technology], I believe, it can encourage movement and learning of skills" (Findings chpt. p. 94). The belief of technology being a beneficial means to promote physical activity resonated with current literature in which digital technology has been found to increase student engagement and motivation (Casey et al, 2017a; Parker et al, 2017; Krause et al., 2020; Szymkowiak et al., 2021). In fact, Ertmer and Ottenbreit-Leftwich (2010) boldly propose that "teachers' mindsets must change to include the idea that "teaching is not effective without the appropriate use of

information and communication technologies (ICT) resources to facilitate student learning" (p. 255).

What teachers believe about technology impacts the degree to which they integrate it into education (Tondeur et al., 2019; Uerz et al., 2018). As noted, teacher-educators in this study believe that digital technology can be an effective tool to promote physical activity, which encouraged and motivated them to integrate digital technology into their physical education lessons. However, their belief in their own ability (self-efficacy) to use technology well also impacts the degree to which they integrate technology into their lessons. Bandura (1997) highlighted that beliefs about one's self-efficacy influence the degree to which a person engages in any given behavior or task. For two of the three teacher-educators their belief that their ability was lacking limited their technology integration. Peter observed that his own ability with technology is a barrier and noted that technology integration by teacher-educators is impacted by their expertise and comfort level. This is consistent with the findings by Tondeur et al. (2019) who determined that teacher-educators' beliefs in their own technological ability impact the degree to which they integrate technology into educational experiences.

The findings of this study suggest that teacher-educators willingness to vulnerably explore digital technology in the presence of their students and fully embrace the facilitator role may help prepare preservice teachers to pedagogically integrate digital technology. Teacher-educators in this study demonstrated vulnerability when they integrated digital technology into their courses even though they did not feel comfortable demonstrating technology integration; they still did so because they thought it would benefit the preservice teachers. The teacher-educator in this study who displayed high self-efficacy with digital technology integration also showed vulnerability when he indicated that a lot of his technology integration into courses has

been “trial and error” and that regarding digital technology teacher-educators should “try new things and it might not always work. And that's totally fine” (Findings chpt. p. 98). Paul’s statement makes the point that teacher-educators do not have to feel totally secure with digital technology to integrate it into courses. As noted in chapter four, vulnerability is defined as “uncertainty, risk, and emotional exposure” that definition extends to include that “vulnerability is not weakness, it's our most accurate measure of courage” (Brown, 2017, p. 154). Casey et al. (2017a) indicate that vulnerability is part of integrating digital technology when they challenge teachers “to be brave enough to enter the digital worlds of their students to fully grasp the sheer power and pervasiveness of the knowledge and processes that are freely available” (p. 251).

However, even though teacher-educators integrating digital technology into their courses may require a certain degree of vulnerability, teacher-educators in this study felt they needed to have a competent amount of technological knowledge and experience to productively explore digital technologies in their classes and effectively facilitate pedagogical integration. Two of the three teacher-educators participating in this study felt that they needed more technological experience to be able to optimally facilitate their preservice students’ integration of technology. The literature review conducted by Uerz et al. (2018) that found many teacher-educators are lacking necessary technological experience to facilitate preservice teachers learning and that professional development provides increased technological knowledge and experience and improves teacher-educators confidence with technology integration. This is similar to the findings of this study as teacher-educators felt that building their technological experience would be beneficial to them being able to support preservice teachers learning to integrate digital technology and specifically indicated that professional development days would be helpful. Teacher-educators in this study supported preservice teachers by vulnerably exploring

technology in the presence of their students and by embracing their role as facilitators of learning. Current research acknowledges that there is bravery needed to venture into the digital world that continues to change rapidly, preventing the security that was provided from the transparency of slower changing educational technologies (Casey et al., 2017a; Mishra & Koehler, 2006). However, vulnerable exploration adds to current research as current research encourages teacher-educators to have knowledge of the technology before entering the classroom but does not include the pedagogical approach of teacher-educators learning digital technology during teaching preservice teachers. The findings of this study found that teacher-educators lack of knowledge of technology and having time to learn technology restricted the amount of technology they introduced. This researcher is suggesting that if the teacher-educators felt more supported to building their technological experience alongside their students, there may be more integration of technology into preservice teacher education. Therefore, the findings of this study suggest that the pedagogical approach of learning technology alongside the students, may foster greater technology integration into education. In addition, digital technology provides students with more autonomy in education and evolves the role of the teacher more fully into the role of facilitator (Churcher et al., 2014; Cicconi, 2014). The second theme that emerged from the findings of this study was the importance of fostering pedagogical digital technology integration, which is discussed in the next section.

5.2 Theme 2: Fostering Pedagogical Digital Technology Integration

"*The concept of teaching and learning through the use of technology is highly complex, and the introduction of technology into a learning environment does not, in and of itself, reflect pedagogy or bring about change in pedagogical practice*" (Parker et al., 2017, p. 41).

In this study, findings indicated that preparing preservice teachers to pedagogically integrate digital technology was of utmost importance. As noted in chapter one, pedagogical integration of digital technology is conceptualized in this study (with insight from Armour's (2011) concept of pedagogy and Casey et al.'s (2017b) articulation of pedagogies of technology) as integration with consideration of the learners' needs, the teacher's teaching, and the educational sociocultural context in such a way that the integration of digital technology effectively addresses the desired learning outcomes. Technology integration into education needs to be done with pedagogical awareness to provide education that is engaging for digital age students (Casey et al. 2017b; Mishra and Koehler, 2006). Mishra and Koehler (2006) in their TPACK framework discussed technological pedagogical knowledge (TPK) and how this knowledge is part of the dynamic system of knowledge types that are needed for integration of digital technology into education. This study found that teacher-educators fostered pedagogical integration through two main strategies: 1) exposing preservice teachers to various digital technologies and 2) providing preservice teachers with guided exploration time. These findings align with the Teacher Education Technology Competencies' criteria developed by Foulger et al. (2017) that include the criteria of modeling technology integration and facilitating opportunities for preservice teachers to integrate technology. In addition, the findings in this study are consistent with an article written by Krause et al. (2020) who highlight that exposing preservice teachers to technology and challenging them to make informed decisions about technology are valuable strategies for preparing them to effectively integrate technology into their future classes.

In this study, the category of exposure emerged from the importance teacher-educators placed on both role modeling digital technology and on increasing their students' awareness of various technological tools that they can add to their teacher "toolbox" of technologies. The

second main category found in this study, that of exploration, was formed from the significance teacher-educators placed on providing preservice teachers with the time to practically explore digital technologies through hands-on experiences. The category of exploration also emerged from teacher-educators in this study highlighting the significance of encouraging preservice teachers to qualitatively reflect on their use of digital technology and critically analyze its impact on teaching and learning. The first part of this section discusses the importance of role modeling and increasing preservice teachers' overall awareness of tools for their "technological toolbox". The second part of this section highlights how exploration, through time for hands-on learning opportunities and thoughtful reflection, is a key strategy in preparing preservice teachers to pedagogically integrate digital technology into their teaching.

5.2.1 Exposure

Role modeling was emphasized by the teacher-educators in this study as key to preparing preservice teachers to pedagogically integrate digital technology. Preservice teachers learning by watching another teacher engage in their practice is also discussed in Kadri et al. (2017) in relation to Vygotskian theory. This is consistent with current research, which has found the teacher-educators are effectively using role modeling as a main strategy for preparing preservice teachers for technology integration (Baran et al. 2019; Tondeur et al., 2019; Tondeur et al, 2012). In addition, teacher-educators made comments about the responsibility of teacher-educators to set examples integrating digital technology that shows preservice teachers technology's potential and capacity to enhance education. This is consistent with Szymkowiak et al. (2021) who highlighted the importance of teachers setting good examples of technology integration noting that students are likely to emulate their teacher's use of technology. The study by Baek et al. (2018b) found that there was a positive impact on teachers' technology integration into physical

education if they had the opportunity to observe colleagues integrating technology into physical education. Mishra & Koehler (2006) note that "knowing how to use technology is not the same as knowing how to teach with it" (p. 1033); they propose that context-neutral technology training is likely to fail and that to prepare teachers to teach with technology, education programs need to expose preservice teachers to technology integration in the classroom. This approach will have preservice teachers learn technology integration, and develop their TPACK through having direct exposure to the interaction and application of technology, pedagogy, and content (Mishra & Koehler, 2006).

Teacher-educators in this study noted that even though there is a vast amount of digital technology available, if preservice teachers are not exposed to various digital technologies in their education, including the practical act of how to integrate the technologies, then preservice teachers are not likely to integrate technology in education. This is similar to the findings of Krause et al. (2020), Scrabis-Fletcher et al. (2016) and Tondeur et al. (2019) who determined that teacher-educators role modeling technology integration to preservice teachers is extremely influential on whether preservice teachers will choose to integrate digital technology in their future courses. Further, research has demonstrated that teachers who are exposed to digital technology and have opportunity to gain experience with digital technology are more likely to use digital technology in their teaching (Baek et al, 2018b; Szymkowiak et al., 2021).

As established, role modeling is a significant strategy for preparing preservice teachers to integrate digital technology; role modeling has also been identified as strongly influential on preservice teachers' understanding of how to integrate technology in pedagogical ways (Baek et al, 2018b; SITE, 2023; Tondeur et al., 2012; Tondeur et al., 2019; Uerz et al., 2018). Teacher-educators in this study emphasized the importance of assisting preservice teachers to understand

why and how they are integrating the digital technology, with learning outcomes being of utmost importance. Specifically, teacher-educators emphasized with their students that digital technology is a tool and like all other educational tools digital technology must be critically integrated into the educational context with consideration of course outcomes. This aligns with the findings of Casey et al. (2017a) who identify that digital technology is an educational tool that "should not be used indiscriminately but should be judged on its ability to facilitate the achievement of our educational aims" (p. 6). The pedagogical integration of digital technology requires developing technological pedagogical knowledge, which was conceptualized into a definition by Mishra and Koehler in 2006, who define technological pedagogical knowledge as:

> having the knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies. This might include an understanding that a range of tools existing for a particular task, the ability to choose the tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. (p. 1028)

Teacher-educators need to be developing preservice teachers' knowledge of and ability with using "technology as a tool for teaching" (Uerz et al., 2018, p.14). When discussing the role of teacher-educators in preparing preservice teachers to integrate digital technology, Peter commented that it is the responsibility of teacher-educators "to help them [preservice teachers] add tools to their toolbox and become effective instructors" (Findings chpt. p. 113). The study by Wyant et al. (2015) found that preservice teachers receiving a lack of exposure to digital technology was a barrier to technology integration. Teacher-educators in this study demonstrated

and discussed a variety of technological uses with their students. For example, teacher-educators used such technological tools as digital images and videos to demonstrate proper form of various physical movements. Teacher-educators specifically identified using video to replay physical movement to students to help students analyze their movement and increase their overall understanding of movement. Teacher-educators shared that students being able to see themselves execute a skill can help students cognitively understand their movement; in addition, teacher educators noted that replaying video can also be a meaningful assist for preservice teachers to develop their understanding of motor skill patterns and how to facilitate development. Teacher-educators also highlighted additional benefits they have found with integrating digital technology into physical education such as technology's capacity to be effective for: providing immediate feedback to students, affirming proper skill execution, facilitating movement pattern improvement, tracking physical activity, setting physical activity goals, and providing students with more responsibility for their learning. These findings align with the digital technology standards put out by ISTE (2023) that indicate students should be supported to use technology for feedback that informs their practice and to take ownership of their learning goals. Further, the findings of this study are consistent with specific physical education research by Krause et al. (2020) who put forth that digital technology can help preservice teachers to identify skill execution errors, analyze movement, provide accurate feedback, and help students to analyze their own skills.

As identified in this section, effective strategies that help preservice teachers learn to integrate technology are faculty role modeling and increasing awareness of the various digital technologies available, including how the technologies can be integrated into education. The next section focuses on how opportunity to practically explore with digital technology can enhance

preservice teachers' ability to pedagogically integrate digital technology (Krause & Lynch 2018; Krause et al.2020).

5.2.2 Exploration

Authentic personal experience with integrating technology is an effective strategy for preparing preservice teachers to integrate digital technology into various educational settings (Tondeur et al., 2012; Tondeur et al., 2019). Teacher-educators in this study identified providing time and opportunity to explore with digital technology integration as a significant strategy in supporting preservice teachers to integrate digital technology into physical education. As highlighted by Pat who noted that preservice teachers "are either motivated to use that [digital technology] or not based on their experience" (Findings chpt. p. 117) and Peter who noted that it is important for preservice teachers to be "given the tools and the information and are allowed to *explore* [emphasis added] what's currently on the market in terms of technological advances" (Findings chpt. p. 114). The TPACK framework was not only developed to inform teachers about the types of knowledge needed for technology integration but also as an aid to guide the development of TPACK; Mishra and Koehler (2006) emphasize "learning by doing" as a key means of developing TPACK. This also aligns with research conducted by Baek et al. (2018a) who conducted a study on educational practices in physical education also found that preservice teachers need opportunities to practice integrating technology into physical education lessons. Baek et al. (2018b) highlighted that providing pre- and in- service teachers with "time to experience and explore technologies" appeared to be an optimal strategy for fostering pedagogical digital technology integration (p. 181). In addition, the study by Wyant et al. (2015), which investigated strategies being used to prepare preservice teachers to integrate digital technology found that hands-on learning was needed. Further, the study by Baek et al. (2018b)

found and that hands-on experience for preservice and in-service teachers integrating digital technology into physical education enhanced the teachers' knowledge, pedagogy, and confidence with technology integration.

Reflection was highlighted by teacher-educators in this study as a key component of exploring pedagogical digital technology integration; reflection that encourages preservice teachers to contemplate the why and how of technology integration, and includes consideration of how the technology is enhancing learning. As exemplified by Peter's statement in chapter four in which he noted that supporting preservice teachers to integrate digital technology includes helping preservice teachers become "aware of what's available and *how* [emphasis added] they [technologies] can then be implemented in their physical education lessons" (Findings chpt. p.111) Further, when Paul was discussing encouraging preservice teachers to integrate digital technology, he emphasized the importance of having preservice teachers engage in a "self-reflection" analyzing "why am I doing what I am doing right now?" (Findings chpt. p.120). Paul also shared that after he has provided preservice teachers with time for practical exploration, he encourages them to have a "reflective conversation" and critically consider such things as "what are some other ways that you could see this [digital technology] working" (Findings chpt. p.120) in your future classrooms. This aligns with the findings by Uerz et al. (2018) who conducted a cross-article analysis of 26 articles and discovered that reflection is an effective strategy used with teachers to develop their competency in the pedagogical use of technology for teaching and learning. The findings in this study are also consistent with a study conducted by Tondeur et al. (2012) who completed a meta-ethnography synthesis of 19 articles that focused on discovering the strategies used by education programs to prepare preservice teachers to integrate technology; they found that reflection was a key strategy used to develop preservice teachers' ability to

integrate digital technology into teaching and learning. In the study by Tondeur et al. (2012), preservice teachers were encouraged to reflect on the role of technology in education, attitudes towards technology in education, and their own performance with technology after they had had time to experience practical exploration. Overall, research has shown that incorporating reflection as a strategy for preparing preservice teachers to integrate digital technology is beneficial to developing their pedagogical technological knowledge and their ability to pedagogically integrate technology into their teaching (Baran et al., 2019; Casey et al. 2017b; Tondeur et al., 2012; Tondeur et al., 2019; Uerz et al. 2018).

Mishra and Koehler (2006) indicate the significance of *pedagogical* integration in the TPACK framework in which they highlight the importance of teachers critically considering the relationship between course content, technology, and pedagogical approaches. Casey et al. (2017b) also indicate the need for a focus on pedagogical integration when they bring attention to the observation that many teachers struggle with integrating digital technology in "pedagogically sound … ways" (p. 294). Uerz et al.' (2018) cross-article analysis highlights pedagogical integration through determining that when integrating digital technology into education, preservice teachers being prepared to select digital technology that enhances the achievement of educational goals is "essential for pedagogically meaningful use" (p.18).

Teacher-educators in this study used strategies - such as, exposing preservice teachers to digital technology through role modeling and through increasing awareness of technologies, and providing time for hands-on exploration with various digital technologies that was followed with critical reflection - to support preservice teachers being prepared to integrate digital technology. Viewed through the TPACK lens, these teacher-educators modeling various uses of digital technology and providing authentic hands-on experiences for preservice teachers to integrate

digital technology was significant to the preservice teachers developing their understanding of the dynamic interplay between technology, content, and pedagogy, and how the interaction between these three areas will impact their teaching practices. TPACK affirms that modeling and authentic personal experience are needed for teachers to develop their ability to pedagogically integrate digital technology. Teacher-educators using strategies that foster preservice teachers to pedagogically integrate digital technology provides support for preservice teachers to grow with an education system that is rapidly evolving to keep up with societal demands.

5.3 Theme 3: Growing with Evolving Education

Growing with evolving education is the third theme that emerged in this study; it emerged from the importance teacher-educators place on their responsibility to encourage preservice teachers to critically consider how technology is impacting their students' physical education and activity within and beyond the walls of the classroom. Increasing awareness and guiding preservice teachers to consider the scope of impact of technology on their students' physical activity is consistent with research conducted by Casey et al. (2017a) that found that "The influence of digital technologies on learning about physical activity and health occurs within and beyond the physical education classroom" (p. 256). In addition, the theme, growing with evolving education, developed from the emphasis teacher-educators in this study place on providing socially relevant education to students. This is in keeping with current research that has found that digital technology is well-embedded in society (Jones et al, 2017; Scherer et al., 2019; Wyant & Baek, 2019). The first part of this section adds to the discussion regarding technology empowering and engaging students within and beyond the walls of the classroom. The second part of this section highlights the social significance of peer-to-peer/collaborative

learning and the responsibility of education to respond to the societal expectation that teachers will prepare students to engage meaningfully in an increasingly digital world.

5.3.1 Beyond the Walls

Teacher-educators in this study put forth that preservice teachers learning to integrate digital technology to achieve physical education goals with their future students has the potential to empower their future students to take more responsibility for being physically active and can foster their students' engagement in physical activity both during and outside of school hours. Current research aligns with the perspective that 21st century students find digital technology to be an engaging and motivating resource for learning (Jones et al., 2017; Krause et al., 2020; Szymkowiak et al., 2021). Teacher-educators in this study highlighted two attributes of digital technology that can promote students being physically active is 1) the immediate personalized feedback that can be provided by digital devices such as fitness trackers and 2) the capacity of technology to provide students with more control of their own information and more ownership of their learning. Cicconi (2014) acknowledges that "technology allows for a new definition [of education] to be written one that celebrates students driving their own instruction" (p. 59). The benefit of activity trackers supporting students to track their own progress and give them a better cognitive understanding of how and why they are doing various activities was specifically identified. Peter articulated that with technology "students are more empowered about their learning and they realize the why they're doing something and the value of what they're doing. And so, it increases their engagement" (Findings chpt. p. 123). In addition, teacher-educators highlighted that they build preservice teachers' awareness of technology enabling self-analysis of skill development and providing a means of self-comparison. The teacher-educators in this study highlighted trackers and videos as some of the key technologies available that support self-

analysis. Pat identified that digital technology affords students the opportunity to view their physical activity "based on their performance as opposed to someone else's performance" (Findings chpt. p. 125). Peter expressed that technology gives "students more ownership over their learning" (Findings chpt. p. 99). Recent research has also indicated that one of the benefits of digital technology is that it can provide students with more autonomy in their learning and support them to develop more accountability and responsibility for their physical activity (Casey et al., 2017a; Krause et al., 2020). It is significant to include that teacher-educators highlighted the need to address with preservice teachers the importance of knowing their school's policy around the use of digital technology, especially when using digital technology that records students such as digital trackers, digital images, or digital video. Paul mentioned that some schools, because of the frequent use of digital technology, are now having consent forms in which the form is actually an opt-out form.

Teacher-educators also identified that digital technology empowers and engages students by allowing them to connect with course content outside of class time and thereby facilitates learning outside of school hours. Paul noted that if teachers are able to use digital technology to reinforce course content outside of school hours "then chances are students are going to be more primed to perform when they come back in" (Findings chpt. p. 124). Peter added that technology "can also be used to connect away from classrooms" (Findings chpt. p. 124). Then Peter went on to highlight how technology can encourage student to be physically active, "students can go out into the community, into their own environment. They can use it [technology] as part of their own personal activity involvement away from school" (Findings chpt. p. 124). Technology has been found to extend learning outside of the classroom (Casey et al, 2017a; Szymkowiak et al., 2021).

Teacher-educators in this study brought awareness to preservice teachers that if digital technology is integrated pedagogically into physical education in elementary school there are many potential benefits. These benefits include such things as: 1) empowering students by enabling self-analysis and by providing increased ownership of physical activity information, 2) actively engaging students and motivating them to be physically active, and 3) facilitating students' connections with course content outside of the classroom. These potential benefits support the main goal of physical education, which is to promote a lifetime of regular physical activity. Digital technology has the capacity to enhance physical education by providing education that supports lifelong physical activity (Baert et al., 2017). As noted in chapter four, Peter highlighted that technology could be used to achieve the main goal of physical education, which is

> Not only to encourage physical activity three or four times a week in physical education classes… but to encourage kids to be involved in movement all the time, seven days a week with their families, with their friends out in nature and out in the environment. And so, I think a very effective and astute instructor can have tools at their disposal to engage students beyond the walls of the classroom (Findings chpt. p. 125).

5.3.2 Social Relevance

Results from this study indicated that teacher-educators use collaborative learning, specifically peer-to-peer learning as a strategy to prepare preservice teachers to integrate digital technology into physical education. Teacher-educators highlighted that they use peer-to-peer learning to synergistically expose preservice teachers to various digital technologies through fostering learning that supports the preservice teachers to learn from their peers' experiences and perspective. Teacher-educators in this study indicated that they expose the preservice teachers

during class to various digital technologies and then facilitate critical discussions to expand one another's perspectives. This is consistent with the study conducted by Baek et al. (2018b) that found peer discussion was an effective strategy to develop technological pedagogical knowledge through “broadening perspectives” via shared learning. Teacher-educators in this study share the perspective that peer teaching is a means of fostering effective peer-to-peer learning; for example, Pat indicated that “instead of being top down, having more of a peer-to-peer type of instruction may hit that intrinsic motivation button” (Findings chpt. p. 128) for preservice teachers, capitalizing on personal beliefs expanding through preservice teachers observing someone that they feel is at a similar stage to themselves. In the study by Baek et al (2018b), the authors comment on the benefit of observing peers and learning through a “vicarious experience” and highlight that this is more effective when someone is observing a person that they identify as being of similar ability.

A further benefit of peer teaching that was identified in this study was the practical experience that preservice teachers gain by teaching and analyzing their peers. Peter commented on the strategy of peer-to-peer teaching and noted that when he has preservice teachers work together and analyze one another's teaching, “it's a peer coaching, peer teaching opportunity because you have to have someone else there and then you can brainstorm” (Findings chpt. p. 128) together. Peter further added that “teamwork and peer assessment from one student to the next is a powerful learning tool” (Findings chpt. p. 128). This aligns with a study by Tondeur et al. (2019) that found peer learning to foster an encouraging educational environment due to learners being able to receive immediate low stress feedback by observing their peers’ ability and compare it to their own ability to integrate technology. The concept of peers, in this case preservice teachers, collaborating and constructing knowledge together as being a beneficial

strategy for learning is rooted in Vygotsky's (1978) social constructivism and his concept of ZPD, which highlights that learning with others may extend learning beyond what one can learn independently. Collaborating with others significantly influencing what and how we learn; this concept has been well established over the years (Barak, 2017; Eun, 2019; Vygotsky, 1978). Barak (2017) indicate that teacher-educators can transform their traditional practices to more constructivist approaches by taking the approach of fostering more collaborative learning and less independent learning. In addition, the meta-ethnography conducted by Tondeur et al. (2012) found that collaborating with peers was a key strategy in nine of the 19 studies reviewed; Tondeur et al. (2012) based this finding on comments made by preservice teachers who indicated that conversing with their peers and sharing their concerns regarding technology integration was significant to their learning. Preservice teachers in the Tondeur et al. (2012) study highlighted that group learning with their peers provided a safe learning environment, one that reduced stress and gave them more courage to explore digital technology.

Teacher-educators in this study found that students gravitate to technology and felt that it was their responsibility to include technology in the preparation of preservice teachers for the digital generation that they will be teaching. As noted, Canadian students are attracted to digital technology and use digital technology regularly in their everyday lives (Johnson, 2015). The attraction to digital technology was made apparent in a survey shared by Johnson (2015), who reported findings from a survey that included 5,436 Canadian students from grades 4 – 11, with participants from every province and territory; the survey found that 99% of the students surveyed had access to the internet outside of school.

Casey et al. (2017a) highlight that some physical education teachers' find digital technology to be "a tool that is contemporary, socially relevant, politically important and

culturally accepted across international boundaries" (p. 249). The findings of this study are consistent with the perspective that technology is socially relevant. Teacher-educators made numerous comments about how prevalent technology is in society and how important it is that education embraces technology. Teacher-educators in this study acknowledged that with society going towards more and more technology integration, that they need to actively support preservice teachers to be prepared to meaningfully grow their students' ability with digital technology. This aligns with Uerz et al. (2018) who put forth that teachers need to prepare their students to be technologically literate to prepare them to interact successfully in the 21st century. Szymkowiak et al. (2021) state that for the current generation of learners, digital tools "are an integral part of their lives" and that "traditional forms of learning … cannot meet the needs of the information society" (p. 4). Krause et al. (2020) put forth that it is the responsibility of teacher-educators to prepare preservice "teachers to integrate technology to enhance learning" (p. 243). Tondeur et al. (2019) further this sentiment putting forth that teacher-educators are the gatekeepers for preparing teachers to teach in the 21st century. This is consistent with the findings of this study and the responsibility highlighted by teacher-educators that they need to meet the challenge of supporting the next generation of teachers to pedagogically integrate technology to enhance learning and address various societal needs such as increasing physical activity. To end with the voice of a teacher-educator (Peter), it is "important to expand one's horizons, to include more relevant topics that meet the needs and demands of education today" (Findings chpt. p. 131).

5.4 Summary

This study found that teacher-educators believe preparing preservice teachers to integrate digital technology into their teaching is an important part of teacher education in the 21st century.

With the complexity that comes from the interplay between the types of knowledge indicated in the TPACK framework (Fig. 1), as well as the pedagogical integration of digital technology having both practical and theoretical aspects, the practical and theoretical implications of this study are presented in the following section.

5.4.1 Implications for Education

In this section, the practical and theoretical implications from this research study into how teacher-educators are supporting preservice elementary teachers to pedagogically integrate digital technology into physical education will be discussed.

5.4.1.1 Practical Implications.

Practical implications from this study concerning how to support preservice teachers to integrate digital technology into physical education address the ways that universities, programs, and teacher-educators themselves could effectively prepare preservice elementary teachers to pedagogically integrate digital technology into education to enhance learning. These practical implications are presented below and are divided into two sections: 1) Implications for university programs and 2) Implications for teachers-educators.

5.4.1.1.1 Implications for university programs.

1) Universities could allocate adequate funding to digital technology, both hardware and software (such as apps) so that there is equitable access to digital technology (Theme 1a, External Factors, University Resources).

2) Digital technology experts could determine and provide a list of effective apps that are freely available for programs. This was likened to the fact that currently universities have libraries, which provide suggested readings and supply reading material that is freely available (Theme 1a, External Factors, University Resources).

3) Universities could hire/train faculty whose sole role is to provide support to faculty for the pedagogical integration of digital technology into courses. This study found that for the participating teacher-educators, although there was IT support for setting up such things as Learning Management Systems, there was no designated support for integrating digital technology into their lessons, other than the support provided by colleagues (Theme 1a, External Factors, University Resources).

4) Education programs could provide planning times for teacher-educators for collaborative learning and sharing of digital technology integration experiences. This would assist with integration of technology into individual courses and departmental curriculum development of digital technology integration (Theme 1a External Factors, Program Structure). Teacher-educators in this study highlighted that collaborating with peers was extremely beneficial to the integration of digital technology into their courses; therefore, if programs do not provide specific collaborative learning opportunities, teacher-educators could take it up on themselves to connect with their colleagues to share their digital technology experience in foster collaborative learning.

5) Education programs could plan the curriculum with digital technology being integrated into every course to provide students with exposure to various digital technology and time to explore various applications of digital technology, including integrating digital technology into lesson assignments (Theme 1a External Factors, Program Structure).

5.4.1.1.2 Implications for teacher-educators.

This study researched how teacher-educators are preparing preservice teachers to integrate digital technology into physical education. Therefore, implications are directed to teacher-educators; however, these implications are applicable to all levels of teachers and to the integration of digital technology into education.

1) Teacher-educators could vulnerably explore digital technology (exploring digital technology even when they do not feel well versed in the technology) (Theme 1b, Internal Factors, Willingness to Vulnerably Explore & Embrace the Facilitator Role).

2) Teacher-educators could fully embrace a facilitator role (Theme 1b Internal Factors, Willingness to Vulnerably Explore & Embrace the Facilitator Role).

3) Teacher-educators with course content knowledge and pedagogical knowledge could role model integration of digital technology and could support preservice teachers to expand their "toolbox" with increased awareness of digital technology integration into education (Theme 2a, Exposure, Role-Modelling and Increasing Awareness – Expanding Preservice Teacher "Toolbox".).

4) Teacher-educators could allocate time for preservice teachers to explore and reflect on digital technology integration into education (Theme 2b, Exploration, Providing Opportunity – "Time" & Encouraging Reflection).

5) Teacher-educators, alongside their preservice teacher students, could explore and reflect on digital technology integration into education, and critically consider pedagogical integration; how does the technology – 1) fit with their teaching, 2) enhance learners' learning; and 3) connect with current sociocultural context to keep education relevant (Theme 2b, Exploration, Providing Opportunity – "Time" & Encouraging Reflection).

6) Teacher-educators could provide opportunities for preservice teachers to collaborate with each other as peers, discussing and reflecting on integration of digital technology into education. It would be beneficial for teacher-educators to encourage collaboration and reflection that includes conscientiously considering the integration of digital technology to achieve specific learning

outcomes, such as physical activity promotion, in ways that are socially relevant. (Theme 3b, Social Relevance, Collaborative Learning).

7) Teacher-educators could engage and empower preservice students to use digital technology to take ownership of their own physical activity outside the classroom so that they could share this with their future students (Theme 3a, Beyond the Walls of the Classroom, Empowerment & Engagement).

5.4.1.2 Theoretical Implications.

The practical and theoretical implications from the findings of this study lead to a suggested adaption of the TPACK framework, one that highlights the importance of pedagogically integrating digital technology and consideration of sociocultural context; this adapted framework is entitled TPACK: Teachers Growing with Evolving Education and is shown in Figure 7.

This adapted TPACK framework operationalises the TPACK model and presents an adaption of TPACK in a flower design to visually portray the significance of Theme 3: Growing with Evolving Education. The original TPACK framework, displaying the intersecting types of knowledge, is represented by coloured circles and is supported by pedagogical integration; this is to highlight that the pedagogical integration of digital technology, as conceptualized in this study (digital technology integration with consideration of the teacher teaching and learning, the learner learning, and sociocultural context), is needed to support the effective integration of digital technology into education. Included in the centre of the flower as foundational to pedagogical integration is sociocultural context to highlight the influence and importance of considering this context when integrating digital technology into education. The outer petals of the flower show the specific supportive strategies found in this study that teachers can use for the

practical application of TPACK and to support preservice teachers to pedagogically integrate digital technology into education.

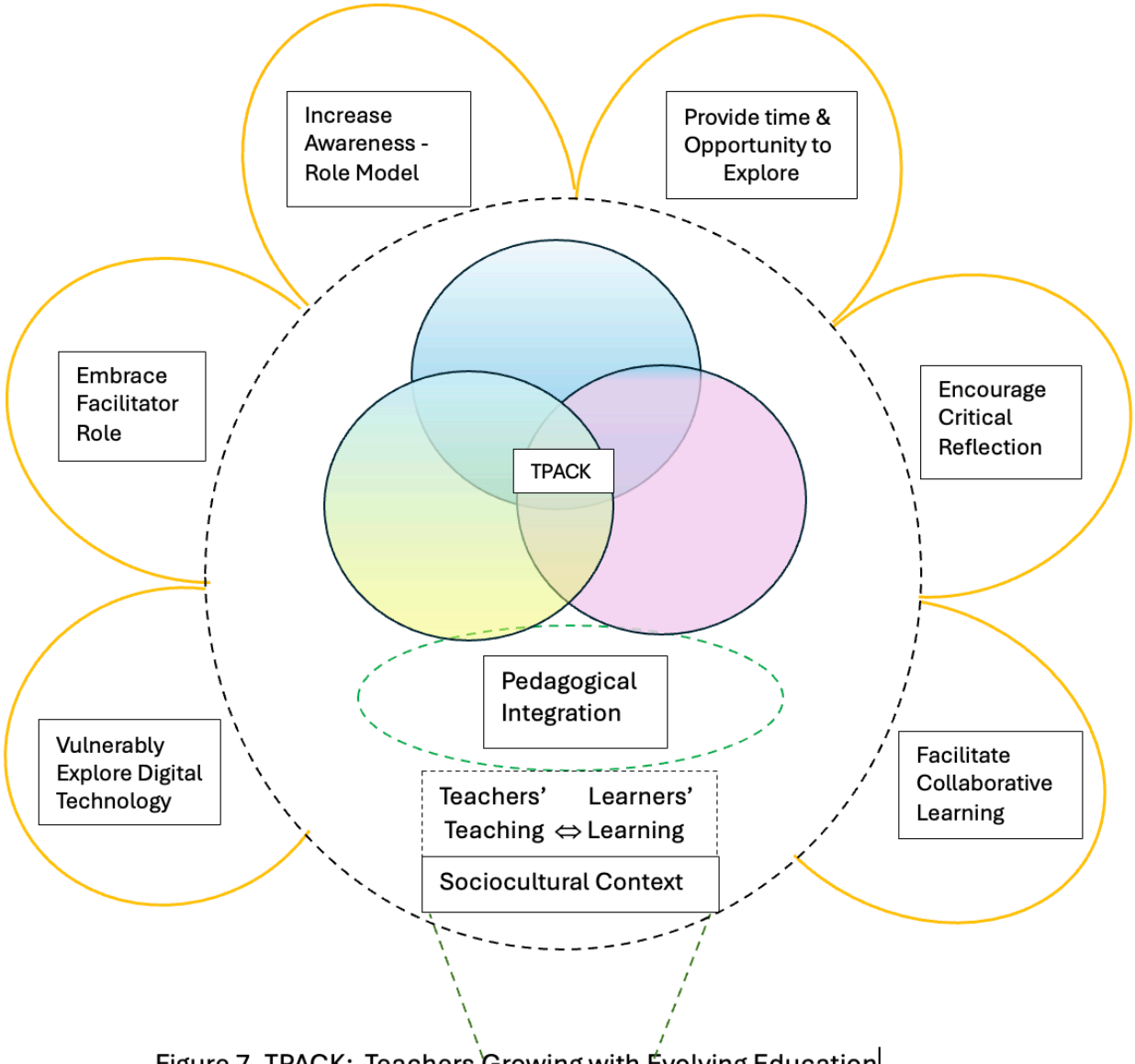

Figure 7. TPACK: Teachers Growing with Evolving Education

In conclusion, it is hoped that the information provided in this study will provide ideas for teacher-educators as to how to support preservice teachers to pedagogically integrate digital technology into physical education. Further, it is hoped that this study will provide insight that will assist education programs to operationalize the TPACK model and support preservice

teachers to pedagogically integrate digital technology throughout the curriculum and confidently enter the profession of teaching in an era of rapidly evolving education.

Limitations

Limitations of this study were discussed in connection with CSR limitations in chapter three in section 3.1.1.2 CSR Limitations Connected to the Limitations of this Study. There were additional limitations that impacted this study: 1) The pandemic due to COVID impacted this study as data collection occurred when education was being forced online and the world was figuring out how to deal with the pandemic; 2) Teacher-educators are actively trying to figure out how to integrate technology into education and this is causing an explosion of publications, which makes it challenging to keep up with current literature as the dissertation is being written; 3) The inexperience of the researcher, which was discussed in chapter three. I am a doctoral student; therefore, this is one of my first research studies and much learning occurred along the way; and 4) There is a complexity to researching teacher-educators preparing preservice teachers, as preservice teachers are both teachers and students and the intricacy of researching from multiple perspectives is challenging.

Future Research

This study led to several potential future research topics. While this study explored the perspective of teacher-educators as to how they are supporting preservice teachers integrate digital technology into physical education; a meaningful complementary study would be to explore the perspectives of preservice elementary teachers on how they are being prepared to integrate digital technology. Another meaningful complementary study could gather data regarding what opportunities to integrate digital technology preservice teachers are being provided during their practicums. Further, a future study could extend to following a preservice

teacher post-graduation to find out what impact their education had on the integration of digital technology into their practice and garner their practical perspective on what could be changed in teacher education programs to further facilitate digital technology integration. A key finding of this study is the need for teacher-educators and their preservice teachers to maintain the social relevance of their practice. The recent development of artificial intelligence (AI) within the world of digital technology highlights this need. Current work is ongoing regarding the uses and impact of AI in education (World Economic Forum, 2024). A study could be conducted to investigate how teacher-educators and their preservice teachers are integrating AI into the curriculum. Directly leading from this study could be a study to further investigate the concept of vulnerable exploration of digital technology integration and how teacher-educators learning digital technology alongside preservice teachers' in a symmetrical zone of proximal development impacts the pedagogical integration of technology into education.

References

Alley, K. M. (2019). Fostering middle school students' autonomy to support motivation and engagement. *Middle School Journal*, *50*(3), 5-14. https://doi.org/10.1080/00940771.2019.1603801

Amineh, R. J., & Asl, H. D. (2015). Review of constructivism and social constructivism. *Journal of Social Sciences, Literature and Languages*, *1*(1), 9-16.

Anderson, E., & Durstine, J. L. (2019). Physical activity, exercise, and chronic diseases: A brief review. *Sports Medicine and Health Science*, *1*(1), 3-10. https://doi.org/10.1016/j.smhs.2019.08.006

Anderson, L. B., Mota, J., & Di Pietro, L. (2016). Update on the global pandemic of physical inactivity. *The Lancet*, *388*(10051), 1255-1256. http://dx.doi.org/10.1016/S0140-6736(16)30960-6

Armour, K. M., Casey, A. & Goodyear, V.A. (2017). A pedagogical cases approach to understanding digital technologies and learning in physical education. In A. Casey, V. A. Goodyear, & K.M. Armour (Eds.), *Digital technologies and learning in physical education pedagogical cases* (pp. 13-30). Abingdon: Routledge.

Armour, K. M. (2014). *Pedagogical cases in physical education and youth sport*. Abingdon: Routledge.

Armour, K. M. & Harris, J. (2013) Making the case for developing new PE-for-health pedagogies. Quest 65(2): 201–219. https://doi.org/10.1080/00336297.2013.773531

Armour, K. M. (2011). *Sport Pedagogy: An Introduction for Teaching and Coaching*. Abingdon: Routledge.

Austys, D., Sprudzanaitė, A., Arlauskas, R., & Stukas, R. (2020). Personal cell phones among children: Attitudes of parents of primary school pupils. *European Journal of Public Health*, *30*(Supplement_5), ckaa166-012.

Avelino, F., Wittmayer, J. M., Pel, B., Weaver, P., Dumitru, A., Haxeltine, A., ... & O'Riordan, T. (2019). Transformative social innovation and (dis) empowerment. *Technological Forecasting and Social Change*, *145*, 195-206. https://doi.org/10.1016/j.techfore.2017.05.002

Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education*, *5*(6), 66-70.

Baek, J. H., Keath, A., & Elliott, E. (2018a). Physical Education Teachers' Technology Practices and Challenges. *International Journal of Human Movement Science*, *12*(2), 27-42. https://doi.org/10.23949/ijhms.2018.08.12.2.2

Baek, J. H., Jones, E., Bulger, S., & Taliaferro, A. (2018b). Physical education teacher perceptions of technology-related learning experiences: A qualitative investigation. *Journal of Teaching in Physical Education*, *37*(2), 175-185. https://doi.org/10.1123/jtpe.2017-0180

Baert, H., Winiecki, T., Madden, M., Bryan, R., & MacDonald, C. (2017). Tom: Using digital technology and physical education to transform pedagogy. In Casey, A., Goodyear, V. A., & Armour, K. M. (Eds.), *Digital technologies and learning in physical education: Pedagogical cases.* (pp. 191-212). Abingdon: Routledge.

Bakir, N. (2016). Technology and teacher education: A brief glimpse of the research and practice that have shaped the field. *TechTrends*, *60*(1), 21-29. https://doi.org/10.1007/s11528-015-0013-4

Bandura, A. (1997). *Self-efficacy: the exercise of control.* New York: Freeman.

Barak, M. (2017). Science teacher education in the twenty-first century: A pedagogical framework for technology-integrated social constructivism. *Research in Science Education*, *47*(2), 283-303. https://doi.org/10.1007/s11165-015-9501-y

Baran, E., Canbazoglu Bilici, S., Albayrak Sari, A., & Tondeur, J. (2019). Investigating the impact of teacher education strategies on preservice teachers' TPACK. *British Journal of Educational Technology*, *50*(1), 357-370. https://doi.org/10.1111/bjet.12565

Befani, B. (2013) Between complexity and generalization: Addressing evaluation challenges with QCA. *Evaluation* 19(3): 269–83. https://doi.org/10.1177/1474022213493839

British Columbia Ministry of Education. 2020. Supporting the K-12 Education Response to COVID-19 in B.C. March 27. Retrieved on March 30, 2020 from www.sd8.bc.ca/sites/default/files/k-12-covid-19-integratedplanning-frameowrk---march-27-2020.pdf

British Columbia Teacher's Federation (BCTF). (2020a). Technology. Retrieved from https://bctf.ca/Research.aspx?id=47782

British Columbia Teacher's Federation (BCTF). (2020b). Priorities for public education. https://bctf.ca/publications/BriefSection.aspx?id=46995

British Columbia Teacher's Federation (BCTF). (2020c). Educational technologies and teacher autonomy: Educational technologies, deprofessionalization and the threat to teacher autonomy. Retrieved from https://bctf.ca/publications/ResearchReports.aspx?id=50534

Brown, B. (2017). *Braving the wilderness: The quest for true belonging and the courage to stand alone*. Random House.

Cale, L., Harris, J., & Duncombe, R. (2016). Promoting physical activity in secondary schools: Growing expectations,'same old'issues?. *European Physical Education Review*, *22*(4), 526-544. https://doi-org.ezproxy.library.uvic.ca/10.1177/1356336X15623774

Campbell, S. (2015). Conducting case study research. *Clinical Laboratory Science*, *28*(3), 201-205.

Carson, V., Hunter, S., Kuzik, N., Gray, C. E., Poitras, V. J., Chaput, J. P., ... & Kho, M. E. (2016). Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. *Applied Physiology, Nutrition, and Metabolism*, *41*(6), S240-S265. https://doi.org/10.1139/apnm-2015-0630

Casey, A., Goodyear, V. A., & Armour, K. M. (2017a). *Digital technologies and learning in physical education: Pedagogical cases.* Abingdon: Routledge.

Casey, A., Goodyear, V. A., & Armour, K. M. (2017b). Rethinking the relationship between pedagogy, technology and learning in health and physical education. *Sport, education and society*, *22*(2), 288-304. https://doi.org/10.1080/13573322.2016.1226792

Casey, A., & Jones, B. (2011). Using digital technology to enhance student engagement in physical education. *Asia-Pacific Journal of Health, Sport and Physical Education*, *2*(2), 51-66. https://doi.org/10.1080/18377122.2011.9730351

Cattaneo, L. B., & Chapman, A. R. (2010). The process of empowerment: A model for use in research and practice. *American psychologist*, *65*(7), 646-659. https://doi.org./10.1037/a0018854

Centers for Disease Control & Prevention (CDC) (2022). Physical Activity Guidelines for School-Aged Children and Adolescents. Retrieved from https://www.cdc.gov/healthyschools/physicalactivity/guidelines.htm#:~:text=Aerobic%3A%20Most%20of%20the%2060,least%203%20days%20a%20week

Chaput, J. P., Genin, P. M., Le Moel, B., Pereira, B., Boirie, Y., Duclos, M., & Thivel, D. (2016). Lean adolescents achieve higher intensities but not higher energy expenditure while playing active video games compared with obese ones. *Pediatric obesity*, *11*(2), 102-106. https://doi.org/10.1111/ijpo.12027

Charmaz, K. (2014). Constructing grounded theory (2nd ed.). Sage Publication. Kindle Edition.

Churcher, K., Downs, E., & Tewksbury, D. (2014). "Friending" vygotsky: A social constructivist pedagogy of knowledge building through classroom social media use. *Journal of Effective Teaching*, *14*(1), 33-50.

Cicconi, M. (2014). Vygotsky meets technology: A reinvention of collaboration in the early childhood mathematics classroom. *Early Childhood Education Journal*, *42*, 57-65. https://doi.org/10.1007/s10643-013-0582-9

Colley, R. C., Carson, V., Garriguet, D., Janssen, I., Roberts, K. C., & Tremblay, M. S. (2017). *Physical activity of Canadian children and youth, 2007 to 2015*. Statistics Canada. Retrieved from https://www150.statcan.gc.ca/n1/pub/82-003-x/2017010/article/54876-eng.htm

Collins. (2022). Collins Dictionary. Retrieved from https://www.collinsdictionary.com/dictionary/english/role-model on August 29th, 2022.

Couros, G. (2024). Developing the innovators mindset through remote, face-to-face, and blended learning. Retrieved from https://george-couros-school.teachable.com/p/developing-the-innovator-s-mindset-through-remote-face-to-face-and-blended-learning

Creswell, J. W. (2016). *30 essential skills for the qualitative researcher*. Thousand Oaks CA: Sage publications.

Creswell, J. W. & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Thousand Oaks CA: Sage publications. WAS 2014

Creswell, J. W. & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice?. *European journal of teacher education*, *40*(3), 291-309. https://doi.org/10.1080/02619768.2017.1315399

Denzin, N. K., & Lincoln, Y. S. (2024). *Introduction: The discipline and practice of qualitative research. The SAGE handbook of qualitative research* (6th ed). Thousand Oaks, CA: Sage Publications

Doreleyers, A. & Knighton, T. (2020). COVID-19 Pandemic: Academic impacts on postsecondary students in Canada. Data to Insights for a Better Canada. *Statistics Canada*. Retrieved from https://files.eric.ed.gov/fulltext/ED605390.pdf

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of research on Technology in Education*, *42*(3), 255-284. https://doi.org/10.1080/15391523.2010.1078255

Eun, B. (2019). The zone of proximal development as an overarching concept: A framework for synthesizing Vygotsky's theories. *Educational Philosophy and Theory*, *51*(1), 18-30. https://doi.org/10.1080/00131857.2017.1421941

Fix and Play. (2023, January 24). Would you Rather? Workout! (Snacks Edition 2)[Video]. YouTube. https://www.youtube.com/watch?v=KFLUvvWrR-8

Foulger, T. S., Graziano, K. J., Schmidt-Crawford, D., & Slykhuis, D. A. (2017). Teacher educator technology competencies. *Journal of technology and teacher education*, *25*(4), 413-448.

Frenette, M., Frank, K., & Deng, Z. (2020). *School closures and the online preparedness of children during the COVID-19 pandemic*. Statistics Canada= Statistique Canada. Retrieved from https://www.researchgate.net/profile/Kristyn_Frank/publication/340720825_School_Closures_and_the_Online_Preparedness_of_Children_during_the_COVID-19_Pandemic/links/5e9a01284585150839e3fcc5/School-Closures-and-the-Online-Preparedness-of-Children-during-the-COVID-19-Pandemic.pdf

Friel, T., Britten, J., Compton, B., Peak, A., Schoch, K., & VanTyle, W. K. (2009). Using pedagogical dialogue as a vehicle to encourage faculty technology use. *Computers & Education*, *53*(2), 300-307. https://doi.org/10.1016/j.compedu.2009.02.002

Gaetano, A. L. (2016). Relationship between physical inactivity and effects on individual health status. *Journal of Physical Education and Sport*, *16*(2), 1069-1074.

Gal, R., May, A. M., van Overmeeren, E. J., Simons, M., & Monninkhof, E. M. (2018). The effect of physical activity interventions comprising wearables and smartphone applications on physical activity: a systematic review and meta-analysis. *Sports medicine-open*, *4*(1), 1-15. https://doi.org/10.1186/s40798-018-0157-9

Gard, M. (2014). eHPE: A history of the future. *Sport, Education and Society*, *19*(6), 827-845. https://doi.org/10.1080/13573322.2014.938036

Gawrisch, D. P., Richards, K. A. R., & Killian, C. M. (2020). Integrating technology in physical education teacher education: A socialization perspective. *Quest*, *72*(3), 260-277. https://doi.org/10.1080/00336297.2019.1685554

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*, *1*(2), 175-191.

Ghozy, S., Abdelaal, A., Shah, J., Parker, K. E., & Islam, S. M. S. (2021). COVID-19 and physical inactivity: Teetering on the edge of a deadlier pandemic?. *Journal of Global Health*, *11*. https://doi.org/10.7189/jogh.11.03031

González-Álvarez, M. A., Lázaro-Alquézar, A., & Simón-Fernández, M. B. (2020). Global trends in child obesity: are figures converging? *International journal of environmental research and public health*, *17*(24), 9252. https://doi.org/10.3390/ijerph17249252

Goodrich, K. M., Kingsley, K. V., & Sands, H. C. (2020). Digitally responsive school counseling across the ASCA national model. *International Journal for the Advancement of Counselling*, *42*, 147-158. https://doi.org/10.1007/s10447-020-09396-9

Government of British Columbia. (2023a). BCs New Curriculum: Curriculum Overview. Retrieved from https://curriculum.gov.bc.ca/curriculum/overview

Government of British Columbia. (2023b). BCs Curriculum: Curriculum Overview: ICT-enabled Learning Environments. Retrieved from https://curriculum.gov.bc.ca/curriculum/overview

Government of British Columbia. (2023c). Digital Literacy. Retrieved from https://www2.gov.bc.ca/gov/content/education-training/k-12/teach/resources-for-teachers/digital-literacy

Government of British Columbia. (2023d). Physical Activity. Retrieved from https://www2.gov.bc.ca/gov/content/health/managing-your-health/physical-activity

Government of British Columbia. (2023e). Area of Learning: Physical and Health Education. Retrieved from

https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/curriculum/physical-health-education/en_physical-health-education_k-9_elab.pdf

Government of British Columbia. (2023f). Daily Physical Activity. Retrieved from https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/legislation-policy/public-schools/daily-physical-activity#:~:text=Policy%20in%20full,Physical%20and%20Health%20Education%20curriculum.

Government of British Columbia. (2023g). BCs New Curriculum: New Curriculum Info: Flexible Learning Environments. Retrieved from https://curriculum.gov.bc.ca/rethinking-curriculum#:~:text=Flexible%20learning%20environments&text=The%20integration%20of%20areas%20of,the%20students'%20needs%20and%20interests

Government of British Columbia. (2022). BCs Curriculum: Physical and Health Education. Retrieved from https://curriculum.gov.bc.ca/curriculum/physical-health-education

Government of British Columbia. (2016). British Columbia's education program. Retrieved from https://www2.gov.bc.ca/assets/gov/education/administration/kindergarten-to-grade-12/diverse-student-needs/educationwelcomeletter_jan2016_english_final.pdf

Government of Canada (2023a). Childhood Obesity. Retrieved from https://www.canada.ca/en/public-health/services/childhood-obesity/childhood-obesity.html

Government of Canada. (2023b). Provincial Definitions of a Minor. Retrieved from https://www.canada.ca/en/immigration-refugees-citizenship/corporate/publications-manuals/operational-bulletins-manuals/refugee-protection/canada/processing-provincial-definitions-minor.html

Government of Canada. (2023c). COVID-19: Canada's response. Retrieved from https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/canadas-reponse.html

Government of Canada. (2019). Daily Physical Activity. Retrieved from https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/legislation-policy/public-schools/daily-physical-activity

Government of Canada. (2017). Action schools! BC: A 'whole school' approach to getting kids active. Retrieved from http://www.cihr-irsc.gc.ca/e/46478.html

Government of Canada. (2016). Children and physical activity. Retrieved from https://www.canada.ca/en/public-health/services/being-active/children-physical-activity.html

Hall, J. A. (2018). Flipping with the first principles of instruction: An examination of preservice teachers' technology integration development. *Journal of Digital Learning in Teacher Education*, *34*(4), 201-218. https://doi.org/10.1080/21532974.2018.1494520

Hancock, D. R., & Algozzine, B. (2017). *Doing case study research: A practical guide for beginning researchers.* (3rd ed.). New York: NY: Teachers College Press.

Hanemann, U. (2015). Lifelong literacy: Some trends and issues in conceptualising and operationalising literacy from a lifelong learning perspective. *International review of education*, *61*(3), 295-326. https://doi.org/10.1007/s11159-015-9490-0

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of research on technology in education*, *41*(4), 393-416. https://doi.org/10.1080/15391523.2009.10782536

Harrison, H., Birks, M. Franklin, R., & Mills, J., (2017). Case study research: Foundations and methodological orientations. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 18, No. 1, p. 17). DEU. https://doi.org/10.17169/fqs-18.1.2655

Hasselbring, T. S., Smith, L., Glaser, C. W., Barron, L., Risko, V. J., Snyder, C., ... & Campbell, M. (2000). Literature Review: Technology To Support Teacher Development. Retrieved from: https://eric.ed.gov/?id=ED448159

Hills, A. P., Dengel, D. R., & Lubans, D. R. (2015). Supporting public health priorities: recommendations for physical education and physical activity promotion in schools. *Progress in cardiovascular diseases*, *57*(4), 368-374. http://dx.doi.org/10.1016/j.pcad.2014.09.010

Howard, S. K., & Thompson, K. (2016). Seeing the system: Dynamics and complexity of technology integration in secondary schools. *Education and Information Technologies*, *21*(6), 1877-1894. http://doi.org/10.1007/s10639-015-9424-2

Howard, S. K., Tondeur, J., Ma, J., & Yang, J. (2021). What to teach? Strategies for developing digital competency in preservice teacher training. *Computers & Education*, *165*, 104149. https://doi.org/10.1016/j.compedu.2021.104149

Huber, J. (2013). *Applying Educational Psychology in Coaching Athletes.* Human Kinetics. ISBN:9780736079815

ISTE. (2023). International Society for Technology in Education (ISTE) standards for teachers. Retrieved from https://www.iste.org/standards/iste-standards-for-students.

Johnson, M. (2015). The Online Lives of Canadian Youth. Retrieved from https://vanierinstitute.ca/the-online-lives-of-canadian-youth/

Johnson, T. G., & Turner, L. (2016). The physical activity movement and the definition of physical education. *Journal of Physical Education, Recreation & Dance*, *87*(4), 8-10. https://doi.org/10.1080/07303084.2016.1142192

Jones, E. M., Baek, J. H., & Wyant, J. D. (2017). Exploring pre-service physical education teacher technology use during student teaching. *Journal of Teaching in Physical Education*, *36*(2), 173-184. https://doi.org/10.1123/jtpe.2015-0176

Kadri, M. S. E., Roth, W. M., Gil, A. J., & Mateus, E. (2017). Towards a more symmetrical approach to the zone of proximal development in teacher education. *Revista Brasileira de Educação*, *22*, 668-689. http://dx.doi.org/10.1590/S1413-24782017227034

Kakazu, K., & Chow, J. Y. (2023). Influence of acculturation and professional socialization on student teachers' beliefs about teaching physical education. *Asian Journal of Sport and Exercise Psychology*, *3*(3), 192-199. https://doi.org/10.1016/j.ajsep.2023.06.002

Katzmarzyk, P. T., Chaput, J. P., Fogelholm, M., Hu, G., Maher, C., Maia, J., ... & Tudor-Locke, C. (2019). International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE): contributions to understanding the global obesity epidemic. *Nutrients*, *11*(4), 848. https://doi.org/10.3390/nu11040848

Kelchen, R., Ritter, D., & Webber, D. (2021). The lingering fiscal effects of the COVID-19 pandemic on higher education. *Federal Reserve Bank of Philadelphia*. https://doi.org/10.21799/frbp.dp.2021.01

Kelchtermans, G. (2009). Who I am in how I teach is the message: self-understanding, vulnerability and reflection. *Teachers and Teaching: theory and practice*, *15*(2), 257-272. https://doi.org/10.1080/13540600902875332

Kelchtermans, G. (2019). Early career teachers and their need for support: Thinking again. *Attracting and keeping the best teachers: Issues and opportunities*, 83-98. https://doi.org/10.1007/978-981-13-8621-3_5

Kesharwani, A. (2020). Do (how) digital natives adopt a new technology differently than digital immigrants? A longitudinal study. *Information & Management*, *57*(2), 103170. https://doi.org/10.1016/j.im.2019.103170

Kessler, A., & Phillips, M. (2019, March). What do published abstracts reveal about the TPACK research community? Let us tell you! *Society for Information Technology & Teacher Education International Conference.* Association for the Advancement of Computing in Education (AACE), p. 2130-2133. Retrieved from https://www.learntechlib.org/primary/p/207995/

Kingston, Ú., Adamakis, M., Lester, D., & Costa, J. (2023). A scoping review on quality physical education programmes and their outcomes on primary-level pupils. *International Journal of Environmental Research and Public Health*, *20*(4), 3575. https://doi.org/10.3390/ijerph20043575

Koehler, M. J. & Mishra, P. (2009). What is technological pedagogical content knowledge. *Contemporary Issues in Technology and Teacher Education, 9*, (1), 60 -70.

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)?. *Journal of education, 193*(3), 13-19. https://doi-org.ezproxy.library.uvic.ca/10.1177/002205741319300303

Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The technological pedagogical content knowledge framework. In J. M. Spector, J.M. et al. (Eds.), *Handbook of research on educational communications and technology* (4th ed.) (p. 101- 111). New York. Springer.

Koehler, 2024. Using the TPACK image. Retrieved from tpack.org

Krause, J. M., O'Neil, K., & Jones, E. (2020). Technology in Physical Education Teacher Education: A Call to Action. Quest (National Association for Kinesiology in Higher *Education)*, *72*(3), 241–259. https://doi.org/10.1080/00336297.2019.1685553

Krause, J. M., & Lynch, B. M. (2018). Faculty and student perspectives of and experiences with TPACK in PETE. *Curriculum Studies in Health and Physical Education*, *9*(1), 58-75. https://doi.org/10.1080/25742981.2018.1429146

Krause, J. M., & Sanchez, Y. (2014). Meeting the national standards: There's an app for that! *Strategies, 27*(4), 3–12. https://doi.org/10.1080/08924562.2014.917997

Krause, J. M., Franks, H., & Lynch, B. (2017). Current technology trends and issues among health and physical education professionals. *Physical Educator*, *74*(1), 164. https://doi-org.ezproxy.library.uvic.ca/10.18666/TPE-2017-V74-I1-6648

Kretschmann, R. (2015). Physical education teachers' subjective theories about integrating information and communication technology (ICT) into physical education. *Turkish Online Journal of Educational Technology, 14*(1), 68–96.

Kretschmann, R. (2016). *Technology integration in physical education: Examining the physical education teachers' domain*. Verlag nicht ermittelbar. (Doctoral dissertation, Universitätsbibliothek Johann Christian Senckenberg).

Lee, H.-Y., Chung, C.-Y., & Wei, G. (2022). Research on Technological Pedagogical and Content Knowledge: A Bibliometric Analysis From 2011 to 2020. *Frontiers in Education (Lausanne)*, *7*. https://doi.org/10.3389/feduc.2022.765233

Lee, J. E., & Gao, Z. (2020). Effects of the iPad and mobile application-integrated physical education on children's physical activity and psychosocial beliefs. *Physical Education and Sport Pedagogy*, *25*(6), 567-584. https://doi.org/10.1080/17408989.2020.1761953

Lewis, B. A., Napolitano, M. A., Buman, M. P., Williams, D. M., & Nigg, C. R. (2017). Future directions in physical activity intervention research: expanding our focus to sedentary behaviors, technology, and dissemination. *Journal of behavioral medicine*, *40*(1), 112-126. https://doi.org/10.1007/s10865-016-9797-8

Liefner, I. (2003). Funding, resource allocation, and performance in higher education systems. *Higher education*, *46*, 469-489.

Linker, J. M., & Woods, A. M. (2018). "Like, We Don't Want to Be PE Teachers:" Preservice Classroom Teachers' Beliefs About Physical Education and Willingness to Incorporate Physical Activity. *Physical Educator*, *75*(1), 77-98. https://doi-org.ezproxy.library.uvic.ca/10.18666/TPE-2018-V75-I1-7640

Lubans, D. R., Smith, J. J., Peralta, L. R., Plotnikoff, R. C., Okely, A. D., Salmon, J., ... & Hilland, T. A. (2016). A school-based intervention incorporating smartphone technology to improve health-related fitness among adolescents: rationale and study protocol for the NEAT and ATLAS 2.0 cluster randomised controlled trial and dissemination study. *BMJ open*, *6*(6), e010448. https://doi.org/10.1136/bmjopen-2015-010448

Lupton, D. (2014). Health promotion in the digital era: A critical commentary. *Health Promotion International*, 30(1), 174-183). https://doi.org/10.1093/heapro/dau091

Luria, A. R., & Vygotsky, L. S. (1992). *Ape, primitive man, and child: Essays in the history of behavior*. Translated by Evelyn Rossiter. New York: Harvester Wheatsheaf CRC Press.

Make a future: Careers in BC Education (2025). Elementary and Middle Schools. Retrieved from https://www.makeafuture.ca/careers-in-bc-education/teachers/elementary-and-middle-school-teachers/#:~:text=In%20B.C.%2C%20elementary%20schools%20are,to%20one%20group%20of%20students

Martinez, G., & Shaker, E. (2018). Counseling 110 Career and Life Planning.

McKinley, J. (2015). Critical argument and writer identity: Social constructivism as a theoretical framework for EFL academic writing. *Critical inquiry in language studies*, *12*(3), 184-207. : https://doi.org/10.1080/15427587.2015.1060558

McPhee, P. G., Singh, S., & Morrison, K. M. (2020). Childhood obesity and cardiovascular disease risk: Working toward solutions. *Canadian Journal of Cardiology*, *36*(9), 1352-1361. https://doi.org/10.1016/j.cjca.2020.06.020

Means, B., & Olson, K. (Eds.) (1997). Technology and education reform. Washington, DC: National Academies Press, Office of Educational Research and Improvement, US Department of Education. Retrieved from https://books.google.com.sg/books?id=AnauBFap5JQC&printsec=frontcover#v=onepage&q&f=false

Meldrum, D. R., Morris, M. A., & Gambone, J. C. (2017). Obesity pandemic: causes, consequences, and solutions—but do we have the will?. *Fertility and sterility*, *107*(4), 833-839. http://dx.doi.org/10.1016/j.fertnstert.2017.02.104

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education. Revised and Expanded from Case Study Research in Education*. San Francisco, CA: Jossey-Bass Publishers

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation (ed*.). San Francisco, CA: John Wiley & Sons.

Merriam-Webster (2019). Definition of Integrate. Retrieved from https://www.merriam-webster.com/dictionary/integrate

Merriam-Webster (2022). Definition of Pedagogy. Retrieved from https://www.merriam-webster.com/dictionary/pedagogy

Miles, M. B., Huberman, A. M. & Saldaña, J. (2020). *Qualitative data analysis: A methods Sourcebook (4th ed.)*. sage.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers college record*, *108*(6), 1017-1054.

Mjåtveit, A., & Giske, R. (2020). Formative assessment in Physical Education: An analysis of teaching and mentoring in preservice training practice. *Acta Didactica Norden*, *14*(1), 23. http://dx.doi.org/10.5617.adno.7910

Mullender-Wijnsma, M. J., Hartman, E., de Greeff, J. W., Doolaard, S., Bosker, R. J., & Visscher, C. (2016). Physically active math and language lessons improve academic achievement: a cluster randomized controlled trial. *Pediatrics*, *137*(3), 1-9. https://doi.org/10.1542/peds.2015-2743

Olson, A. J., & Roberts, C. A. (2018). Teacher educators' perspectives: Preparing preservice teachers to provide access to the general curriculum. *Remedial and Special Education*, *39*(6), 365-376. https://doi-org.ezproxy.library.uvic.ca/10.1177/0741932517738567

O'Neil, K., & Krause, J. M. (2019). Physical education teacher education faculty self-efficacy toward educational technology. *Physical Educator*, *76*(5), 1287-1305. https://doi.org/10.18666/TPE-2019-V76-I5-9107

Oxford University Press. (2022). Oxford English Dictionary. Retrieved from https://www.oed.com/

Pangrazi, R. P., & Beighle, A. (2019). *Dynamic physical education for elementary school children*. Human Kinetics Publishers.

Parker, M., Morrison, J., Patton, K., Stellino, M. B., Hinchion, C. & Hall, K. (2017). Jaime: "I couldn't teach without technology": A teacher and student learning journey. In A. Casey, V. A. Goodyear, & K.M. Armour (Eds.), *Digital technologies and learning in physical education pedagogical cases* (pp. 31-48). Abingdon: Routledge.

Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). Thousand Oaks CA: Sage publications.

Peirson, L., Fitzpatrick-Lewis, D., Morrison, K., Warren, R., Ali, M. U., & Raina, P. (2015). Treatment of overweight and obesity in children and youth: a systematic review and meta-analysis. *CMAJ open*, *3*(1), E35. https://doi.org/10.9778/cmajo.20140047

Penninx R., Garcés-Mascareñas B. (2016) The Concept of Integration as an Analytical Tool and as a Policy Concept. In: Garcés-Mascareñas B., Penninx R. (eds) Integration Processes and Policies in Europe. IMISCOE Research Series. Springer, Cham. Retrieved from https://link.springer.com/chapter/10.1007/978-3-319-21674-4_2#citeas

Phillips, A., Rodenbeck, M., & Clegg, B. (2014). Apps for Physical Education: Teacher Tested, Kid Approved! Column Editor: Brent Heidorn. *Strategies*, *27*(3), 28-31. https://doi.org/10.1080/08924562.2014.901047

Piggin, J., & Bairner, A. (2016). The global physical inactivity pandemic: an analysis of knowledge production. *Sport, education and society*, *21*(2), 131-147. https://doi.org/10.1080/13573322.2014.882301

Poitras, V. J., Gray, C. E., Borghese, M. M., Carson, V., Chaput, J. P., Janssen, I., ... & Tremblay, M. S. (2016). Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied physiology, nutrition, and metabolism*, *41*(6), S197-S239.

https://doi.org/10.1139/apnm-2015-0663

Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and teacher education*, *26*(4), 863-870. https://doi.org/10.1016/j.tate.2009.10.024

Pyle, B., & Esslinger, K. (2014). Utilizing technology in physical education: Addressing the obstacles of integration. *Delta Kappa Gamma Bulletin*, *80*(2), 35.

Rao, D. P., Kropac, E., Do, M. T., Roberts, K. C., & Jayaraman, G. C. (2016). Childhood overweight and obesity trends in Canada. Tendances en matière d'embonpoint et d'obésité chez les enfants au Canada. *Health promotion and chronic disease prevention in Canada : research, policy and practice*, *36*(9), 194–198.

Robinson, D., & Randall, L. (2017). Gadgets in the Gymnasium: Physical Educators' Use of Digital Technologies| Les gadgets au gymnase: l'utilisation des technologies numériques par les enseignants en éducation physique. *Canadian Journal of Learning and Technology/La revue canadienne de l'apprentissage et de la technologie*, *43*(1).

Rosenberg, J. M., & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of research on technology in education*, *47*(3), 186-210. https://doi.org/10.1080/15391523.2015.1052663

Roth, W. M., & Radford, L. (2010). Re/thinking the zone of proximal development (symmetrically). *Mind, culture, and activity*, *17*(4), 299-307. https://doi.org/10.1080/10749031003775038

Saldaña, J. (2021). *The coding manual for qualitative researchers*. Sage.

Saldaña, J., & Omasta, M. (2016). *Qualitative research: Analyzing life*. Sage Publications. Kindle Edition.

Sargent, J. (2018). Digital technologies and learning in physical education: pedagogical cases. *Sport, Education, and Society, 23*(1), 108-110. https://doi.org/10.1080/13573322.2017.1394836

Saubern, R., Urbach, D., Koehler, M., & Phillips, M. (2020). Describing increasing proficiency in teachers' knowledge of the effective use of digital technology. *Computers & Education*, *147*, 103784. https://doi.org/10.1016/j.compedu.2019.103784

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education*, *128*, 13-35. https://doi.org/10.1016/j.compedu.2018.09.009

Scrabis-Fletcher, K., Juniu, S., & Zullo, E. (2016). Preservice physical education teachers' technological pedagogical content knowledge. *Physical Educator*, *73*(4), 704. https://doi-org.ezproxy.library.uvic.ca/10.18666/TPE-2016-V73-I4-6818

Sharkins, K., Newton, A., Causey, C., & Ernest, J. M. (2017). Flipping theory: Ways in which children's experiences in the 21st century classroom can provide insight into the theories of Piaget and Vygotsky. *Southeast Asia Early Childhood Journal*, *6*, 11-18. https://doi.org/10.37134/saecj.vol6.2.2017

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, *15*(2), 4-14.

Siedentop, D., & Van der Mars, H. (2022). *Introduction to physical education, fitness, and sport*. Human kinetics.

Society for Information Technology and Teacher Education (SITE). (2023). Teacher Educator Technology Competencies. Retrieved from https://site.aace.org/tetc/

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage.

Stake, R. E. (2006). *Multiple case study analysis*. New York, NY: Guilford Press.

Stake, R. E. (2010). *Qualitative research: The study of how things work.* Guilford Press.

Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., & Kundi, G. S. (2021). Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people. *Technology in Society*, *65*, 101565. https://doi.org/10.1016/j.techsoc.2021.101565

Tondeur, J., Scherer, R., Baran, E., Siddiq, F., Valtonen, T., & Sointu, E. (2019). Teacher educators as gatekeepers: Preparing the next generation of teachers for technology integration in education. *British Journal of Educational Technology*, *50*(3), 1189-1209. https://doi-org.ezproxy.library.uvic.ca/10.1111/bjet.12748

Tondeur, J., Van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. Computers & Education, 59, 134–144. https://doi.org/10.1016/j.compedu.2011.10.009

Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., Latimer-Cheung, A. E., Chastin, S.F. M., Altenberg, T.M., & Chinapaw, M. J. (2017). Sedentary behavior research network (SBRN)–terminology consensus project process and outcome. *International journal of behavioral nutrition and physical activity*, *14*, 1-17. https://doi.org/10.1186/s12966-017-0525-8

Tremblay, M. S., Barnes, J. D., González, S. A., Katzmarzyk, P. T., Onywera, V. O., Reilly, J. J., & Tomkinson, G. R. (2016). Global matrix 2.0: report card grades on the physical activity of children and youth comparing 38 countries. *Journal of physical activity and health*, *13*(s2), S343-S366. http://dx.doi.org/10.1123/jpah.2016-0594

Truelove, S., Johnson, A. M., Burke, S. M., & Tucker, P. (2021). Comparing Canadian generalist and specialist elementary school teachers' self-efficacy and barriers related to physical education instruction. *Journal of Teaching in Physical Education*, *40*(1), 10-20. https://doi.org/10.1123/jtpe.2019-0091

UBC. (2023). UBC Today: Faculty & Staff. Retrieved from https://ubctoday.ubc.ca/faculty-resources

Uerz, D., Volman, M., & Kral, M. (2018). Teacher educators' competences in fostering student teachers' proficiency in teaching and learning with technology: An overview of relevant research literature. *Teaching and Teacher Education*, *70*, 12-23. https://doi.org/10.1016/j.tate.2017.11.005

UNESCO. (2023). ICT in Education Policy Toolkit. Retrieved from https://en.unesco.org/icted/content/pedagogical-integration-ict-successes-and-challenges-100-african-schools

van Huizen, P., van Oers, B., & Wubbels, T. (2006). A Vygotskian perspective on teacher education. *Journal of curriculum studies*, *37*(3), 267-290. https://doi.org/10.1080/0022027042000328468

Vygotsky LS. (1978). *Mind in society*. Cambridge: Harvard University Press.

Willermark, S. (2018). Technological pedagogical and content knowledge: A review of empirical Studies published from 2011 to 2016. *Journal of Educational Computing Research*, *56*(3), 315-343. https://doi.org/10.1177/0735633117713114

Williamson, B. (2015). Algorithmic skin: health-tracking technologies, personal analytics and the biopedagogies of digitized health and physical education. *Sport, education and society*, *20*(1), 133-151. https://doi.org/10.1080/13573322.2014.962494

Williamson, B., Eynon, R., & Potter, J. (2020). Pandemic politics, pedagogies and practices: Digital technologies and distance education during the coronavirus emergency. *Learning, media and technology*, *45*(2), 107-114. https://doi.org/10.1080/17439884.2020.1761641

World Economic Forum. (WEF). (2024). Shaping the future of learning: The role of AI in education 4.0. Retrieved from https://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Learning_2024.pdf

World Health Organization (WHO). (2020). Physical Activity. Retrieved from https://www.who.int/southeastasia/health-topics/adolescent-health

World Health Organization (WHO). (2022a). Physical Activity. Retrieved from https://www.who.int/news-room/fact-sheets/detail/physical-activity

World Health Organization (WHO). (2022b). Country Profiles: Global status report on physical activity 2022. Retrieved from https://iris.who.int/bitstream/handle/10665/365761/9789240064119-eng.pdf?sequence=1

World Health Organization (WHO). (2024). Physical Activity. Retrieved from https://www.who.int/health-topics/physical-activity#tab=tab_1

Wu, Y. C., Chen, C. S., & Chan, Y. J. (2020). The outbreak of COVID-19: An overview. *Journal of the Chinese Medical Association*, *83*(3), 217. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7153464/ https://doi:10.1097/JCMA.0000000000000270

Wyant, J., Jones, E., & Bulger, S. (2015). A mixed methods analysis of a single-course strategy to integrate technology into PETE. *Journal of Teaching in Physical Education, 34*, 131-151. http://dx.doi.org/10.1123/jtpe.2013-0114

Wyant, J., & Baek, J. H. (2019). Re-thinking technology adoption in physical education. *Curriculum Studies in Health and Physical Education*, *10*(1), 3-17. https://doi.org/10.1080/25742981.2018.1514983

Yin, R. K. (2018). *Case study research and applications. Design and methods* (6th ed.). Thousand Oaks, CA: Sage publications.

Yurkofsky, M. (2022). Environmental, technical, and representational uncertainty: A framework for making sense of the hidden complexity of educational change. *Educational Researcher*, *51*(6), 399-410. https://doi-org.ezproxy.library.uvic.ca/10.3102/0013189X221078590

Appendix A Ethics Approval

University of Victoria

Certificate of Ethical Approval for Harmonized Minimal Risk Behavioural Study

University of Victoria
Human Research Ethics Board
Michael Williams Building, R. B202 PO Box 1700
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Victoria, BC V8W 2Y2
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Also reviewed and approved by:

- **UBC Behavioural Research Ethics Board**
- **Simon Fraser University**
- **Thompson Rivers University Research Ethics Board**

Principal Investigator:	Primary Appointment:	Board of Record REB Number:	UBC REB Number:
Michelle Wiebe	University of Victoria	**Board of Record:** University of Victoria Study Number: BC20-0481	H20-03008

Study Title:
Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion

Study Approved: October 20, 2020 **Expiry Date: October 20, 2021**

Research Team Members: Tatianna Little, UVic Graduate Student & Instructor, Thompson Rivers University

Sponsoring Agencies: N/A

Documents included in this approval:

Document Name	Version	Date
Protocol:		
Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion	N/A	September 23, 2020
Consent Forms:		
Consent Form	3	October 16, 2020
Questionnaire, Questionnaire Cover Letter, Tests:		
Interview Questions	N/A	September 23, 2020
Letter of Initial Contact:		
Letter of Initial Contact	2	October 16, 2020
Other Documents:		
Interview Protocol	2	October 16, 2020
Observation Collection Guide	N/A	September 23, 2020
Signatory Form	N/A	October 16, 2020
Observation Protocol	2	October 16, 2020

TCPS 2: CORE	N/A	April 24, 2016

This ethics approval applies to research ethics issues only and does not include provision for any administrative approvals required from individual institutions before research activities can commence.

The Board of Record (as noted above) has reviewed and approved this study in accordance with the requirements of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2, 2014).

The "Board of Record" is the Research Ethics Board delegated by the participating REBs involved in a harmonized study to facilitate the ethics review and approval process.

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

This study has been approved either by the Board of Record's full REB or by an authorized delegated reviewer.

Appendix B Letter of Initial Contact

University of Victoria

Good afternoon (name),

My name is Tatiana Little. I am a doctoral student in the Curriculum and Instruction program at the University of Victoria and a physical education methods teacher-educator at Thompson Rivers University in Kamloops, BC. I am conducting a research study on the faculty perspective of supporting preservice teachers' preparation to promote physical activity in the 21st century.

I am kindly requesting your participation in this study, which is entitled: *Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion.*

Your perspective as a physical education teacher-educator is significant for this study, regardless of whether or not you include technology integration in your course. Participation in this study is completely voluntary and participants can withdraw at any time. Participant participation will be kept confidential.

This study is intended to be conducted during the academic school year of 2020/2021. The expected commitment for participating in this study is two 30-45 minute interviews via, whichever mode you are most comfortable, a phone call or video conferencing, In addition, I hope to observe one classroom session, either via video conferencing or through viewing a previously recorded lesson, whichever is being offered for your course. If available, I am also hoping to review any documents relevant to the classroom session.

Your participation in this study would be significant in helping to advance understanding of preservice teacher physical education preparation, specifically on the topic of supporting preservice teachers to promote physical activity in the 21st century.

If you are interested in being a part of this study, please read the consent form attached to this email. I will contact you via email on (specific date) to inquire as to your interest in being a part of this study. In the meantime, you are welcome to let me know if you have any questions; I can be contacted via email at tlittle@tru.ca or via phone at 250-318-3027.

Thank you for your time,
Tatiana Little

Version Date: October 16th, 2020 version 2

Appendix C Consent Form

University of Victoria

Letter of Informed Consent

You are invited to take part in a research study designed to explore the perspective of teacher-educators on supporting preservice teachers to be prepared to promote physical activity in the 21st century. This study is being conducted by Tatiana Little (the researcher) and will form a part of her thesis in fulfillment of her doctoral studies in the Curriculum and Instruction Program at the University of Victoria. The study is entitled: *Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion.* It is important to note that your perspective as a physical education teacher-educator is significant for this study, regardless of whether or not you use technology in your course.

Procedures

This study will be conducted during the academic school year of 2020/2021. Teacher-educators teaching physical education at approved Education Programs in British Columbia are being asked to share their perspectives through the following ways:

- Two 30 – 45 minute interviews via whichever mode the teacher-educator is most comfortable (video conferencing or audio call). Interviews will be audio recorded. Interview data will be anonymized through the use of pseudonyms. If more data would be beneficial to the study, participants may be asked to participate in a third interview; however, this would be optional. Participants can decline to answer any question.
- One class observation – the researcher plans to observe one class via video conferencing. The researcher will request to audio record the class; however, having the class audio-recorded is optional. If more data would be beneficial to the study, participants may be asked if a second class could be observed; this would be optional.
- Documents – teacher-educators will be asked to share relevant documents, such as course syllabi and plans. Data collected from documents may be summarized in the results of this study. The researcher understands that such documents may not be available and sharing such documents is not a requirement of being a part of this study.

Information Safety and Confidentiality

Participation in this study is completely voluntary and participants can withdraw at any time. Participants wishing to withdraw can do so by sending an email to the researcher at tlittle@tru.ca.

Participation will be kept confidential. Participants' names will not be associated with the research findings, only the researcher will know of your participation in the study. Interview data will be anonymized through the use of pseudonyms.

A copy of this consent will be left with you, and a copy will be taken by the researcher.

During the research study electronic data will be stored on the hard drive of a private, password protected device and a private, external flashdrive, both of which will be stored in a locked room. Audio recordings (which will be recorded on an independent recording device) and hard copy data will be stored in a locked cabinet located in a locked room.

The researcher and her advisory committee will be the only people that have access to the data collected. Participants will be given opportunity to read and comment on the preliminary analysis results prior to the dissertation being submitted. Data collected will be destroyed five years after being collected; electronic data will be deleted and hard copy data will be shredded. There are no known risks associated with this study. You may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria, 250-472-4545 or ethics@uvic.ca. The expected benefit is that of contributing to a study that will add to the overall body of knowledge on preservice teacher education. Specifically, your participation in this study will be significant in advancing understanding of preservice teachers' preparation to promote physical activity in the 21st century.

Information Dissemination

Participants can contact Tatiana at tlittle@tru.ca any time up to five years after data is collected and request to have the findings of the study emailed directly to them at an email address they provide.

Once the study is completed, the resulting thesis will be posted on UVicSpace, which is publicly accessible. In addition, the results may be disseminated at conferences or through future publications.

I have read and understood the above information regarding this research study; I voluntarily agree to participate in the study and understand that I have the right to withdraw at any time. I understand that my identity and any information obtained will be kept confidential throughout the process. The recordings and the transcripts will be kept in a locked filing cabinet in a locked private room. Five years after data collection, the data collected for this study will be destroyed. The results from this study will be published in a dissertation posted on UVicSpace, and may be presented at conferences and published in professional journals. The names of participants will be replaced with pseudonyms and all identifying information will be removed. I have had adequate opportunity to ask questions. Questions can be asked at any time during this study by contacting Tatiana at tlittle@tru.ca or 250-318-3027. This study is being conducted under the supervision of Dr. Michelle Wiebe, who may be contacted via email at mxw@uvic.ca or via phone at 250-721-7894. Please sign your consent with full knowledge of the nature and procedures of the study. A copy of this consent form will be provided to you.

Date_____

Participant's Signature _____

Researcher's Signature_____

Appendix D Interview Protocol

Interview Protocol

Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion

The Department of Curriculum and Instruction
Faculty of Education
The University of Victoria
Tatiana Little

The researcher plans to conduct two 30-45 minute interviews. The mode of interview will be either a phone call interview or a video-conference interview; this will depend upon the participant's preference. The researcher will audio record the interview; consent for audio recording was included on the informed consent form that the participant will have already signed at this point. If, after the two 30-45 minute interviews, the researcher determines that an additional interview would be beneficial to the study, participants will be asked if a third interview would be acceptable; the participants will be reminded that a third interview is completely optional.
This interview protocol is designed to be used with the Semi-Structured Interview Questions that have already been submitted to this ethics application.

Data Recorded Prior to the Interview Commencing
Date:
Location of both the researcher and the participant:
Researcher:
Participant:
Type of interview: Phone call, video-conference

Welcome & Thank you

Hello, thank you for agreeing to be a part of this study on preservice teacher education. Your perspective as a physical education teacher-educator is meaningful for this study and will contribute to the knowledge base of preservice teacher-education, as well as expand teachers' understanding of promoting student physical activity in our current world.

Reminders

I have a few reminders for you:

- You can withdraw from this study at any point
- You can choose not to answer any of the questions posed to you today
- This interview is being audio recorded and will be transcribed by myself. Once the interview is transcribed, you are welcome to have a copy of the transcribed interview

- emailed to you and can let me know if you think anything should be changed. Would you like a copy sent to you?
- I would also like to assure you that participants and their associated schools will remain completely confidential
- Do you have any questions at this point? Before we get started would you please state your name. Have you read and signed the consent form, do you have any questions regarding the form?
- This interview will be semi-structured - I have prepared questions but I may ask questions based on the information in your answers. In addition, you may think of information that does not directly answer my question but will be meaningful to the study, please feel free to share this information.

The Purpose of the Study as Explained to Participants

The purpose of this study is to explore physical education teachers' perspectives on supporting pre-service teachers to be prepared to use digital technology to promote physical activity. This study was motivated by the serious global health issue of inactivity. Within Canada, the lack of physical activity amongst children has contributed significantly to rise in obesity and to a dramatic decline in the health of Canadian children. As such, the government has identified schools and teachers as having a key role in addressing children's needs for increased physical activity. Yet there is still limited research on how preservice teachers are being prepared to promote activity in the 21st century. Thus, the motivation for this study.

The Researcher's Background as Explained to Participants

This study is of interest to me because I am both a registered nurse and physical education educator; therefore, I am involved in preparing preservice teachers to promote physical activity and have regular reminders in my work as a nurse how important it is to have children be physically active. What I witness in both occupations inspired me to complete this study.

Do you have any questions prior to the interview commencing?
Please remember that you can add in information at any time even if it relates to a question from earlier in the interview.

The Semi-Structured Interview Questions (already uploaded to the ethics application) will be commenced at this point.

Thank you

The interview will be concluded by the participant being thanked for their participation in the study and reminded how meaningful their contribution is to the study. In addition, the researcher will inquire with the participant as to if they have any questions, concerns, or comments. Further, the researcher will remind the participant that the researcher can be contacted at any time if the participant has comments or questions at a later time.

Appendix E Interview Guide for Interview One

University of Victoria

Semi-Structured Interview Questions
Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion

The Department of Curriculum and Instruction
Faculty of Education, The University of Victoria
Tatiana Little

1. a. Please describe your opinion on physical activity promotion in Elementary and High schools?
b. In your opinion, does physical activity fit in school curricula?
If yes, please describe how? In your opinion, within the school system, whose responsibility is it to promote PA?
If no, what is your viewpoint on whose responsibility it is to educate and encourage students to be physically active?

2. a. In general, what is your opinion on digital technology?
b. What is your opinion on digital technology use in elementary and high schools? Do you feel digital technology fits with school curriculum?
If yes, in what ways, please describe?
If no, please explain why you feel digital technology does not fit with school curriculum?

3. a. Do you use digital technology in the courses you teach?
a. If yes, how so, and are you being supported to integrate digital technology into your courses? (What is the support like?)/Have you been supported as a teacher-educator in bringing digital technology into preservice teacher courses?
b. If no, please describe some of the strategies you use in your courses to facilitate learning?

4. a. What is your opinion on whether preservice teachers should be being prepared to integrate digital technology into their practice?
If their opinion is yes:
b1. Have you been supported to prepare teachers to integrate digital technology into their teaching practice? How?
b2. How do you view your role in preparing preservice teachers to integrate technology into their practice?
b3. Could the support provided to you for preparing preservice teachers to use digital technology be stronger? Do you have ideas on how it could be stronger?/If yes, please describe.
If their opinion is no:
c1. Would you please expand on why preservice teachers do not need to be prepared to integrate digital technology into their practice?

5. a. Have there been obstacles in supporting preservice teachers to use digital technology in their lessons? Please describe the obstacles. (This question is only asked if 4 was affirmative)

6. a. How would you describe the relationship between digital technology and physical activity?
b. What is your opinion on supporting preservice teachers to integrate digital technology to promote physical activity?

Version Date: September 23, 2020

Appendix F: Observation Protocol

University of Victoria

Observation Protocol

Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion

The Department of Curriculum and Instruction
Faculty of Education
The University of Victoria
Tatiana Little

The researcher plans to observe one class via live video conferencing or through observing a previously recorded classroom session; this will depend on the class delivery mode. The researcher will request to audio-record the class; however, having the class audio recorded will be optional. The observation will be for the duration of the class, which varies with each instructor; the expected class length is between 45 – 120 minutes. If, after the first observation, the researcher determines that more observational data would be beneficial to the study, participants will be asked if a second observation would be acceptable; the participants will be reminded that a second observation is completely optional.

1. The researcher will use the Observation Collection Guide, uploaded in "9.7 Other Documents" of this ethics application. to guide data collection.
2. The researcher will be strictly an observer and will not be a participant-observer. Therefore, the researcher's role in the class will be solely that of observation.
3. For this doctoral research study the participant will have already signed an informed consent form. Therefore, access will have been gained and the participant will have consented to having a class observed. The date of the class being observed will be determined through consultation with the participant as to what best fits their schedule.
4. The researcher will be dressed professionally and will be quiet throughout the class, unless specifically addressed by the participant.
5. The researcher will remind the participant that observations will be confidential and that no data collected will reveal the participant or the students' identities.
6. Participants will be provided the following description to share with their students in order to acknowledge the presence of the researcher. We have a doctoral student, Tatiana Little, from UVic who will be observing our class today for research she is doing for her degree. Observations will be focused on the instructor and how the course is delivered. Student identities will be completely confidential and data will not be collected on student observations or student verbal exchanges. In addition, students will be asked to participate in the class as usual, as if a researcher was not present.
7. a. The researcher will consult with the participant ahead of time if the participant is comfortable with the class being audio recorded.
   b. As the class will be observed remotely, the researcher will take notes on her laptop during the class and audio record if audio recording was deemed acceptable with the participant. The researcher is a quiet touch-typist, so typing should not create any disruption for the class.
8. The observation will be concluded by the participant being thanked for their participation in the study. In addition, the researcher will inquire with the participant as to if they have any questions, concerns, or comments. Further, the researcher will remind the participant that the researcher can be contacted at any time if the participant has comments.

Appendix G: Preplanned Observation Guide

Date, Time, & Course Topic	Physical Description	Social Description	Participants & Positioning	Activities	Observations -digital technology used -Physically active?	Relevant Quotes

Appendix H Interview Guide for Interview Two

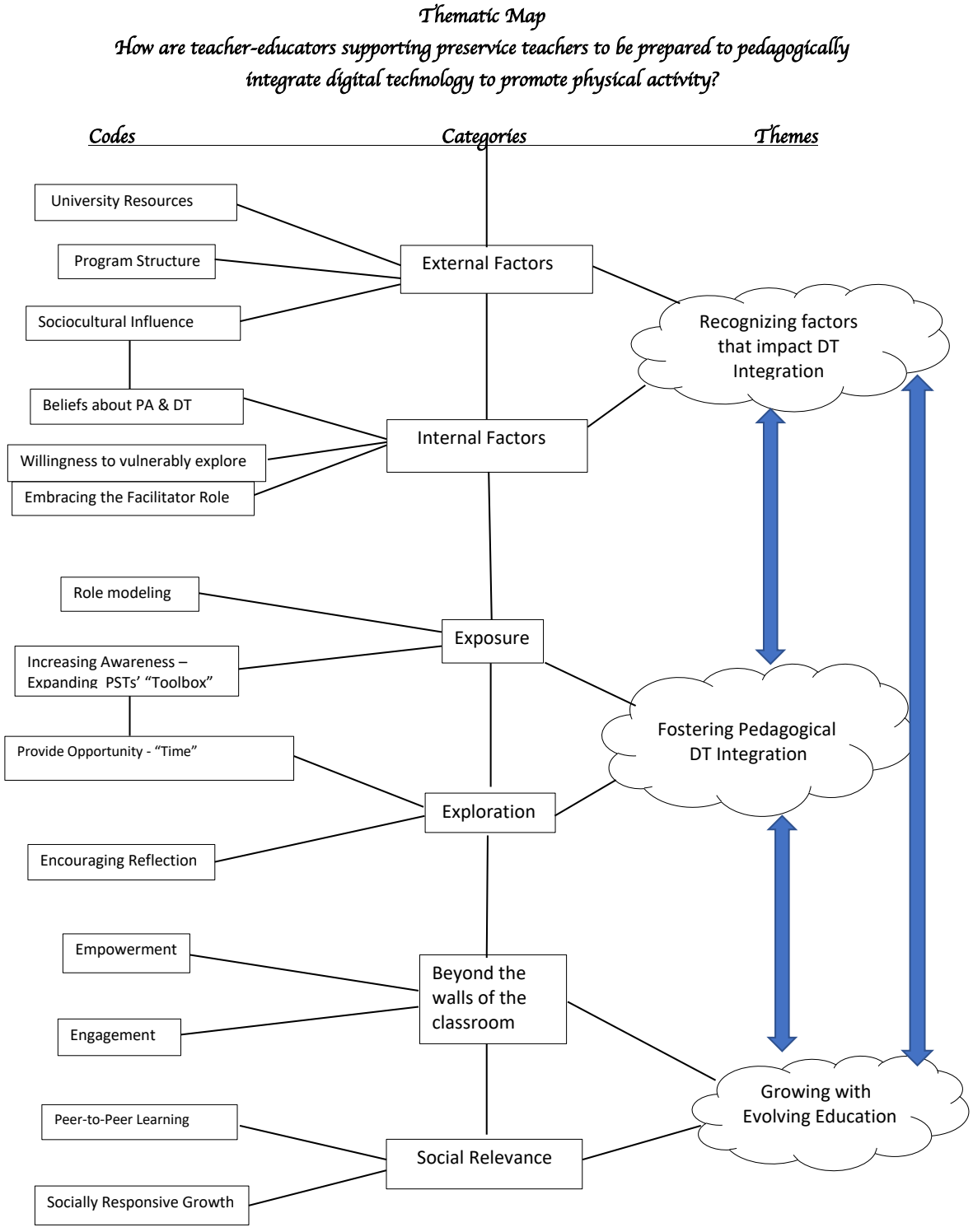
Semi-Structured Guiding Interview Questions
For Interview # 2
Motivating movement: Exploring educators' perspectives on supporting preservice teachers to integrate technology for physical activity promotion

The Department of Curriculum and Instruction
Faculty of Education, The University of Victoria
Tatiana Little

Interview Introduction: Thank TEs for previous interview and for this second interview. Remind TEs of interview protocol. Start with general questions to reorient TEs to topic, then continue with questions that developed from interview #1 and observations.

1. Thinking about general strategies to prepare preservice teachers to promote physical activity. How are you supporting preservice teachers to be prepared to go into the field and motivate students to be physically active?
2. How would you, as a teacher educator, describe the strategies you are incorporating to support preservice teachers to be prepared to integrate digital technology into lessons to promote physical activity?
3. BC's new curriculum puts forth that students need opportunities to use digital technology in all areas of education, including physical and health education. What factors do you identify as impeding your ability to support preservice teachers to be prepared to integrate digital technology to promote physical activity?
4. One theme that came up in the initial interviews for this study, was the importance of the pedagogical integration of digital technology to effectively promote physical activity.
    a. Can you describe the supports have have/need to support preservice teachers to be prepared to pedagogically integrate DT for PA promotion?
    b. Can you describe the supports you think preservice teachers need to be able to pedagogically integrate digital technology?
5. Pedagogical integration was identified as important in ensuring that digital technology was effective in meeting learning objectives. When thinking about meeting physical education learning objectives:
    a. How are you or how do you envision supporting preservice teachers to integrate DT to meet specific learning objectives?
    b. For example, when we look at facilitating competence of fundamental movements in school age children. How do you see supporting preservice teachers to use digital technology to support a learning objective such as that?
6. Bringing this interview back around to our roles as teacher educators, how would you describe your role as a teacher educator in supporting preservice teachers to be prepared to integrate digital technology to promote physical activity?
7. Do you have any final thoughts that you would like to share on how you, as a teacher educator, are supporting preservice teachers to be prepared to integrate digital technology to promote physical activity?
    a. Is there anything that we did not touch on in our discussion that you would like to share on supporting preservice teachers to integrate DT for PA promotion?

Appendix I Thematic Map



Appendix J Observation Comparison Chart

Overview of Course Description	One 3 credit course that integrates lecture and lab in each class Knowledge and pedagogical development for teaching PE. Increase understanding and ability to develop inclusive plans to encourage PA for life.	One 3 credit course with a separate Lecture & Lab Gain knowledge for teaching PE with a focus on understanding developmentally appropriate PA. Teaching games for understanding & inclusivity.		One 3 credit course with a separate Lecture & Lab Gain knowledge & pedagogical skills for teaching quality PE. Lesson planning to encourage movement & PA for life.	
Participant	**Paul/Deer**	**Pat/Giraffe - Lecture**	**Pat/Giraffe - Lab**	**Peter/Dragon - Lecture**	**Peter/Dragon - Lab**
Point in Career	New instructor working as sessional	Long-time professor		One year from retirement	
Date & Time of Class Observation	Jan. 28th, 2021 8:30 am – 9:50 am	Feb. 2nd, 2021 10:30 am – 12:30 pm	Feb. 2nd, 2021 2:00 – 4:00 pm	Feb. 22nd, 2021 3:00 - 4:15 pm	Feb. 24th, 2021 3:00 - 4:15 pm
Time per week for course	Course has 2 – 1 hour 20-minute classes that are both a mix of lab and lecture.	2-hour class Lecture	2-hour class Lab	1 hour 15-minute class on Mondays - Lecture	1 hour 15-minute class on Wednesdays - Lab
Class Topic	Gymnastics – focus on increasing elementary students understanding of balance in a fun and encouraging way -inclusive and motivational engagement in PA	Teaching – teaching methods & styles, learning domains, achieving learning outcomes - progressive development & inclusive engagement	Applying theory from lecture to developing a Striking/Fielding Game Lesson Plan Development	Creative Movement - Theory on creative movement -promote engagement in long-term PA	Creative Movement - Lab that had students create creative movement lessons
Physical Description All classes were being delivered online via Zoom due to the Covid pandemic	34 students 1 instructor 1 observer Videos being on was strongly encouraged. TE taught on screen from a large classroom that had tables, chairs (pushed to the side of the classroom) with one gymnastics mat central in the room, so that students could see the TE. The TE was large on the screen and the student images were small, which appeared to reduce	33 students online 1 instructor 1 observer Instructor had live feed video on One student had video on 3 students chose to have photos on screen of themselves.	33 students 1 instructor 1 observer Background behind instructor– image of pool with people swimming	19 students in courses 15 students attended 1 instructor 1 observer Video was optional but encouraged Most students with videos on – number of students with videos on changed throughout class – usually 12	19 students in course 14 students attended 1 instructor 1 observer Video was optional but encouraged Most students (usually 12) with videos on Peter's background online was an unembellished wall with
	feelings of being on camera for the students. A computer, keyboard, coloured beanbags on a table and pictures of people being physically active on a board were all within the camera view, creating a welcoming school room/educational space.	Background behind instructor– image of pool with people swimming and throughout lecture was showing slides that coordinated with course content		students with video on at any given time Peter's background online was an unembellished wall with a window that had blinds down for the PSTs to be able to see him clearly.	a window that had blinds down for the PSTs to be able to see him clearly. and throughout lecture was showing slides that coordinated with content
Social Description Participants & Positioning	Synchronous Video Lecture & Lab All online videos on TE would note things in the students' backgrounds and engage/connect with them in discussion prior to class starting to further set an open and welcoming atmosphere. Group activities described in more detail in activities section of this chart.	Synchronous Video Lecture Teacher with live feed video and sound on TE friendlily greeted students and clearly introduced the lesson for the day Having videos on was completely optional during lecture 1 student chose to have video on the rest chose no sound & no video while listening to lecture but many turned on video to ask questions However, students appeared more comfortable with text messaging and videos off By personal choice, students mostly used chat to communicate - 3 students communicated in chat TE encouraged questions at any time	Synchronous Video Lab Afternoon TE friendlily greeted students and reminded students of the activities for the day and sorted them into groups. TE checked for questions prior to group work beginning. 6 student groups in video break out rooms Students unmuted sound for discussion, but videos stayed off Room 6 – 6 St. Room 5 - 6 St. Room 4 - 6 St. Room 3 - 7 St. Room 2 – 6 St. Room 1 - 5 St. Groups activities described in more	Synchronous Video Lecture TE greets many by name and said good morning TE Social check in – how is everyone, opens it up to the floor with a specific question of "did anyone do anything exciting over reading break?" Students orally answered questions	Synchronous Video Lab TE greets many by name and says good morning TE asks questions to connect with students Content for class clearly communicated. TE asks for questions. The students sorted into groups to work as a team and prepare a creative movement lesson. Group activities described in more detail in activities section of this chart. When students shared ideas, TE provided positive affirmations - "That is a good idea"

		and orally answered chat questions TE was visible while delivering lecture	detail in activities section of this chart.		
DT used in Class	Zoom – video conferencing Phone & Spotify for music PowerPoint slides Blogs in groups called "teams" with fun team names that the students made up – with team moderators so already learning leadership. Google docs for self-reflection assessment survey on how they felt before and after exercise Which balance did they find the most difficult and the easiest How would you rank your participation between 1 = "poor effort" and 10 = "my best class ever" *Note – no specific PA apps being used Students used own DT Some PSTs used multiple devices – ie. Laptop for course access and cell phone/iPad to find relevant information	Zoom – video conferencing Used powerpoint slides to deliver lecture – instructor was visible while going through slides (used "talking head" approach) Played videos for example Images of PA in background *Note – no specific PA apps being used Students used own DT	Zoom – video conferencing Students used google docs to record group lesson plan Canvas – learning platform for delivering online content *Note – no specific PA apps being used Students used own DT	Zoom – video conferencing Video embedded in lecture Encouraged use of DT for music PowerPoint slides Used video to show how diverse abilities are included DT used to show images relevant to lecture Used DT to show baseball team dance and to show PSTs ways that DT can encourage movement with elementary students Images to represent concepts – for example – photos of young children doing creative movement in class and photos of dance performances – professional ballerinas Videos of creative dance *Note – no specific PA apps being used Students used own DT	Zoom – video conferencing Video embedded in lab information as a demonstration. PowerPoint slides Images of baseball play for sport example *Note – no specific PA apps being used Powerpoint slides were used to display key text and images were used that represented lesson concepts. PA promotion DT was used through video being embedded in the lecture that showed examples of creative movement. creative movement. Emailed a handout to all students *Note – no specific PA apps being used Students used own DT NO PA APPs used during class Laptop for course access and cell phone/iPad to find relevant information
Content Delivery & Description Activities	Started with warm welcome and check in and played music to set class tone. Students had been made aware before class that they would be engaging in PA. All students strongly encouraged to turn cameras on and take part in PA together. Then the students were encouraged at the beginning of class to use whatever space was available to them, which ranged from one student in a full gymnastics centre to a small room with a mat, all surroundings were supported by the TE. TE overviewed what was going on in the course to ensure students were on the same page and shared his screen - so they were reviewing together as a class. Check in for questions often. Students doing blogs in groups called "teams" with fun team names that they made up – with team moderators so already learning leadership. Began the class with showing a few balances first (led the class as though leading an elementary class – good role modeling) Started with basic moves and clear description – such as balancing on one foot with leg-off-ground infront of body, then another one foot balance with leg-off-ground behind body. TE did movements with the students simultaneously online. After showing three balances and having everyone try them together then the game was clearly described – students moved with music until music stopped and then hit one of the three poses and froze in that position. The students in the least 'chosen' pose would engage in an additional activity, such as 5 jumping jacks. Used student names regularly.	Started with warm welcome and check in. Started with letting students know the agenda for the day Check for questions Lecture based class focused on three teaching methods (direct (psychomotor), discovery, games) and learning domains (Cognitive, Affective and Psychomotor) Reminder to use curriculum to develop learning outcomes and plan lesson Started with completing reflection questions on Canvas that had PSTs identify activities in which they are at in the cognitive stage, associative stage and autonomous stage. Students were provided with class time to complete questions on Canvas and then check for understanding TE checked in often with students if they had any questions During class, Pat acknowledged that the students may be more familiar with some of the DT being used and commented in	Teacher welcomed students and reminded students of the outline for the lab Students collaborated in groups in Zoom breakout rooms to create lesson plans on striking/fielding games and how the games related to the three learning domains (Cognitive, Affective, Psychomotor) Groups presented lesson on video during lab time Every student had to take a turn speaking and describing a portion of the activities.	Check in for comments and questions. Creative movement theory shared with students - Labans Movement Framework was discussed Talking and asking but no physical movement included Create and share creative movement lessons Brainstormed for creative movement themes as a group - idea stimulation from sharing was apparent Video was shown by TE to provide example of how diverse abilities can be included in creative movement One video was proving to be challenging to share on a particular device; Peter welcomed insight from his students, who provided guidance on how to address the situation. Throughout his lecture, Peter asked if any students had	Check in that students had lesson plan templates and check in for questions from last class Students were reminded of the planned activity for the class - Create and share creative movement lessons Emailed a handout to all students so that they all had the creative lesson plan guide to assist their learning As the full class, students reviewed identified themes for creative movement Then students were sent to breakout rooms and instructed that each person in group must contribute – then group will present and share the theme created. I observed in breakout rooms – students shared well in breakout room with videos on - Actively engaged as small groups to create lesson plans that support students to engage in creative movement When time to rejoin as full class - TE enthusiastically welcomed student back

	TE commented on students' env to show connection. 30+ students (32). air skipping TE used Spotify to play and pause music for a freeze game. After warm up, TE then described activity, so TE role modelled instant activity to start the class and then proceeded with information "Gymnastics puzzle" – showed progression and adaptations Significant survey - gave students an opportunity to be heard - shared their opinions and conscientiously noted how they are feeling Wove DT throughout lesson and verbally identified for PSTs that they could do this in their classrooms, play music, stop it, etc. Fostered engagement by TE showing examples of what a position puzzle could look like with various points of contact on the ground, as if "ink were on your contact points" Put up many slides of balance examples In their cams - 8 poses for each group that they went into group break out rooms and determined – used DT: google docs for lesson planning and took photos of team members performing the balance as an answer, then screen shared with class – created slides to screen share	reference to DT to students "that you students know this better than me".		questions or needed clarification. Breakout rooms for a start on the group activity of lesson planning	to main room with live video Then student groups shared their creative dance theme lessons with the full class and most included that they would use video, such as YouTube videos to engage their future students in creative movement and to help future students start developing their own ideas.
Were students physically active during this class?	Yes First led in activity for warm up by TE Then each group created a balance PowerPoint lesson and were moving in their own groups during creation. Then each group shared one main puzzle pose with the class and students tried to do the pose and solve the puzzle.	No	No The students appeared to actively engage in class activities and were effective in using DT to develop lessons that would encourage PA in their future	No	No to actively engage in class activities and were effective in using DT to develop lessons that would encourage PA in their future elementary classes. However, did not engage in any PA during class.

			elementary classes. However, did not engage in any PA during class.		
Assessment of own experience comments	When asked if he uses DT in the courses he teaches, the answer was – "absolutely, all the time." He also provided examples of use, such as "different types of video analysis with everyone on the cell phone. Now, it's very easy to do this." Paul's response when asked how he viewed his role in preparing PSTs to integrate DT for PA promotion was as "a facilitator for them to develop their own ideas".	Pat commented that she is "not an experienced user of DT" "a computer dinosaur [when it comes to DT] because I really do not embrace technology at maybe the level that I should". DT identified by TE as used to promote PA and to assess physical movement: Pat commented that she uses DT to "play videos" and then had the PSTs "answer questions about the videos". When Pat was talking about TEs' responsibilities as PST educators, she referred to the role of TEs "as facilitators at the university level for teachers".		Peter commented: "There seems to be a continuum of where people fall on the technology spectrum from very little to a whole lot. And I would probably place myself in the center." Peter further explained that "certainly in my teaching and in my lectures and my delivery of my courses, I use technology, but there's areas where I could certainly enhance." And commented that "a weakness in my course at this present time is that I have not adopted a lot of other technological aspects."	