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Understanding the Transition of Teachers from Game Users to Game Designers

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Understanding the Transition of Teachers from Game Users to Game Designers

by

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A THESIS

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Abstract

Video games play an important role in education, having a strong influence on the Net Generation; however, the idea of teachers as designers of digital classroom games to support student learning has not been widely embraced. The purpose of this study was to gain a deeper understanding of internal and external factors that influence teachers' capacity to teach and inspire them to move from game users to game designers.

This mixed-method case study involved a group of teachers who used and/or designed games for students. The four unique case groups were grounded in three cities and four school districts in Alberta, Canada. Qualitative data were collected from five teachers and six school administrators, six student focus group interviews, eight in-class observations, and two teacher-designed games. Quantitative data were collected from one online survey completed by all five participating teachers.

First and second cycle data coding and analyses (Saldaña, 2013) were used to answer the following four research questions:

- 1) What are the key factors that influence teachers in using digital game-based learning environments?
- 2) What are the key factors that influence teachers in designing digital game-based learning environments)?
- 3) What are the conditions needed to develop teachers' capacity to be designers of digital games?
- 4) What factors influence the transition of teachers from being game users to game designers to support student learning.

Key findings from the analysis showed that 1) teachers' passion towards Digital Game-based Learning (DGBL) played an important role in motivating them not only to use games but design games, and 2) their technical and pedagogical knowledge worked as a foundation to help teachers transition from game users to game designers.

The implications of this study are: 1) my research showcased potential opportunities for both pre-service and in-service teachers regarding designing games in the classroom; 2) school administrators my reference my study to provide resources to support teachers' innovative teaching approaches and encourage them to be risk-takers; and 3) my research offers options for professional developers to develop courses on game design in order to prepare teachers to use/design games in pedagogically sound ways.

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I owe a debt of gratitude to the participants of my study. They took their valuable time to share their thoughts on gaming and opened their classrooms to me. I also appreciate their passion not only towards gaming but more importantly teaching. It is because of them that our students thrive and grow.

I also would like to thank my University of Calgary colleagues and friends (Dr. Carol Ing, Dr. Peter Gabor, Dr. David Este, Dr. Patti Dyjur, Dr. Ilyan Ferrer, Dr. Alan Stephen, and more) for their support and encouragement. I give special appreciation to my work supervisor Dr. Ellen Perrault from Faculty of Social Work. Thank you for believing in me and the time off you granted so I could finish this dissertation on time.

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Lastly but definitely not the least, I give honour and thanks to my Lord for your unfailing love and granting me the opportunity to be in this journey accompanied by all the amazing people above. “I know the LORD is always with me. I will not be shaken, for He is right beside me” (Psalm 16:8).

This dissertation was copyedited and proofread by an associate of Editing Group, Canada, and Dr. Amy Fulton according to the editing guidelines of Editors Canada.

Dedication

*For my son, Jesse De Yi Yang (暖暖)
You are the best present from God*

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CHAPTER ONE: INTRODUCTION

Background and Context

Gaming and game-based learning have been growing in popularity with children and young adults. The amount of time young people spend playing computer and video games is estimated at 10,000 hours by the time they reach age 21 (Prensky, 2001). Based on the 2017 Horizon Report,

Classrooms are shifting from teacher centered to student centered with the aid of games such as Minecraft or Community in Crisis, which puts students in decision-making roles while they navigate real-world crises. Teachers implementing new games and software learn alongside students, which requires a degree of risk on the teacher's part as they try new methods and learn what works (Freeman, Adams Becker, Cummins, Davis, & Hall Giesinger, 2017, p.30).

Jenkins (2009) outlined 11 core skills that students need in the new media culture; games utilizing play, simulation, performance, and appropriation play an essential role in supporting students to gain skills for the 21st century. By using games, students get a chance to reconstruct and reconfigure knowledge to help them become critical thinkers and effective designers (Bogost, 2005; Jenkins, 2009; Ke, 2008). However, Robinson (2006), an English educator and author, challenged the ways teachers have been educating our children by cultivating them to be "good students" instead of critical thinkers, which means hindering their thinking skills by not allowing them to make mistakes. Games provide freedom for learners to make mistakes fearlessly; in turn, these mistakes encourage students to exert their creativity and imagination to a greater extent,

being able to solve problems by thinking, evaluating, and analyzing (Wagner, 2012).

Kastelle (2010), a professor at the University of Queensland, argued that “making mistakes is a key innovation skill” (para. 1). Innovative thinking is one of the most desired qualities for teachers to impart to their students (Robinson, 2006; Wagner, 2012).

The use of digital games for teaching and learning has become a popular trend in education (Huang, Cheong, & Baek, 2012; Hwang & Wu, 2012; Mitchell & Savill-Smith, 2004). The 2017 Horizon Report (Freeman et al., 2017) stated, “To equalize education opportunities in developing countries and conflict zones, Google.org recently pledged \$50 million dollars to non-profits using scalable technologies. Supported organizations include War Child Holland, which has developed a game-based platform to “deliver curricula to displaced refugee children” (p. 34). It was also reported that 97% of children and adolescents played digital games at least one hour per day in the United States (Slovak, Salen, Ta, & Fitzpatrick, 2018). More importantly, research has shown digital games significantly enhance students’ aptitude in problem-solving, spatial awareness, and creativity (Shute, Ventura, & Ke, 2015).

In 2015, American former President, Barack Obama, announced the National STEM Video Game challenge throughout the country to engage students in STEM subjects and improve teachers’ professional development (The White House, 2015). He commented:

I’m calling for investments in educational technology that will help create educational software that’s as compelling as the best video game. I want you guys

to be stuck on video games that are teaching you something not just blowing something up (The White House, 2011, para. 26).

By employing activity-based approaches such as games and simulations, formal education programs are becoming more effective and meaningful (Conner, 2005 as cited in Quinn, 2005). Studies have shown various benefits of using digital games for supporting educational objectives and outcomes:

- 1) digital games “can promote student motivation in core academic subjects” (Papastergiou, 2009, p.11) and “their unpredictability and competition spark players’ curiosity and inner motivation” (Fu, Su, & Yu, 2009, p. 101);
- 2) digital games “have a potential to foster players’ metacognitive regulation and engage them in active cognitive thinking” (Ke, 2008, p. 554);
- 3) well-designed digital games can stimulate and promote students’ problem-solving skills (Gee, 2005; Sancho, Moreno-Ger, Fuentes-Fernandez, Fernandez-Manjon, 2009; Sun, Wang, & Chan, 2011);
- 4) digital games can encourage collaborative learning among learners (Bekebrede, Warmelink, & Mayer, 2011; Ke & Grabowski, 2007);
- 5) digital games provide personalized learning opportunities (Ash, 2011; Felicia, 2011; Klopfer, Osterweil, & Salen, 2009);
- 6) digital games offer immediate feedback to the players (Gee, 2008; Shute & Ke, 2012; Wu, Chang, & He, 2010).

Overall, digital games have the potential of creating an interactive learning environment while empowering learners by motivating their critical and problem-solving skills through introducing “play” elements into the learning experience.

In autumn 2013, Olds College in Alberta launched a new game-based course in entrepreneurship with over \$2 million dollars in investment; the course is delivered through an iPad application, and all the students in Olds College are required to complete this game, *Spirit of Entrepreneurship*, to graduate (Olds College Communications, 2013). It was designed to 1) facilitate students in learning and applying entrepreneurship concepts, 2) provide students with curriculum delivered in a manner that is relevant to the Net Generation, and 3) help prepare students for life after college (Olds College Communication, 2013). Olds College aims to promote this game to other colleges and universities with entrepreneurship courses throughout Canada. In 2015, Arizona State University (ASU) launched a series of online games to teach Environmental Sciences. This decision was prompted by the “demand of new ways of learning” (Gamelearn, 2015).

Quest to Learn (Q2L) is a 6-12 public school founded in 2009 in the United States that has adopted game-based pedagogy into their curriculum. In Q2L, each teacher teams with a game designer and a curriculum designer every trimester to create curricula and games that address students’ learning goals based on New York State Learning Standards (Quest to Learn, 2018). These games are not only digital but customized, and they have gradually become a trend in primary, secondary, and post-secondary schools to meet the learning needs of students.

Problem Statement

Researchers have examined both how to use commercial games for educational purposes and advise game designers on creating educational games (Gros, 2007; Ke, 2008; Papastergiou, 2009; Squire, 2005; Squire & Jenkins, 2003; Tsai, Yu, & Hsiao, 2007). However, some teachers are still reluctant to use digital games in the classroom since many educators consider the search for appropriate commercial or educational games to be impractical, time-consuming, and costly because the games may not be designed for the intended audience (Liu & Li, 2011; Van Eck, 2006). For example, it may prove challenging to find a game that aligns with a particular instructional objective (Schaaf, 2013; Van Eck, 2006) and teachers with limited technical experience require significant support when using digital games in class (Gros, 2007). Therefore, it is necessary for educators and researchers to explore the challenges and propose guidance and recommendations to fill these gaps. In fact, researchers (Fantz, De Mirandan, & Siller, 2011; Gibson, 2013; Koehler & Mishra, 2005a) have long been advocating for the need of teachers to use technology since merely introducing technology is not enough to guarantee appropriate successful integration. Technology alone does not lead to change (Koehler & Mishra, 2005a).

The notion of teacher-designed games is not a master key to solve all the issues related to using digital game-based learning in education. However, the nature of a teacher's role provides a strong rationale to prove the value and meaning of teacher-designed games, in that teachers are the subject matter experts and have a better and deeper understanding of their students' learning needs. They know their target audience's

prior knowledge, learning needs, personalities, strengths, and areas of improvement, all of which are valuable resources in terms of game-design principles (Fladen & Blashki, 2005; Pulsipher, 2012).

Additionally, not all schools have the financial capability to invest two million dollars in designing a game. Teacher-designed games may use free platforms and thereby save significant resources while achieving similar or even more positive outcomes than professionally made commercial and educational games. In fact, some researchers have noted that many schools could not supply continuous technical support when using professionally designed educational games or commercial games due to limited budgets (de Freitas, 2006; Hense & Mandl, 2012).

Although commercial games have been successfully used in education, there are some barriers that are hard to overcome. For example, it is impossible for commercial games to meet the learning needs of all students. In some areas (e.g., second language learning), teachers needed specially customized digital games to facilitate students' learning (Chin, Lin, & Kaluna, 2013) due to the various stages of language acquisition. In this research, participants used a customized mobile game to learn Hawaiian by focusing on small sets of vocabulary and employing them in different ways. It is not hard to apply this idea to other educational areas for learners with special needs (e.g., students with disabilities, women's education), in which commercial or educational games may either be too costly to create or not be available for use. As such, "unlike commercial games that are often closed off from being modified by the players, game building approach enables teachers to customize the gaming experience to fit the unique needs of each classroom

for any specific content” (Li, 2010, p. 441).

Lastly, with the development of diverse gaming resources (e.g., game design platforms, and iPad and iPhone application tools), teachers have fewer difficulties in designing games of their own. Because of the similar curriculum content (e.g., grade 2 math) and target audience (e.g., grade 2 students in Alberta), a successful game can be used by different teachers in similar school contexts (Talaiver, Bowen, Hendrom, & Cantor, 2011), which would save significant amount of time in searching for appropriate games and would bring financial benefits for both teachers and schools.

In harnessing the power of games, I examined teachers who used and/or designed digital games to learn what supported their capabilities to use and/or design games in class; I also examined the essential conditions needed for teachers to be transformed from game users to game designers. My research provided a unique perspective regarding the model of using digital games in education and offered practical routes for teachers when commercial games do not work.

Purpose of the Study

The purpose of the study was to yield a better and deeper understanding of internal and external factors as well as the supports that built teachers’ capacity of game use and game design and inspired them to move from being game users to game designers.

Specific research questions included:

- 1) What are the key factors that influence teachers in using digital game-based learning environments?

- 2) What are the key factors that influence teachers in designing digital game-based learning environments?
- 3) What are the conditions needed to develop teachers' capacity to be designers of digital games?
- 4) What factors influence the transition of teachers from being game users to game designers to support student learning?

Significance of the Research

The benefits of this study were six-fold.

- 1) It contributed to the growing body of literature on DGBL since few researchers study teacher-designed games.
- 2) It identified the essential conditions to support teachers to be users and designers of digital games.
- 3) It helped to inform professional development opportunities that can be used to build the capacity of in-service teachers and pre-service teachers to become users and designers of digital classroom games.
- 4) It helped teachers to design customized and personalized games with the knowledge of the content, pedagogy, and the local context in order to create a more engaging and interactive learning environment to meet learning needs of their students.
- 5) It yielded another practical option when teachers have difficulties using commercial games to meet students' particular learning needs.

- 6) It helped schools save significant amounts of money and time on designing, using, and technically supporting commercial games in class.

Theoretical Framework

The basic premise underlying my research was that teacher-designed games work as a teaching and learning tool in a constructivist learning environment, in that teacher-designed games help to construct a practical combination of interactive classroom structure and engaging learning tasks through teachers' application on their understanding of content, pedagogy, and technology. To provide the theoretical foundation to guide this research study, three perspectives of theoretical concepts were described. First, constructivism was used to provide the epistemological stance of the research. Second, a social constructivism perspective supplied the rationale for learning and development as a social and collaborative activity since school-based learning should occur in a meaningful context and not be separated from the outside world (Vygotsky, 1963). In addition, teacher-designed games involve the incorporation of feedback from students in order to address their particular learning needs. Third, the technological, pedagogical, and content knowledge framework supported the notion of teacher-designed games by providing a theoretical foundation in terms of a teacher's work as a combination of a subject matter expert, a game designer, and an instructor.

Constructivism. Constructivists believe that knowledge is not discovered but is instead actively constructed (Guba & Lincoln, 1994; Jonassen, Peck, & Wilson, 1999). In other words, learners construct their own knowledge instead of merely copying it from books or teachers (Kanselaar, De Jong, Andriessen, & Goodyear, 2000). This worldview

includes a belief that a learner's individual and social experiences act as a filter through which new meaning and knowledge are constructed. A basic assumption of teaching based on the constructivist learning method is that knowledge cannot be simply transferred from teachers to students; rather, students must be engaged in building their own knowledge in order to become the owner of that knowledge (von Glaserfeld, 1987). Learning in the constructivist environment is perceived as an ongoing process where learners construct and reconstruct their knowledge when they encounter new information and experiences (Marlowe & Page, 1998; Piaget, 1985).

In terms of enhancing teaching and learning within a digital game-based approach, this section explores the significance of the constructivist worldview through four design principles. First, prior knowledge is very important. Koehler and Mishra (2005b & 2009) claimed that prior knowledge had a more prominent impact on what was learned than the presentation of new information itself. According to Mayer (2004), learners' active participation was a crucial characteristic of the constructivist learning environment because students' participation in knowledge building required purposeful attempts to process new information based on what was already known, thus requiring an instructors' support. Based on this principle, games could be used to elicit learners' prior knowledge to facilitate the integration of prior and new knowledge. For example, the educational games developed by World Food Programme or organization (World Food Programme, 2013) such as *Food Force*, *Darfur Is Dying*, and *Free Rice*, give players a chance to understand the hunger issues in some areas in the world. Students might use

their prior knowledge to help distribute and deliver food appropriately and based on feedback, adjust their decisions and explore solutions based on feedback.

Second, a teacher could work as a coach and analyzer (Jonassen, 1999). When students learned in an effective and meaningful manner, constructivist teaching supported the integration of prior learning and experience with academic content (Kincheloe, 2005). Rather than simply being information transmitters, teachers helped solve students' confrontations with the world (Kincheloe, 2005). In other words, teaching was a process of "helping learners to construct their own meaning from the experiences they have by providing those experiences and guiding the meaning-making process" (Jonassen et al., 1999, p. 3).

Third, learners have multiple perspectives on the world. The meaning-making process of each learner reflected their perceptions of the world because each student built unique beliefs based on a unique set of experiences (Jonassen et al., 1999). In the constructivist worldview, students have the ongoing need to build and rebuild knowledge to fit their own individual context (Jaworski, 1993). According to Gardner (1999), effective teaching required the provision of diverse representations of content and a variety of opportunities in which learners demonstrate their understanding. Game playing aims to realize the multiple and diverse representations of content and help learners to demonstrate their understanding in various ways (Stewart, Bleumers, Van Looy, Mariën, All, Schurmans, Willaert et al., 2013). For example, *CivWorld* provides a journey from the Stone Age to the Space Age. Players can select individual nations and band with others to

form civilization. Players select a different nation and time with the ultimate goal of building their own great civilization individually or with others.

Fourth, authentic activity is a key feature in constructivist learning environments. Jonassen (1999) provided a three-fold characterization of authenticity, which included situating learning in a real-world issue, ensuring that learning was personally interesting, and ensuring that students thought at the level of sophistication they are likely to encounter in real life. Researchers (Duffy & Jonassen, 1992; Williams & Burden, 1997) noted that many educators and cognitive psychologists have applied constructivism to the development of learning environments. From these applications, researchers have isolated a number of design principles such as creating real environments that employed problems in which learning was relevant and focusing on realistic approaches to solving them (Gee, 2008). In the classroom, the constructivist view of learning encouraged students to use experiments and real-world problem solving to create more knowledge and then reflect on what they were doing and how their understanding was changed (Matsuoka, Doyle, Tatsuoka, Kaufman, Wilson, Liepolt, Rahman et al., 2004). Meanwhile, teachers played a critical role to know students' existing knowledge and conceptions and to create activities that addressed the new knowledge points and built upon them.

In general, during the process of learning by playing, students were able to integrate new information into their current understanding by experiencing required knowledge (Inhelder & Piaget, 1958; Yilmaz, 2008). Games also provided a chance for learners to collaborate. Constructivists believe that knowledge does not belong to individuals but that it is distributed and shared in a group setting (Dori & Belcher, 2005).

The role of social interaction is crucial in teaching and learning (Vygotsky, 1963) because students benefit from collaboration and integration.

Social Constructivism. Some digital games involve teamwork since some of the goals can only be achieved by players working together (e.g., sharing resources or strategies). In addition, teacher-designed games entail integrating students' ideas into original and further revised game design. Therefore, social constructivism was a critical component of this research. Piaget (1971) emphasized that learning involved individual knowledge construction; however, Vygotsky's (1978) social constructivism perspective viewed that children learn and develop in social and collaborative settings and focused on learners' co-construction of knowledge (Taylor, Geelan, Fox, & Herrmann, 1997). Guided by this theory, digital games could be used not only as a designed object but also a social practice (Khine & Bin Suja'ee, 2008).

Technological, Pedagogical, and Content Knowledge. In order to realize the change and innovation of teaching, helping teachers apply various technologies in the classroom is important to success. When teachers became confident and competent with educational technology (Zhao, 2003), they were able to develop an understanding of the complex relationships among users, technologies, practices, and tools. Technology became a knowledge system (Hickman, 1990) that made some technologies more applicable in some situations than others (Koehler & Mishra, 2005a). As such, technological, pedagogical, and content knowledge (TPCK) was introduced to understand the interaction of these three knowledge areas; particularly for my research, these

knowledge areas worked as a framework to support the notion of teacher-designed games.

The model below (see *Figure 1.1*) elaborates the relationship among technology and pedagogy, technology and content, and pedagogy and content (American Association of Colleges for Teaching Education [AACTE], 2008). In this model, there are three main elements: technology knowledge (TK), pedagogy knowledge (PK), and content knowledge (CK).

- 1) TK refers to teachers' capacities on operating systems or computer hardware to manipulate and produce their desired outcomes (Mishra & Koehler, 2006);
- 2) PK refers to a deep understanding of teaching and learning practices and strategies, which include classroom management, lesson plan development, and student learning (Mishra & Koehler, 2006);
- 3) CK refers to teachers' understanding of facts, concepts, theories, and procedures in a given area (Shulman, 1986).

TPACK is a complex relationship among teachers' technological skills, teaching approaches, and subject matter expertise and about effectively bringing them together.

TPACK framework has also been used for "helping teachers taking advantage of technology to improve students' learning" (Thompson & Mishra, 2008, p. 38).

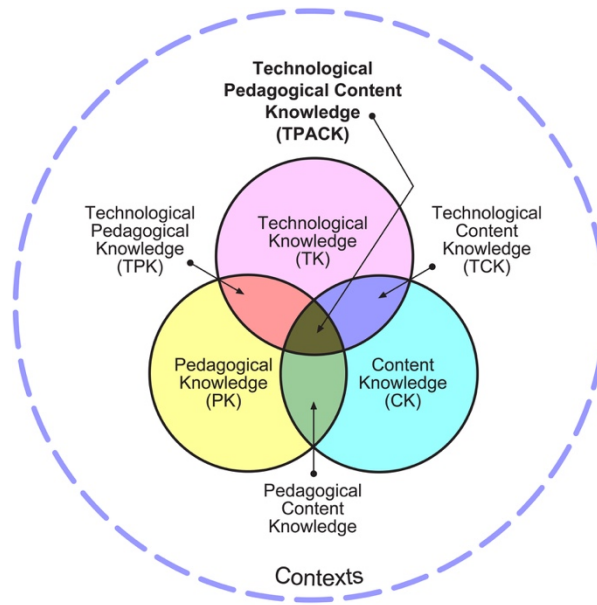


Figure 1. 1: Technological Pedagogical and Content Knowledge. From “The Seven Components of TPACK,” reproduced by permission of the publisher, Copyright 2012 by tpack.org.

Because of the lack of connection between technology and pedagogy (Franklin & Annetta, 2011; Gresalfi, Barnes, & Pettyjohn, 2011; Meletiou-Mavrotheris & Prodromou, 2016; Okojie, Olinzock, & Okojie-Boulder, 2006; Shah & Foster, 2015), the TPACK module of technological pedagogical knowledge will be used to bridge the gap between those two pieces and to help guide and inform teaching (Koehler, 2012). In other words, “technological pedagogical knowledge is an understanding of how teaching and learning changes when particular technologies are used” (AACTE, 2008, p.16). The best practice of teaching and learning is always the ultimate goal of integrating technology into education. With this framework, teachers who have the desire to design digital games will be guided to create an authentic, well-structured, and reflective learning environment to ultimately enhance the critical learning and thinking skills of their students.

Summary. The concept of teacher-designed games is strongly supported by the TPACK framework. During the process of designing digital games, teachers customized their games by incorporating students' individual learning needs with instructional objectives. Teachers also constructed their technological knowledge by integrating students' feedback while at the same time students' knowledge was constructed by customized teacher-designed games. The TPACK framework is naturally embedded in this designing practice since teachers use technology to achieve their pedagogical goals as well as accomplish learning tasks. In addition, teacher-designed games could provide a direction for teacher professional development by assisting teachers to understand the use of various technologies through "learning-by-designing."

Assumptions Related to the Study

Based on my experience and background in gaming and instructional design, there were three assumptions related to my study. The first assumption was that I could understand participants' thoughts and ideas of their understanding and awareness in terms of game designs during interviews. The second assumption was that the staff, school administrators, and students would be open to use and/or design digital games in class. The third assumption was that teachers who were interested in using digital games would consider it reasonable to obtain useful, functional, and relatively simple software and programming skills to create digital games for students' learning.

Definitions

For the purposes of this study, the following terms are defined:

Digital Game-Based Learning (DGBL): A learning and teaching approach that utilizes digital games/game-based environments to create intriguing, engaging, entertaining, and challenging activities with the goal of achieving learning objectives and producing learning outcomes that can be objectively measured (Coller & Scott, 2009).

Educational Game: A game designed to instruct individuals, specifically children, on a particular subject or to help them learn a skill as they play.

Game: “A rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable” (Juul, 2003, p. 5).

Gamification: “Gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems” (Kapp, 2012, Introduction, para. 1).

Simulation: “is the imitation of the operation of a real-world process or system over time” (Banks, Carson, Nelson, & Nicol, 2001, p. 3). “Many games are a simulation in the sense of ‘simulating a real-life situation’ (i.e. to act ‘as if’), offering an artificial game reality, or even imitating real-life” (Martens, Diener, & Malo, 2008).

Teacher-Designed Game: designed by classroom teachers for their students to integrate teaching, learning, and game play. The digital games designed by teachers include video and audio activities that are embedded with learning objectives based on the curriculum.

Technology-Enabled Learning Environments (TELEs): “learning environments, as places arranged to enhance the learning experience, are defined on an interdisciplinary basis comprising three essential components: pedagogical functions, appropriate technologies and social organization of education” (Adams & Granić, 2008, p. 1).

Organization of the Dissertation

This dissertation is composed of ten chapters. Chapter two explores the literature of contemporary learning environments, digital game-based learning in terms of how DGBL affects student learning, and teacher education in DGBL. This chapter closes with defining the gap in current literature and how my research addressed the gap. Chapter three presents the research design, methodology, and the methods of data collection and analysis. Chapters four, five, six, seven, and eight present the data of the four cases from four different school districts in southern Alberta. The findings are presented by themes and sub-themes. Chapter nine comprises a discussion around the findings with the support of relevant literature in relation to addressing the four research questions. Chapter ten concludes with a summary of the study, contributions to the research, successes and challenges of the study, implications for practice, and recommendations for future research.

CHAPTER TWO: LITERATURE REVIEW

Introduction

This chapter provides an understanding of context, development, issues, and current research directions within the study of digital game-based learning and its relation to teaching and learning. In conducting the literature review, I explored multiple resources which included research databases (ERIC, Google Scholar, Google Books, and ACM Digital Library), books, peer-reviewed journals, and dissertations. Through the literature review, the research questions for the study were generated as a result of identifying gaps in the current literature.

The literature review is divided into five main sections. The first section deals with the contemporary learning environment, which covers the distinct changes of learning and the critical learning skills for the Net Generation who were born during or after the 1980s (Oblinger & Oblinger, 2005). This section also discusses why the changes and learning skills are so important for learning. The second section explores the roles of digital game-based learning in education in helping teachers understand the technological transitions within classrooms as well as to help students meet the 21st century's social and economic needs and succeed in a modern and globalized world. The third section introduces the definition of gamification, the tools and platforms used to gamify a class, and current trends of using gamification in K-12 educational context. The fourth section describes mainstream teacher development opportunities. The fifth section examines the gap of current research on digital game-based learning and identifies the practice of teacher-designed games as one of the approaches to fill the gap.

Contemporary Learning Environments

Entering the 21st century, our world has become more technology-driven. The Net Generation spends a large amount of time on Facebook, Twitter, and other social media platforms even in class and at work (Tapscott, 2008). They intuitively communicate, learn, search, and do many other things through the Internet, playing games, and other multimedia technologies (de Freitas & Gráinne, 2010; Tapscott, 2008; White & Martin, 2012). It is important for teachers to pursue new ways of teaching due to new ways of learning. However, pursuing new ways of teaching is not just about how students use technology, but about how they behave and gain knowledge differently with it. More importantly, pursuing new ways of teaching is about how teachers help students build knowledge, explore problems, and share information with each other, shifting digital technology from a tool of play and socializing to a tool of knowledge building and creating (Jacobsen & Friesen, 2011).

Technology-enabled learning environments. Based on Jacobsen and Friesen's study (2011), technology-enabled learning environments (TELEs) contain components that enhance and stimulate strong inquiry, such as real-world problems, straightforward learning outcomes, engaging learning tasks, proper use of technology, and timely assessment and feedback. In other words, technology is not the main ingredient in TELEs, and it is not the key factor that successfully improves teaching and learning. Rather, technology actually functions as a booster to make the rest of the lesson's components to work harmoniously.

In Fisher's research (2010), he explored three case studies to demonstrate how TELEs effectively enhanced teaching and learning outcomes. In these three cases, participants ranged from high school students to doctoral candidates. All classrooms were designed to encourage collaborative learning by providing spaces for group work and socializing, combining students from different levels and grades, and allowing students to choose technologies in which they felt both comfortable and interested. The courses incorporated real-world project- or problem-based learning tasks, which were closely integrated with curriculum content. In addition, one of the cases gave students flexibility to organize and host activities, so they felt more appreciated and confident. Students were also allowed to choose their preferences among the available technologies to complete learning tasks. While teachers stepped back as facilitators instead of owners in class, students are allowed to actively participate and become independent learners. In this learning environment, not only did students enjoy studying but teachers enjoyed teaching. All parties commented that the learning and teaching outcomes were significantly improved because of in-class engagement, collaboration, and pedagogical flexibility. TELEs facilitate shifting the traditional passive teaching model to active learning while enhancing students' engagement and motivation by proper use of technology.

One sample of TELEs was the project at Massachusetts Institute of Technology (MIT). The iCampus research group at MIT initiated the project of using technology-supported programs, tools, and visualizations to pilot the research for an introductory physics course that had a the course's lack of student engagement (less than 50% of the

lecture attendance rate) and high failure rates (almost 15%) (Dori & Belcher, 2005). This technology-enabled learning environment was a studio format course to accommodate a large number of students (mainly incoming freshmen). The course included hands-on experiments that allowed students to collect real-time data, visualizations that helped make abstract ideas concrete and technology-enabled questions that provided instant feedback for students (Dori & Belcher, 2005). This research experiment included two experimental groups (Fall 2001, N=176; Spring 2003, N=514) and one control group (Spring 2002, N=121). All three groups studied the same course in a similar sequence. One of the project's goals was to decrease students' failure rate while strengthening their conceptual and analytical understanding, both of which were fully achieved (Dori & Belcher, 2005). The failure rates in the two experimental groups were less than 5%, compared with 13% in the control group (Dori & Belcher, 2005). In addition, both experimental student groups improved their conceptual understanding significantly more than the control group did. Each group was divided into three sub-groups by their academic levels (low, intermediate, and high). The net gain of pre and post-tests among the three groups were the following: Fall 2001: 34, 24, 23, Spring 2003: 40, 33, 22, and Spring 2002: 35, 16, 4. The net gain of the two experimental groups was much higher than that of the control group. This study demonstrated that the "TELEs have indeed had a significant and strong positive effect on the learning outcomes of students" (Dori & Belcher, 2005, p. 274).

New skills and competencies. The new designs in the aforementioned cases mirror the learning patterns of the Net Generation. The Net Generation has grown up with various new technologies; social networking, gaming, and online collaboration are

part of their lives. They learn and live by their digital devices, and they think and process in a different way than earlier generations. However, the Net Generation does not necessarily care about the technologies per se but rather about the activities embedded in within them (Wager, 2005). This generation favours visual content, needs instant feedback, learns at a rapid pace, and enjoys multitasking (Oblinger & Oblinger, 2005). Apart from connecting with each other through technologies, they also have the desire to collaborate with people and be active in their communities (Roberts, 2005).

As a consequence of the new characteristics of the Net Generation, researchers proposed various studies of new skills that youth need in order to succeed in the 21st century. In other words, it is more meaningful to create new knowledge with the information you have learned than merely being aware of what you have known. Wagner (2012) also accentuated that our young generation needs initiative and curiosity to keep learning new knowledge and skills and to have the courage to take adventures and never stop trying. With the fading of traditional careers, these attributes have become more and more important. Wagner (2008) identified seven survival skills for the 21st century: critical thinking and problem solving, collaboration across networks and leading by influence, agility and adaptability, initiative and entrepreneurialism, effective oral and written communication, accessing and analyzing information, and curiosity and imagination. Wagner argued that what the young generation needs to succeed in the 21st-century world is not only what they are being taught at school; he emphasized the importance of thinking creatively and the ability to engage and work well with others.

A United Nations Educational, Scientific, & Cultural Organization [UNESCO] (2012) report identified three categories of skills for the Net Generation to acquire. First, foundation skills are the basic skills for getting jobs in order to earn wages to meet daily needs (United Nations Educational, Scientific, & Cultural Organization, 2012). These skills are also the prerequisite to obtaining transferable skills and other vocational skills. This category of skills not only covers the knowledge from schools, teachers, and textbooks, but more importantly, it refers to the tacit knowledge from their daily life, society, relationships, and nature.

Second, transferable skills are required for the Net Generation to adapt to different jobs and environments. The transferable skills include “analyzing problems and reaching appropriate solutions, communicating ideas and information effectively, being creative, showing leadership and conscientiousness, and demonstrating entrepreneurial capabilities” (UNESCO, 2012, p. 186). This category of skills is similar to Wagner’s (2012) seven survival skills. In order to adjust to the rapid change of our society, the Net Generation needs to learn how to master their future, which means mastering the abilities of thinking, judging, imaging, expressing, and socializing in order to know and change the world (Sawyer, 2011; Wagner, 2012). In addition, one of the key features of the 21st century is globalization. The Net Generation also needs to have a better and deeper understanding of the importance of dependent relationships between people, nations, and countries.

Third, technical and vocational skills cover specific technical know-how at work places. If young people want to get the most benefits of technical and vocational training,

both foundational and transferable skills are essential (United Nations Educational, Scientific, & Cultural Organization [UNESCO], 2012). These abilities are not only required to improve the young generation as individuals but are also the foundation of realizing creativity and innovation in the 21st century.

Current learning design. “Current education systems are facing unprecedented challenges. Traditional education systems alone, despite the essential role they have played and will continue to play in learning, are simply not capable of serving the world’s growing and changing needs” (Chambers, 2010, p. 1 as cited in Cisco Systems, 2010). While researchers argue about the new skills the Net Generation need to acquire, what are the educators able to do to help that generation achieve them? Based on research studies in education, the following four salient themes emerged.

First, class design needs to be shifted from teacher-centred to student-centred (Kilic, 2010; Tapscott, 2008). The relationship between students and teachers has changed. In the classroom, teachers have become facilitators instead of leaders. Teachers must put students’ needs, inquires, and interests as the first priority instead of simply preparing students for tests when they design curricula and activities (Wagner, 2008). In a student-centred learning environment, learners are expected to actively participate in the decision-making process, such as what to learn, how to learn, how much to learn, and what help they need to achieve the learning objectives (Lea, Stehanson, & Tray, 2003; Sharma, Millar & Seth, 1999). Creative, reflective, and critical thinking skills form the basis of student-centred learning. This learning environment will foster students to effectively achieve the social and economic skills needed for the 21st century (Kilic, 2010).

Second, class design needs to be shifted from one-way broadcasting to interactive learning (Liaw & Huang, 2013; Tapscott, 2008). In the old model of teaching, the teacher was “the transmitter and student was a receptor in the learning process” (Tapscott, 2008, p. 130); it was assumed that students received knowledge or content in a linear fashion. However, in the new model of teaching, students are not empty bottles waiting to be filled. The Net Generation does not find one-way broadcasting appealing; they expect to have connections to what they have already known in order to learn how to apply new knowledge (Brown, 2005; Song, Wong & Looi, 2012). Interactive learning enables students to control their learning and be responsible for constructing and demonstrating knowledge (Sessoms, 2008). Interactive learning environments can create a high-level communicative environment that fosters learners to share information and retrieve useful information. Interactive learning activities provide a chance for learners and teachers to share their knowledge and experiences (Liaw & Huang, 2013).

Third, class design needs to shift from individual learning to collaborative learning (Kim, Lavonen, Juuti, Holbrook, & Rannikmae, 2013; Tapscott, 2008). Traditionally, students have not been encouraged to share information. The rule was especially crucial during tests or test preparation. However, the individual learning model is foreign to the Net Generation who “collaborate, share and create together online” (Tapscott, 2008, p. 137). Collaborative learning essentially refers to an approach that helps students at various performance levels work together in small groups to complete a common learning goal (Chiu, 2008; Mitnik, Recabarren, Nussbaum, & Soto, 2009). Collaborative learning encourages students not only to share and combine the knowledge they already have but

also to continue improving ideas (Nonaka & Takeuchi, 1995; Scardamalia & Bereiter, 2006). Collaborative learning creates a positive learning environment that enables learners to motivate and teach each other in order to achieve the learning objectives (Istifci & Kaya, 2011). When students are responsible for each other's learning and their own, the success of their own helps others become successful as well (Wu, Hwang, Kuo, & Huang, 2013). Additionally, collaborative learning encourages students' creative thinking and problem-solving skills through intensive reflection, interaction, and collaboration (Baloche, 1994; Yang & Cheng, 2010).

Fourth, the class design needs to be shifted from one-size-fits-all to one-size-fits-one learning (Hsu, Hwang, & Chang, 2013; Kreuter, Strecher, & Glassman, 1999; Martinez, 2001). Personalized learning is another emerging topic in technology-enhanced learning environments. The traditional "mass-education" idea was to "teach the same thing to students in the same way and assess them all in the same way" (Tapscott, 2008, p. 139). This method has been challenged because learners are different in terms of gender, age, background, and ways of learning. Therefore, it is important to offer unique learning objectives, contents, and teaching tactics based on individual needs (Song et al., 2012). Personalized learning aims to optimize each learner's potential and success by developing individualized learning programs. Personalized learning also encourages a student-driven learning pace, which may ease learners' stress and foster a favourable learning environment (Hsu et al., 2013; Song et al., 2012).

Researchers (Sawyer, 2011; Wagner, 2008, 2012) have indicated that it was crucial to reconstruct and reform our educational system to meet the learning requirements of the

Net Generation. The goal is to teach higher thinking skills, enhance learning capability, and encourage innovation and creativity. Wagner (2012) and Fullerton (2014) also argued that play, passion, and purpose are the three main factors which foster the young generation's creativity and innovation skills.

Children learn through play (Piaget, 1936, 1945; Vygotsky, 1978; Wagner, 2012). Play is part of human beings' nature which motivates us to explore, experience, and find answers. Montessori education provides an excellent example of integrating the importance of play into the classroom and achieves great success (The Montessori Foundation, 2013). Digital games in class give students a chance to investigate problems in a free, fun, and engaging environment. By playing, children learn to think creatively and gain real expertise in ways that intrinsically encourage intrinsic motivation (Wagner, 2012).

Digital Game-Based Learning

Digital game-based learning (DGBL) has been used in formal education, in particular in military, medical, physical, and training (Pivec & Dziabenko, 2004). These games can create a friendly and relaxed environment where learners are able to learn while playing and make mistakes while practicing (Dweck, 2006; Maats & O'Brien, 2013; Majgaard, 2014; Pope, Kuhn, & Foster, 2009). The increasing interest in DGBL is related to the growing game-playing population. In 2013, 65% of American household play video games, and the age of the average gamer was 32 years old (Education Database Online, 2013). In the game-playing world, children immerse themselves in a complex and dynamic space. When they fail, they have to learn from failure in order to reach the next level

(Brown, 2005). For example, *Second Life* (www.secondlife.com), *Innov8* (www.ibm.com/software/solutions/soa/innov8.html), and *Quest Atlantis* (www.questatlantis.org) have been widely adopted to teach different subjects in various classes (Barjis et al., 2012; Louis, 2013). Among them, *Quest Atlantis* has been used to enhance students' learning in different subjects (e.g., math and environmental sciences) in various research studies. Games have the potential to enhance the learning interest of students (Ebner & Holzinger, 2007) and increase their motivation (Burguillo, 2010; Dickey, 2010).

Interactive learning. One of the key elements about digital games is that “they always include an interactive virtual playing environment” (Fabricatore, 2000, p. 3). An interactive learning environment is a “high-level communicative e-learning environment that allows learning not only to share but also to retrieve useful information” (Liaw & Huang, 2013, p. 15). Researchers (Rokeby, 1998; Ryan, 2000) claimed that an interactive learning environment made a significant intellectual and emotional investment in enhancing students' learning as well as defined the interactive experience as an active form of engagement. Many educators and educational technologists (Barker, 1994; Malone & Lepper, 1987; Sims, 1997) also expressed the need for interactivity in learning: the player in the highly interactive and participatory environment is able to modify, build, appropriate elements, test ideas, and become engaged in problem-solving and critical thinking tasks, all of which are closely tied with “learning by doing” practices (Roussou, 2004). Therefore, games have the potential to enhance learners' involvement, motivation,

and creativity by providing interactions with others and interactivities with scenarios (Hämäläinen, 2011).

Games require continuous interaction between the player and the game with the requirement to solve a series of problems. This interactive instructional environment sustains learners' attention by providing ongoing feedback and appropriate and adaptive levels of challenge. During this process, learning is inherently situated in context with the ongoing interactions between the player and the game (Shute & Ke, 2012). According to Doolittle (1995), interactive games are good vehicles for embedding curriculum content such as abstract concepts that may be hard to visualize or manipulate with concrete materials. Evidence shows interactive computer games have been successfully used with college students to enhance creativity and other forms of critical thoughts (Doolittle, 1995). Analysis conducted at the University of California Medical School showed the improvement of students in terms of their grade point average, undergraduate dropout rates, and medical school admission and retention rates (Doolittle, 1995).

Collaborative learning. According to Gee (2007a), a game-based learning environment needs a social platform and context for learners to share and co-construct their knowledge, which is like the idea of “community of practice” (p. 108), “affinity groups” (p. 27) or “affinity spaces” (Gee, 2007b, p. 96). In a collaborative environment, students cooperate and communicate with each other, gaining and sharing knowledge together. During this process, learning occurs when learners reconstruct what they have learned, demonstrating a new and improved understanding (Silseth, 2012). Researchers (Boughzala, Bououd, & Michel, 2013; Ke, 2008; Paraskeva, Mysirlaki, & Papagianni, 2009;

Squire, 2005) found that DGBL environments improved learning among students who were part of collaborative activities. In Ke's (2008) research, 106 fifth grade students were randomly assigned to six experimental groups, which included individualistic, competitive, and cooperative gaming and drill & practice groups. The researcher used the state-standard math exam as pre- and post-tests to examine their math performance. Among the six groups, Ke (2008) found the cooperative gaming group was most effective in promoting positive math attitudes, yet not math test performance or metacognitive awareness. One reason that collaboration may be an effective way of enhancing learning outcomes through playing games in the classroom is that "such games may influence discussion, such as that pertaining to the content received through the game" (Meluso, Zheng, Spires, & Lester, 2012, p. 11). Furthermore, collaboration may have an effect on the quality of information that children receive from playing games; students may learn from each other while playing the game, a benefit which cannot be replicated when playing individually (Mikropoulos & Natsis, 2011). Foko and Amory (2008) investigated two groups of grade 11 students playing an adventure game that attempted to rectify misconceptions related to photosynthesis and respiration. Three groups who played the games on their own only understood 31.9%, 28.4%, and 30.8% of the concepts respectively, compared with 42.5%, 50% and 50% in the groups who played in pairs. Foko and Amory (2008) concluded that playing with peers was more effective than playing individually and that collaboration helped students clarify their misconceptions about concepts. The authors also found that students' visualization, logic, and numeric skills

improved after playing the educational video game in their study with peers as opposed to on their own (Foko & Amory, 2008).

Personalized/customized learning. Based on Gee's (2007a) 36 Learning Principles embedded in games, personalization/customization is one of the key features of well-designed educational games. "For learners of all levels of skill, there are intrinsic rewards from the beginning, customized to each learner's level, effort, and growing mastery and signaling the learner's ongoing achievements" (Gee, 2007a, p. 64). "The learner is an 'insider,' 'teacher,' and 'producer' (not just a consumer) able to customize the learning experience and domain/game from the beginning and throughout the experience" (Gee, 2007a, p. 212). Researchers have discovered that teachers need to focus on students' learning styles and design teaching and learning activities accordingly (Coffield, Moseley, Hall, & Ecclestone, 2004; Jenkins, Klopfer, Squire, & Tan, 2003; Redding, 2014; Scarlatos & Scarlatos, 2008; Shifter, 2013). Personalized learning content is one of the most crucial aspects needing improvement in educational systems (Niehaus & Riedl, 2009; Tseng, Chu, Hwang, & Tsai, 2008). In a study conducted by Hwang, Sung, Huang, and Tsai (2012), a personalized educational game was developed based on the learning style theory to enhance students' learning. The experiment was conducted in an elementary school science course "Knowing Campus Plants." In the study, individual student's learning styles information was stored in the student profile database (Hwang et al., 2012). Students with particular learning styles were provided a step-by-step interface to guide them to complete their learning missions; they were guided to the next scene for a new mission only after the present mission had been completed, based on a pre-defined

learning sequence (Hwang et al., 2012). The personalized educational computer game provided an interface that allowed students to select any mission or jump to any scene of the game (Hwang et al., 2012). This study found that the learning motivation of the students with the personalized game was significantly promoted. Furthermore, in terms of students' learning achievement, the personalized educational computer game enabled individual students to learn in a way that matched their information processing styles; their learning achievements were significantly better than those of students with a non-personalized game (Hwang et al., 2012). The mean values and standard deviations of the pre-test scores were 94.73 and 6.17 for the control group, and 96.29 and 3.68 for the experimental group. The t-test result ($t = 0.297$, $p > 0.05$) showed that the two groups of students had equivalent prior knowledge before the learning intervention. However, the mean values and standard deviations of the post-tests scores were 20.69 and 0.86 for the control group, and 23.28 and 0.83 for the experimental group. According to the results ($f = 4.64$; $p < 0.05$), there was significant difference between the groups.

Incidental learning. Based on the *Encyclopedia of the Sciences of Learning* (2012), “[I]ncidental learning refers to any learning that is unplanned or unintended. It develops while engaging in a task or activity and may also arise as a by-product of planned learning” (p. 1517). According to Eshet-Alkalai and Chajut’s research (2007), a potential for incidental learning may take place in any engaging, interactive, and playful learning environment. Additionally, the environment was not purposefully designed for formal learning but motivated meaningful learning. In this research, foreign language acquisition was the focus of incidental learning (Eshet-Alkalai & Chajut, 2007; Kastoudi, 2011;

Mohsen, 2016). Interestingly, other related literature mainly focused on language learning as well. In Mohsen's study (2016), the incidental vocabulary learning was also examined by using an online video simulation. Forty-three adult English as a Second Language learners were randomly assigned into an experimental group (player group) and a control group (viewer group). In the experimental group, participants played a simulation game to learn English words regarding a knee surgery. In contrast, the control group participants only watched the knee surgery video on YouTube. The results showed that the player group "significantly outperformed" (p. 863) the viewer group in the post-vocabulary test. It was indicated that learners "incidentally" grasped the meaning of new vocabularies while playing the simulation game.

Because incidental learning has been labeled as one of the most effective teaching strategies (Rosas et al., 2003) it has been promoted for teachers to bring the practice into a structured class (Kastoudi, 2011; Triumphant Kids, 2012). Incidental learning usually takes place in a less stressful environment which encourages student engagement, participation, and deep learning (Flynn, n.d.). One of the strategies of applying incidental learning in the classroom is to develop games. For instance, Ebner and Holzinger (2007) found that participants were motivated to play the game more than one time while they failed certain quests simply because they wanted to find the correct solutions and "to learn it" (p. 884).

Allowing students to make mistakes. Another feature of games is they provide a platform or opportunity for users/players to make mistakes without having the consequences of being punished (Cohen, 2011; Egenfeldt-Nielsen, 2006; Majgaard, 2014;

Pope et al., 2009). When playing games, it is almost impossible for players to make no mistakes and be able to successfully pass all the levels at once. Likewise, there are chances for players to fail certain levels or quests more than once. Not only were students encouraged to make mistakes while learning but were teachers as well when exploring learning technologies for teaching (Bitner & Bitner, 2002). Teachers should not feel defeated while experimenting innovative methods or strategies in teaching (Fullan, 1993).

Traditionally, learners tend to feel more nervous while making frequent mistakes in exams or in class. Studies show opposite result when players play games. Students' performance continued to improve and the "cognitive load present became less of an issue" (p. 175) as the game progressed (Ang, Zaphiris, & Mahmood, 2007). In Herrington and Oliver's research (2003), the participating teachers argued that students should be given space to make mistakes and take time to gradually build their capacity.

In Maats and O'Brien's book *The Straight-A Conspiracy: Your Secret Guide to Ending the Stress of School and Totally Ruling the World*, the authors explain that allowing children to make mistakes changes their mindset in terms of what they can or cannot achieve. While playing games, players do not view mistakes as a failure but as a necessary step in figuring out solutions because they usually engage with the game.

Instant feedback - Stealth assessment. Instant feedback is valuable to students in class (Draper, 2009; Jordan & Mitchell, 2009; Li, Liu, & Steckelberg, 2010), as it enables them to learn continually and "organize their knowledge in a more meaningful way" especially when working on complex learning tasks (Wu, Hwang, Milrad, Ke, & Huang, 2012). Additionally, instant feedback is important in game-based learning environments

since it identifies challenging topics or areas that learners have while playing the game (Shute & Spector, 2008). Because of this characteristic of games, Shute and her colleagues promoted the concept of “stealth assessment” while using games in class. In a gaming environment, assessment can be invisibly woven into the gaming/learning opportunities, and the ongoing instant feedback is effective in guiding a student’s learning (Ifenthaler, Eseryel, Ge, & Ebrary, 2012; Mendez & Gonzalez, 2011; Robertson & Howells, 2008). In Wu and his colleagues’ research study (2012), a concept map-oriented learning system had an instant feedback mechanism to provide prompt feedback to students. Students in the experimental group with the instant feedback mechanism were identified to have “significantly better learning achievements” (p. 226); it was also found that instant feedback was helpful to students in “improving their knowledge structures” (Wu et al., 2012, p. 226).

It was identified in the literature that games can motivate players by all of their fun elements, challenges, as well as instant feedback, which is a “crucial aspect for learning” (Rapeepisarn, Wong, Fung, & Khine, 2008, p. 499). In Ke’s research (2008) learners’ metacognitive regulation processes were strengthened with the instant feedback provided in the game. Additionally, the instant feedback mechanism in games allowed students to reflect on what they know/not know and what they are good at and what they still need to work on in such a timely fashion that they appreciate the feedback and are motivated to keep exploring (Chen, 2017; Deterding, 2011; Philpot, Hall, Hubing, & Flori, 2004; Liu, Chen, & Chang, 2010; Sancar-Tokmak, 2015; Yee, 2006; Zhang, 2008). In class, this feature

could also allow both students and teachers to review their progress and adjust learning strategies and teaching instructions accordingly (Ifenthaler et al., 2012).

Gamification

Gamification has started drawing both business and education's attention in the last decade (Basten, 2017; Bicen & Kocakoyun, 2017; Sánchez-Carmona, Robles, & Pons, 2017; Ukala & Agabi, 2017; Sanchez, Young, & Jouneau-Sion, 2017). The idea is to embed gaming elements into non-gaming content (Basten, 2017). In other literature, it was defined as another form of game-based learning (GBL) (Kingsley, Grabner-Hagen, 2015). For example, it refers to using instant feedback, competition system, and digital badges to teach learning on a new software platform (Basten, 2017; Holmes & Gee, 2016). Another form of gamification is to “use insights into how games teach and how they demonstrate good learning to develop instructional activities” (Holmes & Gee, 2016, p. 8). When teachers adopt this form of gamification, there are no games played in class but this idea serves “as inspiration for an educator to structure their own teaching and learning environment” (p. 8) by embracing good game models to support teaching and learning (Holmes & Gee, 2016).

Gamification is defined by Kapp (2012) as “Gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems” (Introduction, para. 1). This definition emphasizes the purpose of gamification is user engagement and the development of problem-solving skills. In fact, gamification and digital games share common characteristics: both are engaging, fun, interactive, and competitive (Kim, 2015). Kingsley and Grabner-Hagen

noted (2015) that “gamification coupled with effective pedagogy can support the acquisition of 21st-century skills” (p. 52) such as new literacies skills. The researchers found that students were able to learn content and practice literacy while playing games (Kingsley & Grabner-Hagen, 2015).

Based on current literature, some common gamification platforms are ClassCraft (Sanchez et al., 2017), 3D GameLab (Kingsley, Grabner-Hagen, 2015), and Kahoot! (Iwamoto, Hargis, Taitano, & Vuong, 2016; Zarzycka-Piskorz, 2016). All of them are based on point systems and digital badges. Students are motivated to complete quests or learning tasks by earning points or digital badges. It was found that students became more committed to their learning because the educational goals were transformed to play goals. In order to achieve higher points or more badges, students were committed to successfully complete tasks (Sanchez et al., 2017). The other popular gamification tool widely used in class is Kahoot!, a free platform that converts quizzes into game-like activities. It was identified that students’ academic performance in the group that used both lectures and Kahoot! was significantly higher than students who only received the course content through lecture and group discussion (Iwamot et al., 2017).

Overall, gamification in class has had a positive impact on students’ learning. In gamified classes, it was reported that students look forward to being involved with gamification tasks, students enjoyed this teaching approach and were more motivated in acquiring content knowledge (Iwamot et al., 2017; Kingsley, Grabner-Hagen, 2015).

Teacher Education in Digital Game-based Learning

It has been argued that teacher education and teacher development play a crucial role in successfully using digital games in class (Kenny & Gunter, 2011; Koh, Kin, Wadhwa, & Lim, 2012), especially considering digital generation (people who are born between 1980-1994) are currently entering the career of teaching (Gilewicz, 2011; Jukes, Mc Cain, & Crockett, 2010; Prensky, 2005). Some of them are interested in gaming or have even been lifelong gamers (Gibson, Halverson, & Riedel, 2007; Heyse & Ohrnberger, 2013). However, most pre-service teacher development focused mainly on the awareness of using digital games as educational tools but not the pedagogical facets of digital games as well as developing a teacher's capacity to integrate games into the classroom (Can & Cagiltay, 2006; Hsu et al., 2017; Shah & Foster, 2015).

Shan and Foster (2015) argued that in order to empower teachers' capacity and assist them in incorporating digital games into the curriculum, a "methods-based approach" should be introduced (p. 245). The framework of Game Network Analysis (GaNA) was developed to help teachers "adopt game-based learning within a new or an existing curriculum" (Shan & Foster, 2015, p. 245). The aim of this framework was to provide guidance for teachers to focus on the pedagogy as well as the content of games in order to appropriately deploy them into the classroom (Shan & Foster, 2015). Researchers (Shan & Foster, 2015) found that this framework may be beneficial in educating teachers about using games for their students.

To ensure teachers are equipped with the knowledge, skills, and capacity of using and designing digital games, another facet of teacher education is to provide professional

development (PD) opportunities for teachers by attending conferences and building professional networks and learning communities (Breyfogle & Spotts, 2011; Fox, 2007; Guskey, 2000; Long, 2011; McLester, 2012; Stronge, 2007). Long's research (2011) aims to examine how professional conference attendance affects teachers' professional development and teaching practices. This study found that teachers attending professional conferences tend to implement innovative teaching strategies or approaches into their teaching that better fostered students' learning (Long, 2011). Additionally, teachers' game knowledge (GK) has been identified as another area that should be addressed in PD; GK is a crucial component to enable teachers to not only see the value of games but to be able to have the capacity to access what games can be used in class (Kenny & McDaniel, 2011).

Another form of PD is through Social Media, for example, Twitter (Carpenter & Krutka, 2014; Lord & Lomicka, 2014; Noble, McQuillan, & Littenberg-Tobias, 2016). According to current literature, it was found that teachers are increasingly using Twitter as their professional growth platform from which they search for novel teaching ideas and stay updated of trends in educational technology (Carpenter & Krutka, 2014). Other research indicates that some K-12 teachers tend to use Twitter as a self-directed professional development tool to improve classroom practice (Visser, Evering, & Barrett, 2014). The interpersonal relationship built on Twitter was found to "foster collaboration and participation" (p. 409) in its online participatory learning community (Visser et al., 2014).

Defining the Gap

The popularity of digital game-based learning has grown in popularity with contemporary youth and young adults. “According to *Trip Wire Magazine*, 61.9 million people participated in online social games in 2011, up nearly 9 million people from 2010. Forty percent of these gamers are between the ages of 20 and 34” (Johnson et al., 2012, p. 18). “Digital gaming is a \$10 billion per year industry, and in 2004 nearly as many digital games were sold as there are people in the United States (248 million games vs. 293.6 million residents)” (Van Eck, 2006, p. 2). Playing digital games has become an important part of current youth’s life.

Gee (2007a) listed 13 features of video games along with 36 learning principles to enhance learning and to facilitate teaching with regard to three different perspectives: 1) empowered learners, 2) problem solving, and 3) understanding. He stated that good video games encourage players to feel like active agents when they play and to devise strategies to go to the final stage on their own, both of which significantly motivates students to learn new things, conquer new challenges, and solve new problems. These new problems force students to integrate old and new knowledge to a higher level through practice, as well as trigger deep learning. During the process of game playing, players are able to work at their own pace (Federoff, 2002; Wills, 1996) and adjust their strategies when continuous feedback is given “just in time” (Gee, 2007a, p. 138). According to Gee’s *What Video Games Have to Teach us About Learning and Literacy*,

“[O]ne good way to make people look stupid is to ask them to learn and think in terms of words and abstractions that they cannot connect in any useful way to

images or situations in their embodied experiences in the world. Unfortunately, we regularly do this in schools.” (Gee, 2007b, p. 72)

Good video games can help make concepts, abstract theories, and philosophical points meaningful and concrete by realizing them in images and simulations (Gee, 2007a).

Squire and Jenkins (2003) also declared that games have tremendous educational potential. A good educational game could enable players to explore ideas in virtual worlds; help develop learning through observation and hypothesis testing (Greenfield, 2010); adjust to the skills of the other players, thus allowing the same product meet the needs of beginning and advanced users (Holland, Jenkins, & Squire, 2003); and constantly require input from the learner and provide feedback (Van Eck, 2006). Researchers believed modern educational digital games were effective tools for teaching difficult and complex concepts because they could: 1) enable multiple learning styles; 2) render pedagogical interactions; 3) help teachers to observe students’ problem-solving skills in actions instead of explanation; 4) provide lecture-style materials with visualization; and 5) have students motivated and satisfied (Holland et al., 2003).

Barab, Gresalfi, and Arici (2009) provided a rationale for why educators should care about games. When playing games, students are empowered actors instead of passive recipients; students gain strategies and use them to accomplish desired ends rather than merely remembering information; and students have the opportunity to experience “a present reality” (Chambers, 2005) that responds to learners’ actions as opposed to knowledge that might be relevant in the future. Researchers (Barab et al., 2009) emphasized the role of games as bridges to help connect virtual accomplishments to real-

life scenarios which grant students the expertise to act in problem-filled contexts where applying their expertise makes a difference.

The other reason for adopting digital games in class is the instant, naturally built-in feedback system. The feedback element means that “players should get an immediate response to their actions and they should be informed on their progress towards a goal” (Taylor, Backlund, Engström, Johannesson, & Lebram, 2009). One of the reasons why games have the power to engage people is that they provide real-time outcomes and feedback (Rieber, 1996), which direct learners to take actions and make decisions. These outcomes and feedback support learning through the continuous interaction between the learner and the game (Burgos, Tattersall, & Koper, 2007; Shute & Ke, 2012). This immediate feedback works as an assessment tool to evaluate students’ learning performance and progress.

According to Van Eck (2006), there are three adopted approaches for integrating games into the learning process: 1) student-built games from scratch, 2) educator-designed games from scratch to teach students, and 3) using commercial off-the-shelf (COTS) games in the classroom. Some researchers (Gros, 2007; Ke, 2008; Papastergiou, 2009; Squire, 2005; Squire & Jenkins, 2003; Tsai et al., 2007) have examined how to use commercial games for educational purposes or have advised game designers on educational games. According to Hsu et al. (2013), more researchers have started to explore how teachers utilize games in the classroom.

Some teachers are still reluctant to use digital games in the classroom for the following four reasons: 1) the search for appropriate commercial or educational games

could be impractical, time-consuming, and costly since these games may turn out not to be designed for the intended audience (Liu & Li, 2011; Van Eck, 2006); 2) it is difficult to identify a particular game which is relevant to the components of the curriculum as well as the appropriateness of the content within the game (Gros, 2007; Li, 2010; Harris, Mishra, & Koehler, 2009; Jackson, Gaudet, McDaniel, & Brammer, 2009); 3) teachers with little gaming experience require significant support during the process of using digital games in class (Gros, 2007; Hense & Mandl, 2012); and 4) considerable effort is needed by teachers to use the game in the curriculum (Gros, 2007; Popescu et al., 2013; Squire, 2005).

There is a gap between the strong demand on teachers for integrating digital games (COTS games, educational games, or serious games) within classrooms and the discomfort of teachers in determining appropriate games for their target audience and corresponding curriculum. Another gap is the need for teachers to acquire gaming skills to meet the learning needs of the Net Generation with the rapidly growing popularity of game playing. Therefore, it is more reasonable for teachers to gain useful, functional, and relatively simple software and programming skills so they can create games that serve the particular learning needs of their students. Some researchers and organizations (Gee, 2007a; Hayes & Games, 2008; Klopfer & Yoon, 2005; Schaaf, 2013) have contributed to gamification. For example, there are platforms and software (e.g., Scratch, Kodu, GameMaker, and StarLogo TNG) that help teachers learn game design with built-in commands instead of traditional programming code. Additionally, more gaming communities have been created for teachers to share resources and experiences.

- 1) *Building games for teaching* (<http://classroom-aid.com/educational-resources/play-and-learn/game-building/>) introduces various free gaming resources (e.g., templates, toolkit) to guide teachers in creating customized digital games.
- 2) *Teacher Gaming Network* (<http://www.ftcomp.com/index.php/teacher-gaming-network>) provides an easy three-step online tool for teachers to create interactive digital games. Teachers can also search a database of shared content from other users and add it to their own games. This online tool also provides detailed statistics about students' responses. (TGN, 2013).
- 3) *Yoyo Wiki* (http://wiki.yoyogames.com/index.php/Information_For_Teachers) is an associated online resource for *GameMaker* to teach teachers about programming, technology, and game design.
- 4) *EdGames* (<http://people.uncw.edu/ertzbergerj/all.html>) provides game templates and tutorials that help teachers design and build digital games.

Van Eck (2006) stated that the educator-designed game would be the “Holy Grail” approach to digital game-based learning “because of its ability to potentially address educational and entertainment equally” (p. 20). He has also surmised that the educator-designed DGBL approach is the future. More importantly, teachers have the potential and capability to build explicit learning objectives and target strategies and skills into the customized games to meet the specific learning needs of their students.

Although there are researchers who study students as game designers (Kafai, 1995; Kafai, Ching & Marshall, 1997), few research studies have explored teachers as the

designers of digital games. Kafai, Franke, Shih, and Ching (1998) explored 16 pre-service teachers' experiences of designing games for mathematics learning. They found the teacher-designed games were characterized by a shift from extrinsic game design (i.e., game idea and math contents separated) to intrinsic game designs (i.e., game idea and math contents integrated), as well as a shift from no consideration of users' thinking to providing opportunities for users' thinking and learning. Other researchers (Becker, 2007; Li, Tay, & Louis, 2012) examined the game design experience of graduate students who took DGBL courses. They found game design skills helped pre-service teachers become more prepared before they started their careers, and the design experience encouraged in-service teachers to become more involved with their students' needs.

In my research study, I examined a group of teachers who are game users and/or designers. They have the content and pedagogy knowledge and an understanding of the learning context (e.g., the students, environments) to discover what the internal and external conditions support them to use and design digital games for their classes.

Summary of Chapter

Chapter two explored the literature in relation to DGBL, gamification, and teacher education in DGBL. Based on the review, several gaps regarding current issues and challenges of using digital games in class have been identified. In the following chapter, the research design, methodology, as well as ethics considerations will be discussed.

CHAPTER THREE: RESEARCH DESIGN

Introduction

A multi-case study approach was used for my research. Case study is “an in-depth exploration of a bounded system (e.g., activity, event, process, or individuals) based on extensive data collections” (Creswell, 2012, p. 465). Yin (1984) defined case study as “an empirical study that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; in which multiple sources of evidence are used” (p. 23). In addition, Miles, Huberman, and Saldaña (2014) claimed, that a case is “a phenomenon of some sort occurring in a bounded context” (p. 28). In my study, the specific phenomenon was that teacher with various gaming and educational backgrounds used and/or designed digital games; the second component of this phenomenon was the transition of teachers from being game-users to game designers.

Using a multi-case study approach, I was able to comprehend the characteristics and perception of the teachers who used and/or designed digital games to enhance their teaching; I was also able to analyze the factors that motivated teachers to use and/or design digital games. In my research, one teacher plus his/her school context was considered as one case. Each case group included the participating teacher, his/her supporting staff, administrators, students, and artifacts. The teacher in each case could be a game user only, or both a game user and a game designer. Each teacher may or may not have had gaming related professional development or training experiences. The key

objective of my research was to explore how and why teachers used digital games, as well as what factors helped transform teachers from being game users to game designers.

The rationale for using case study for the research was based on three key items. First, the case study design is particularly suited to situations involving a small number of cases with a large number of variables (de Vause, 2006). I investigated four cases with five participating teachers in southern Alberta, Canada. Creswell (1998) recommended that no more than four cases be studied because the greater number of cases will affect the depth of each case. Each case involved large amounts of data from interviews with different stakeholders including teachers who used and/or designed games for their students, school administrators, supporting staff, and student focus groups; in-class observations; and analysis of the games which teachers designed.

Second, a case study is appropriate to use for an in-depth exploration of an actual case (Yin, 2009). The goal of the study was not only to describe the behaviours and motivations of the teachers who used and/or designed games for their students; it was also to explore the root and critical reasons behind the phenomenon, which was why and how these teachers had the capacity to be game users and/or game designers.

Third, case study allows for multiple forms of data sources (Creswell, 2012). In this research, interviews, in-class observations, and actual artifacts of teacher-designed games were used to develop an in-depth understanding of the phenomenon. Survey data were collected to provide background information for each participating teacher.

Study Participants

Merriam (2009) noted that the assumption to use purposeful sampling in case study research is “that the investigator wants to discover, understand and gain insight and therefore must select a sample from which the most can be learned” (p.77). For those reasons, purposeful sampling was used to select participants for this research to best help me understand the phenomenon (Creswell, 2012). In this study, I investigated five teachers from four school districts in three cities of southern Alberta, Canada. Four out of five participants were introduced to me by my colleagues who had connections with teachers who were either using or designing games for their students. The fifth participant was my former colleague who designed games for his math and social science classes.

I had no control over the phenomenon of the study, meaning that I did not intervene in any game design, in-class teaching, or offer any ideas. In each case, not only were the participating teachers interviewed, but the curriculum and professional learning leaders, school administrators, and students in focus groups were as well. Each participating teacher and the associated staff voluntarily agreed to be involved in the study.

Data Collection

This study was guided by Yin’s (2014) recommendation to collect multiple sources of data, which can include both qualitative and quantitative evidence. Data were gathered from individual and focus group interviews, class observation, and artifacts. The survey was used to provide background information about participating teachers. Patton (2002)

stated, “by using a combination of observations, interviewing and document analysis, the fieldworker is able to use different data sources to validate and cross-check findings” (p. 244). The triangulation of the data enhances the reliability and validity of the findings.

Surveys. After the consent forms were signed by participating teachers, an electronic survey was sent for them to complete over a two-week period. The survey included seven demographics-related questions to gather basic information from teachers. The following are the proposed survey questions:

- 1) Age:
- 2) Gender:
- 3) Years of teaching:
- 4) Currently, which grade and subject are you teaching:
- 5) Have you used digital games for teaching:
- 6) If yes, please name a few:
- 7) Have you designed games for teaching:

Interviews. Open-ended and semi-structured individual interviews occurred with each participating teacher since this format allowed me to respond to the situation on site and generate new ideas on the topic (Merriam, 2009). “Interviews are an essential source of case study evidence because most case studies are about human affairs or behavior events. Well-informed interviewees can provide important insights into such affairs or events” (Yin, 2009, p.108).

The purpose of the interviews was to gather in-depth information about participants' digital game use and design experiences. The interviews included open-

ended questions and were conducted in an open and non-threatening environment, so the participants were able to freely and comfortably share how and why they used and/or designed digital games for their students with specific purposes that were involved in particular topics (Kvale & Brinkmann 2009).

Individual interviews with curriculum and professional learning leaders and school administrators were conducted to explore the external contribution, encouragement, assistance, and support for teachers who used and/or designed games for their students. In other words, what environment or school culture provided a friendly atmosphere to foster teachers to become game users and/or designers? In a purposeful sampling, individual interviews were chosen, because the participants know the most about the topic (Merriam, 2009). Although I planned to conduct the individual interviews with teachers first and learning leads and school administrators after, some participants' schedules did not allow me to collect the data in this order. Therefore, the interviews were conducted based on participants' earliest availability.

In terms of the research questions, participating teachers had the knowledge to provide the internal reasons why they became game users and/or designers and what made some teachers transform from game users to game. Furthermore, the associated supporting staff, curriculum and professional learning leaders, and school administrators were expected to offer external assistance to encourage participating teachers to use and/or design games in class.

Focus group interviews with students from each case were also undertaken to gather the students' voice which reflected the effects of teacher-used and teacher-

designed games. The interviews also indicated what way students' learning motivation, performance, and achievement were affected. The sample of students from each class was from 4 to 24. Kitzinger (1994, 1995) claimed that interaction was one of the crucial features of focus groups. The interaction between participants highlighted their views of certain topics, issues, or situations. During the process of interaction, participants could re-evaluate and reconsider their own understandings of their specific experiences. Another benefit is that focus groups extract information in a way that helps researchers find out why an issue is salient and is salient about it (Morgan 1988). Lastly, when participants in the focus group are similar and tend to be cooperative with each other, "the interaction among interviewees will likely yield the best information" (Creswell, 2012, p. 218).

In my research, there were five focus group interviews with students. For example, in case one, I had a 15-minute group interview with the whole class (n=24) during break. In case two, I had a 13-minute group interview with one of the classes (n=15). In case four, there was a 10-minute group interview with students (n=8) who signed the consent form. Due to the limited time and large number of participants in the focus group, I found it was challenging to collect comprehensive ideas regarding different interview questions. Therefore, the data from student focus group interviews were not prominent compared with interview data from participating teachers and school administrators.

Observations. In-class observations were conducted. Yin (2009) argued that "if a case study is about a new technology or a school curriculum, for instance, observations of the technology or curriculum at work are invaluable aids for understanding the actual

uses of the technology or curriculum or any potential problems being encountered" (p.110). All in-class observations were conducted before interviewing participating teachers, so I could ask for clarification regarding questions raised during the observations.

I was a nonparticipant observer in each participating teachers' class, taking field notes on how teachers used and designed digital games in the classroom. The nonparticipant observer is an "outsider" who sits in some advantageous place to watch and record the phenomenon without becoming involved in the activities of the participants (Creswell, 2012). In-class observation offers things to an outsider that may lead to better understanding the context (Merriam, 2009). It was also conducted to triangulate emerging findings, which was used in conjunction with interviews and artifacts analysis to substantiate the findings (Merriam, 2009). The observational protocol was guided by the following questions:

- 1) What kinds of games did teachers use and/or design in class and what was the rationale for using these in teaching and learning?
- 2) How did participating teachers use games to facilitate student learning?
- 3) How did students engage with the games (e.g., nature of the discussion, level of integration, and level of participation)?
- 4) How did teachers achieve instructional objectives through game play?
- 5) What types of knowledge and/or skills did students gain from the game experience?

The first question ensured obtaining holistic data on teacher-used or teacher-designed digital games (e.g., type, genre, platform, purpose, etc.). The second question helped me to understand how teachers aligned the embedded activities in games to curriculum content and learning objectives. The third question allowed me to investigate to what extent students became engaged with the games based on their reaction to either teacher-used games or teacher-designed games. The last two questions provided information on how teachers pedagogically designed the DGBL environment. The guiding questions focused on both teachers' design and students' reaction to the games used in class. The aim was to look at teacher-designed games from a more objective perspective to see if they were meeting student learning needs.

Artifacts. Artifacts of teacher-designed games were examined to learn of the challenges, limitations, and efficacy of teacher self-designed games, and also to see how the games mapped to curriculum, learning outcomes, and 21st-century competencies. Each participating teacher's self-designed games were analyzed in terms of the programs used to design the game, the interface and navigation, feedback and interaction function, learning activities embedded in the game, ease of play, and support of active learning and problem-solving skills. Two teachers provided their self-designed games: one was built on 3D GameLab, and the other one was built on Notebook.

Data Analysis

Each data resource was analyzed with different methods and techniques. In Chapter Four, the themes were described and summarized by using the inductive approach "1) to condense extensive and varied raw text data into a brief, summary format;

2) to establish clear links between the research objectives and the summary findings derived from the raw data” (Thomas, 2006, p. 1). The goal of this process was to identify the salient patterns and themes of how teachers used and/or designed games for student learning and what factors encouraged the transition of teachers from being game users to game designers.

Survey Data. A descriptive statistics analysis was used to summarize the survey data in terms of their demographic features. In the survey, participating teachers’ background information was gathered in terms of their age, gender, how long they had been teaching, what digital games they had been using, how they had used digital games for teaching, and their game designing experience and background. The above data provided information as to why each participant used a gaming approach to facilitate their teaching and why they were passionate about gaming.

Interview Data. The interview data from individual and focus group interviews served as the primary data source for the study. Four steps of analysis were taken to gain an accurate interpretation of the interview data: 1) Transcribing all interview recordings; 2) Reading through the transcripts to obtain a general sense of the interview’s content; 3) Coding the interview text to identify the themes generated from the transcript documents; and 4) Reviewing the research questions to select matching themes. In terms of the coding, I followed the template for coding a case study by Creswell (2007). In this multiple case study, codes existed for the context and description of each case. I read all the transcripts carefully and wrote down the ideas. Next, I advanced codes for themes within each case and for themes that were pertinent to a cross-case analysis. Finally,

codes for assertions and generalizations across all cases were included (Creswell, 2007). During the coding process, the predetermined and emerging codes together and generated the description of the setting and people to conduct thematic analysis (Creswell, 2007). In terms of the predetermined codes, it covered Gee's 36 learning principles, various supports from different stakeholders (students, supporting staff, and administrators), and students' in-class behaviour while playing games. Gee's learning principles were used to indicate what theoretical guiding principles teachers embedded and applied in the DGBL environment design.

In conclusion, at the first stage and within case analysis, each case was treated as a comprehensive unit and all data were gathered for me to learn of the contextual variables (Merriam, 2009). At the second stage, cross-case analysis, I compared the similarities and differences of the themes as well as what factors cause the discrepancy. The following chart showcases an example of the coding process (see *Table 3.1*).

Table 3. 1

Example of Coding Process

Quote	Page Number	Theme	Research Question	Gee's 36 principles	Support (A, SS, S)
Learn math, but they don't realize that	P ₃	Incidental Learning	RQ ₁	12	
when the learning is accidental like that it sinks in deeper	P ₁₀				
Math problems you see in a grad six textbook	P ₃	Curriculum focused	RQ ₁	21	
I play the game myself	P ₃	Gamer herself	RQ ₁		
Know the game	P ₄ & 5				
Purchase some of them myself	P ₄	Low budget	RQ 1 & 2		A and community
school helped me...	P ₄				
Kids mostly bring from home...	P ₄				
Ask for donations	P ₆				
put out on Facebook	P ₇				
out of own pocket	P ₇				
Last year I was experimenting with text adventure games	P ₆	Teacher as game designer	RQ ₂	2	

Note. A=Administrator, SS=Supporting Staff, S=Students

Observation. Observation data were organized to generate common themes based on the observational protocol, which was listed under the data collection section. Observation data (descriptive and reflective field notes) were used to acquire first-hand information of: how teachers used digital games and/or self-designed digital games in class, learning activities aligned with the games, and student reactions. The descriptive notes included class activities and the behaviour of students and teachers'. The reflective notes recorded what I was unsure when observing the class as well as questions to ask participants, both of which were addressed in the interview with the class teacher for clarification. All the information was complemented as well as compared to teachers' perspectives on digital game using/designing in class. In each case, at least one class observation was conducted. Data collected through observation allowed me to verify information gathered through interviews with all stakeholders (Gall, Borg, & Gall, 2007). The observations provided opportunities to see if students were engaged with the games as well as if the games were teaching curriculum centred learning objectives. The data from observations were used to triangulate the data collected from surveys, interviews, and artifacts as well as provide support for emerging themes summarized from interviews.

Artifacts Data. A limited number of artifacts were available for me to analyze. Only two participants provided their self-designed games. For the artifacts analysis, a holistic interpretation was used (Miles et al., 2014) which meant that the artifacts were viewed to identify emerging themes.

A flow-chart (see *Figure 3.2*) of case one game was prepared to provide the description of the artifact. At the first stage, the artifacts data were summarized based on the following guiding items: the programs that teachers use, the video and audio elements embedded in the games, and the Gee's 36 learning principles applied in the activities. At the second stage, I employed a process of comparing (see *Table 3.2*) the games. These two stages helped to understand the characteristics of teacher-designed games as well as the differences to teacher-used games. These two stages also helped answer what factors influenced teachers in designing digital game-based learning environments and provoked the transition of teachers from being game users to game designers.



Figure 3. 1: Demonstration of one 3D GameLab Unit.

Table 3. 2

Artifacts Summary

Case	Platform/Program	Game	Subject	Gee's theories applied
1	3D Game Lab	Quest	Social Science	1, 3, 7, 12, 20, 33, 36
2	Notebook	Jeopardy	Math	1, 12, 20, 36

Note. Two teachers provided the artifacts

Integrity of the Study

It is vital for all the research studies to establish reliable, valid, and trustworthy knowledge. According to Yin (2014), the following four tests will be taken to verify the reliability and validity of the current research.

Construct validity. Construct validity identifies “correct operational measures for the concepts being studied” (Yin, 2014, p 46). One of the tactics that can be used to increase construct validity is multiple sources of evidence (Yin, 2014). In this research, interviews, observation, and artifacts were used to triangulate the data to “confirm the emerging findings” (Merriam, 1998, p. 204). Yin (2014) claimed that multiple sources of data provide various measures of the same phenomenon, which naturally increased accuracy within the case study. Data from the interviews with teachers provided information on why they were passionate about the gaming approach, their previous gaming and designing experiences, and how these factors influenced their openness to be game users and designers. The interviews with supporting staff and school administrators supplied perspectives on using and designing digital games for student learning.

Furthermore, these interviews provided additional information in relation to the nature

of the support and resources available to teachers within schools to help them in using and/or designing digital games. Lastly, the interviews with students offered their opinions on the games used in class and the reasons for their preferences on adopted digital games and teacher-designed games. In-class observation provided an opportunity to witness the digital game-based learning environment; it also offered a first-hand resource by observing the way teachers used digital games (either adopted or self-designed) and how students played with and reacted to them. The artifacts supplied evidence of the nature and type of multimedia elements embedded in the games and the pedagogy behind the design. The triangulation of the data resources and analytical methods enhanced the validity of the study.

Internal Validity. Internal validity seeks to “establish a causal relationship, whereby certain conditions are believed to lead to other conditions, as distinguished from spurious relationships” (Yin, 2014, p. 46). Merriam (2009) argued that the best rule of thumb is that the same patterns should reappear until no new information emerges during data collection. The interviews with teachers, supporting staff, and students allowed for the examination of patterns of internal and external factors that affected teachers’ openness to digital game using and/or designing from three different perspectives. The other two data sources—in-class observation and artifacts—provided additional opportunity to observe such patterns in terms of practice in action. Merriam (2009) noted that member checking is one of the most common strategies to achieve internal validity. Each interview participant was provided the interview’s transcript after

data analysis was completed in order to review the accuracy of their interviews. No participants provided any feedback regarding their interviews.

External Validity. External validity “is concerned with the extent to which the findings of one study can be applied to other situations” (Merriam, 2009, p. 223). One of the techniques that used is the use of “rich, thick description” (Merriam, 2009, p. 227), which means a detailed description or presentation of the study’s findings (Merriam, 2009). In my study, an in-depth case report in Chapter Four, Five, Six, Seven, and Eight was produced, which entailed three categories of data analysis: interviews, observation, and artifacts. Each category covered detailed analysis based on the interviews from teachers, supporting staff, administrators, and focus group students, field notes and observation protocols based on in-class observation, and individual reports of each teacher’s game artifacts.

Reliability. Reliability refers to “the consistency and repeatability of the research procedures used in a case study” (Yin, 2014, p. 240). One of the most important issues is “whether the results are consistent with the data collected” (Merriam, 2009, p. 221). One of the strategies was the data triangulation method to achieve consistency and reliability. Multiple sources of data were collected to investigate patterns, and different analytical methods were used in terms of different kinds of data. Due to the limited budget and time, I was the sole coder of the data. However, in order to enhance the reliability of the study, I shared my data findings with my supervisor and supervisory committee for feedback regarding “the process of study, the congruency of emerging findings with the raw data, and tentative interpretations” (Merriam, 2009, p. 229).

Researcher's Role

Before I began my Ph.D., I had a strong interest in DGBL and presented a research paper regarding teacher-designed games at the American Educational Research Association conference. In my research study, I explored a similar topic and broadened the topic to teacher-used games as well. I also hosted a Game-Based Learning workshop for undergraduate students to introduce the current trends to pre-service teachers. I was able to bring theoretical research experiences and skills to this study.

I interviewed all participating teachers, supporting staff, school administrators, and focus group students. After the interviews were completed, they were transcribed by a transcribing company. I coded them into themes. I also conducted one or two in-class observations of each participating teacher as a nonparticipant observer because I did not want to interrupt their natural teaching and learning routine in order to get a more objective impression of what really happened in class. I also recorded the descriptive and reflective field-notes. As a researcher, I acknowledged that it was inevitable to have biases on judging the research design and interpreting findings since I was dealing with people.; therefore, I held ongoing critical self-reflection through discussions with my supervisor, supervisory committee members, and academic peers. The other tactic I used was to test the patterns among the cases to monitor the validity of the study.

Ethical Considerations

An ethics approval form was prepared and sent to the Conjoint Research Ethics Board of University of Calgary before my research was conducted. Participants of this study were introduced by my colleagues. After initial approach, participants were invited

to partake in the research. Participation in this study was voluntary. All the interview documents, field notes, and artifacts data remain confidential. For example, teachers, students, and other interviewees' names will not be revealed and the content will not be discussed after research is completed. Research data was stored in a secure place and will be permanently destroyed according to ethics guidelines.

The four cases were from four different school districts in Southern Alberta. After the participants were confirmed, I sought ethics approval from each school district. Three schools did not need ethics approval, but it took six months to get the approval from the last school.

Limitations

There were five limitations to the study. First, the reliability and validity of interviews and the interpretation of interview data needed to be considered. During the process of interviewing, some participants had unanticipated reflections due to various reasons. Interviewing is a time-consuming process, and some interviewees were not willing to spend the expected time on scheduled interviews.

Second, a case study research approach involves the use of either an individual or a few cases; therefore, findings may not represent the general group or population (Guba & Lincoln, 1981). Generalizability refers to “the degree to which the findings can be generalized from the study sample to the entire population” (Polit & Hungler, 1991, p.645).

A third limitation of case study related to the amount of analysis, description and time required to analyze the phenomenon. I needed to decide: “a) how much to make the

report; b) how much to compare with other cases; c) how much to formalize generalizations or leave such generalizing to readers; d) how much description of the researcher to include in the report; and, e) whether or not and how much to protect anonymity” (Stake, 2005, p. 460).

Fourth, there was a possibility that only a small number of teachers would be willing to participate in the research. In this study, five teachers participated.

Fifth, I might not have been able to find teachers who design digital games for their students. In this research, four out of five designed digital games themselves, but only two teachers shared their artifacts with me.

Delimitations

First, the multi-case study was limited to in-service teachers who used and/or designed digital games in K-12 public schools in southern Alberta. Second, data were collected from November 2014 to October 2015 from four case groups. Third, the administrators, curriculum and professional learning leaders, and students were chosen from the schools of participating teachers.

Conclusion

This mixed method multi-case study aimed to explore the internal and external factors that influence teachers to use and/or design digital games in class to meet their students’ learning needs while creating an engaging learning environment. Data were collected from an online survey, semi-structured interviews, in-class observations, and artifacts. Thematic analysis and inductive approach were used to analyze and summarize

collected data; findings are reported in Chapters four through eight and discussed in Chapter nine.

CHAPTER FOUR: CASE ONE

The findings and data analyses from four cases are individually presented in Chapters four, five, six, and seven. Each case identifies the case context, participant profiles, and findings from the data collection outlined in Chapter three. The overarching themes of each case are presented based on interviews, classroom observation, students' projects, and the games teachers designed for students. Following each individual case, a cross-case analysis is undertaken to compare the similarities and differences amongst the four cases.

Overview of the Four Cases

All the schools from the four cases were in southern Alberta, Canada. Each case included either one or two classroom teachers, a school principal and/or a curriculum lead, and students in participating teachers' classes. Each teacher had different gaming and educational backgrounds (see *Table 4.1*). All the participating teachers used and designed games for their students. They also used games in different classes (e.g., math, social science), mainly as a practicing tool. The following table provided the descriptive statistics of these five participating teachers.

Table 4. 1

Descriptive Statistics Analysis of Online Survey

No.	Questions	Results	Number
1	What is your age?	25 to 34	2
		35 to 44	3
2	What is your gender	Female	3
		Male	2
3	How long have you been a teacher	5 to 21 years	
4	Currently which grade are you teaching?	Grade 4 to Grade 12	
6	Are you a video gamer? If yes, how long have you been a gamer?	Lifelong	3
		Off and on for the last several years	1
		No	1
8	Have you taken any digital game-based learning courses or workshops	Yes	3
		No	2
9	If yes, please list the duration of the courses/workshops and when did you take it.	Yes (a graduate level course, workshops, conferences)	3
		No	2
10	Have you used digital games for teaching?	Yes	5
		No	0
12	Have you designed digital games for teaching?	Yes	4
		No	1

The following sections present the case context, participant profile, and finding of case one.

Case Context

The first case involved a K-6 Catholic elementary school in southern Alberta. A grade six teacher, Cynthia (pseudonym), was recommended to me by my colleague as she has been using and designing digital games for her class, and she was the only teacher who used and designed games in her school. Cynthia has been a lifelong gamer and plays various digital games herself. She has been using Classcraft (www.classcraft.com) and, Rezzly (formerly known as 3D GameLab), which is a customized “content creation platform” (Rezzly Heroic Learning, n.d.) to gamify her class. After contacting her via Twitter, Cynthia agreed to participate in the research. In her response, she said, “I am absolutely in support of anyone wanting to put more research into this type of thing (gaming), and would be happy to help in any way.” She was teaching all subjects in a grade six class. During the two days in her class, I managed to do three class observations in her math, social studies, and game design class as well as conduct interviews with the class teacher, her students, and the school principal.

Participant Profiles

Class teacher. Cynthia had been an elementary teacher for 11 years and had worked at her current school for seven years. She called herself as a “lifelong gamer.” She also wrote educational game reviews for *Common Sense Education* (formerly known as *Graphite*), a website providing resources on digital literacy to both educators and parents. Cynthia had written 51 game reviews mainly regarding educational games (i.e. *Quest Atlantis*, *Prodigy*). In her reviews, she has covered price, recommended grade range, platforms, recommended subject areas, skills enhanced/practiced, content, how teachers

can use the game, and if it is good for learning. Considering not every teacher who was interested in Digital Game-Based Learning (DGBL) was able to explore different games, Cynthia was hoping to provide helpful resources and information for non-gamer teachers.

Cynthia not only played digital games, but was also involved in role play, pathfinder, and board games. She used various digital games for her grade six math class and gamifying approach for her social studies class. In addition, Cynthia was teaching game design in her option class. Although she did not have any official training in game design or DGBL, Cynthia was passionate about using games and gamification to enhance students' learning experience. She also participated and presented at various national and international conferences on gaming. In order to “walk them through the same information in the social studies textbook but in a more interesting way,” she designed a text-based adventure game for her social studies class. With the use of games, she turned a conventional class to an engaging, fun, and interactive gamifying learning opportunity for her students.

School Principal. The school principal, Suri (pseudonym), had been working at this school for seven years as well. Although she admitted that she did not have much experience of gaming, her overall attitude towards Cynthia using games was positive. Suri expressed concern over using and designing games for students. She had provided guidance in terms of supporting teachers to create an engaging and interactive learning environment by using appropriate games. Given the fact that they started working here at the same time and have known each other for seven years, Suri trusted Cynthia's teaching capability.

Students. Three classroom observations occurred during the research. Cynthia's math class was observed the first day and all of her students (n=24) submitted their consent forms. Students were divided into eight groups. Amongst them, three groups were working individual on three different digital games (*Minecraft*, *Prodigy*, *Professor Layton and the Curious Village*); three groups were working on board and paper-based games (*Rush hour*, a Scholastic game, *Algebra Memory*); and two groups were working on worksheets. Please refer to Appendix F for a brief description of each game. Students switched groups every 20 minutes. When the math class was finished, a group interview was undertaken during break time. All of her students participated. Her social studies class was observed the second day with the same group of students. In class, students were working in groups or individually on different quests.

Findings

Data resources for each case were different. Based on the analysis of the data from interviews with educators and students, three class observations, the teacher's self-designed game, one online survey with the class teacher, as well as her game reviews, and her Twitter, the following five themes were identified: 1) advocate games for learning; 2) impact of games on student learning; 3) guiding principles; 4) supportive environment; and 5) challenges.

Advocate games for learning. Cynthia has been a lifelong gamer. She is passionate about games and, more importantly, the power of games. Although she has been keen to play various kinds of games including role-playing games, puzzles, board games, card games, and digital games, Cynthia never thought of using games in her own

class during the early years of her teaching. Six years ago, she came across the book *The Multiplayer Classroom: Designing Coursework as a Game* by Lee Sheldon. The idea of changing a university design-based course into a game really hit her. She started thinking, Why not bring the gaming world into her class? After her experience in the last couple of years, Cynthia found that gaming within the classroom worked very well. The following examples relate how she used games and gamified her class.

In her math class, she found the textbook was “boring,” and students appeared to be frustrated with the math concepts when no background knowledge was introduced. She reported that the concepts were not meaningful to the students. When she introduced games in her math class, she stopped using the textbook. Cynthia had been using games (see *Appendix F*) to teach different subjects. She was hoping to enhance students’ higher thinking skills through games. She stated: “[D]epending on the game and the subject area,” she expected her students to gain “perseverance, critical and creative thinking skills.” After piloting the new game-based approach for a semester, Cynthia reported that students’ favourite subject became math. In her parent-teacher interviews, when her students were asked, “What are you really enjoying this year and what’s a challenge for you this year?” Cynthia recalled that many students said they were really enjoying math. At that point, their parents’ reaction often was: “You are kidding.” The outcome of using games in math class was surprisingly effective.

Cynthia not only had been using educational and commercial games in her math class but also investigating diverse approaches to gamify her classes in other subjects. For

example, she introduced Classcraft as her student's XP (the abbreviation of an experience point in games to track players progress) system to motivate and engage them in class.

The more XP her students received the more equipment they were able to achieve and the more powerful they would become in the Classcraft system. In order to get more XP, students completed various learning tasks in different classes. For instance, Cynthia created a quest-based task in her social studies class by using the platform 3d GameLab to help explain various abstract concepts. By completing the quests, students proceeded to further quests as well as garnered more XP to level them up in Classcraft. Hence, students were highly motivated to learn more and explore topics related to social studies.

During the interview, Cynthia said that gaming could be one of the most effective ways for the current generation to learn and for teachers to reach them. She found that the first two go-to resources had always been either YouTube or Pinterest when students looked up instructions or needed assistance. Given the fact that gaming is included in the visual category and gaming involves interaction with students, Cynthia had been confident in making it work and was determined to keep it in her teaching. When asked of her dream game design, she answered, "I would love if I could design, like, a whole environment where the student could conduct all of their education through one big game."

Impact of games on student learning. Cynthia, Suri, and the students all emphasized what influence the games had brought to class. In the analysis of the interview data, the following themes emerged from information concerning the impact of

games on student learning: 1) engagement, 2) motivation, 3) incidental learning, 4) freedom, 5) allow to make mistakes, and 6) work at your own pace.

First, it appeared that the majority of Cynthia's students were fully engaged in the math class with playing various games. During in-class observation, only one student seemed distracted while she was working on the worksheet. The rest were either engaging with the activities or having a discussion with their peers or the teacher, which were mainly related to how to solve the puzzles in games. When they were asked to switch to a different group, students playing both digital and board games were reluctant to leave their current groups and needed to be reminded to move on.

From the group interview, students identified the games used in class and at home, explaining how they enjoyed the learning experience by playing games. One student said: "With the classes that we use games because a lot of us love using technology, it's kind of more fun and more engaging, I guess than the other classes." Games allowed students to explore and construct new knowledge in an engaging learning environment but they did not realized that they were learning. One student commented, "I like playing Prodigy at home because it's fun and I get to level up my characters and battle against things and learn new math stuff."

Second, students were not only engaged with game playing, but they also felt motivated to learn and explore more. One student commented, "I just feel like it motivates you more than the other classes." Students worked on various quests in their social studies class which helped them receive XP to level them up in Classcraft. Students were able to equip themselves with weapons and armour by using their XP. In order to

gain XP and strengthen their avatars, students tried to complete as many quests as possible. In the meantime, they were able to explore the topics to gain knowledge of the subject. Another student stated “Every time you finish an assignment, we get XP for leveling us up, so we can get new things and cool stuff with it. It just makes us want to learn a lot more.”

Besides the 3D GameLab, students were also motivated to play math-related games at home because they wanted to practice their math skills. In the group interview, six students shared that they were willing to play math games (*Prodigy* or *Minecraft*) after school. For example, one student discussed:

I do *Prodigy* and *Classcraft* after school because we get rewards for learning. You get experience points or gold coins in *Prodigy* that you can use for other things. I like to do those games so I can get more of that and I can get a higher level.

It seemed the external rewards played an important role in motivating students to learn math while playing games.

Third, the notion of incidental learning encouraged Cynthia to explore more games that helped her students enjoy learning while not knowing they were learning. She used the game *Professor Layton and the Curious Village* in her math class because the game was “self-explanatory but [in] kind of a novel setting almost with math integrated but they don’t realize that.” Cynthia believed that “when the learning is accidental like that it sinks in deeper.” In one group interview with students, they stated a similar learning experience while playing games. “You are actually engaged in a piece of technology, playing a game that you may not realize that it’s actually teaching you stuff.”

Fourth, games provided freedom for students to experience and explore topics in which they may be interested. One student explained that they were provided various quests in 3D GameLab for their social studies class and he commented:

I feel like you can find ways to enjoy it more. You usually always do the writing down. You take notes and everything, but with the technology, like XXX was saying, you have a choice. You get to do many other options and stuff.

Cynthia reported that when her students were given more choices, they were able to select the topics they were interested in instead of having to perform the tasks they were assigned. While students were completing quests, they were also required to rate and provide feedback on each quest. All options gave them an opportunity to take ownership of their own learning.

Fifth, another feature of games is that students are allowed to make mistakes while playing and they are willing to try again to achieve their goal. One student commented: “In real life, once you’ve made a mistake, it’s really hard to fix it. In games, you can just restart the game and then try again, over and over until we get it.” Cynthia’s response echoed student feedback. She said,

The other thing that really hit me from video games...is that idea of failure. Like you can watch a kid play a video game and they’ll try the same boss style or whatever fifteen times in a row, and they’ll die and they’ll be like, Okay, how can I do this, although I’m still frustrated, how can I do this differently? They keep coming back.

Cynthia was fascinated by the perseverance students showed in game playing, and she was keen to transfer the same enthusiasm to her class and students' learning. She noted that students tended to feel frustrated easily when doing math problems, so she was wondering how she could encourage students "take this willingness to try and try again." She used the trait of "feel free to make mistakes" in games to provide a non-stressful learning environment for students to learn from "failures."

Sixth, in terms of personalized learning within Cynthia's social studies class, students worked on quests either in groups or individually based on their own pace. Cynthia did not assign the groups in advance, but the groups were formed based on students' interests. Some students took the initiative to work together on one quest and some of them preferred to work on their own. For example, two boys worked on a presentation of democracy together while the other boy decided to work on the same task by himself. Other students were worked on developing posters, blog posting, or story writing. Based on in-class observation, all of them were attentive to their own tasks and none of them seemed distracted or bored. Each quest was worth certain XP and showed their average finishing time. However, they were not assessed by the length of time but the quality of their work. They all started with the same quest at the very beginning but were later given different options based on their interests and learning styles to reach the same learning objectives.

Guiding principles. From the interview with Suri, using or designing games is a cutting-edge teaching approach. There were not many teachers who were involved with gaming, so it was important to have guiding principles to ensure that teachers were using

the strategy to enhance students' learning. Two guiding principles of using games in class were clearly implied in the interviews with Cynthia and Suri: the first principle was using curriculum-oriented games; the second was the game had to be rated General, meaning the content of the game had to be appropriate for audiences of all ages.

First, although games had the potential to enhance students' engagement, Suri emphasized the importance of selecting curriculum-oriented and pedagogically aligned games. She admitted that Cynthia had been using an innovative approach to reach the learning outcomes which was suitable for the digital generation, and students may be able to learn various skills through games like *The Sims*. Suri commented that although it can be argued that games have the potential to make her class more engaging and interactive, the learning experience would not be meaningful to students if the games were not aligned with learning activities, assessment practices, and the learning goals. Moreover, the games used in class were required to be curriculum oriented as well. Suri accentuated that curriculum outcomes sit at the heart of all teaching and learning activities.

Cynthia's comments echoed her principal's statement. She said, "[A] lot times they tend to be what's referred to in the kind of gaming education industry as 'chocolate covered broccoli.'" She emphasized that compiling multiple choice questions with a racing game is not the approach she desired. She had been looking for genuine merging of teaching and gaming, which meant blurring the line between those two activities. One thing that she had been taking advantage of herself was that, as a "lifelong gamer," she

explored hundreds of games to select the ones which would be entertaining, fun, engaging, and have curriculum-orientated content.

It was reported that it had been challenging to find games that are fun and curriculum-oriented at the same time. Cynthia had been trying to design games for her students when “there is a content my students are really struggling with or that the current way of teaching is very, very boring and doesn’t engage my students...and I can’t find anything that would do the job that’s been pre-created.” In her social studies class, she developed a quest-based game on the 3D GameLab platform to teach abstract concepts that were difficult to understand by students. In order to help them understand democracy in ancient Athens, Cynthia scaffolded the unit by creating a series of quests from easiest to the most complicated.

Second, Suri reinforced the importance of clean games several times in the interview. She emphasized that there was zero tolerance for violence and any unhealthy content in classroom games. She explained the following,

[I]f there is a purpose to the violence, I can't imagine what that would be unless you're really studying World War II or something, I'm not sure what that would be at this level, we try to keep it violence free as far as we can.

Suri indicated that it had been a challenge because it was different from selecting a book. Unless she was able to play through the whole game, it would be challenging for her to know all the elements in it. Therefore, it mainly relied on the teacher to eliminate the possibility to use any games with violent and non G-rated content; this reliance required strong faith and deep trust in the teacher and her capacity to choose appropriate games.

Supportive environment. Suri provided PD opportunities for Cynthia to gain more professional experience and expertise in relation to gaming. From the analysis of individual interviews with Suri and Cynthia, it was found there were five supportive environmental factors: trust, low budget, and the value of professional development to support and encourage the teacher to use and design digital games in class.

First, there was the need to have trust in the class teacher. In the interview, Suri expressed strong trust in Cynthia, her gaming skills, and her teaching. “She knows a lot about them (games) and is very technologically astute, and creative, and savvy. So, I trust that what she is doing is going to be good for the kids...I trusted her work and her gaming skills.” Suri emphasized that Cynthia has been balancing different approaches to teach given that some of her students were all about technology/gaming, some of them were more textbook oriented, and some of them did not believe in technology at all. Although Cynthia had a strong belief in gaming, she took students’ learning styles into consideration and applied them to her teaching. Because of her faith in Cynthia and her awareness of what she had been doing, Suri believed that Cynthia’s talent and skills were able to bring benefits to students and to the school. Following are Suri’s comments when asked about the benefits when working with Cynthia in terms of game use or design in class:

I think it's a great benefit to have a different way to approach the same curriculum...I think we have to encourage our teachers to be creative ... Within the parameters of working with the students and really understand that their world is all about technology, except some of it is not necessarily a wise use of it. When you

have a teacher who is so well versed in the use of technology as a learning tool, I think that's a great benefit to the students.

Suri's trust towards Cynthia came from their regular open discussions on her game use in her class. The two started from the planning/coaching stage by mapping out the learning outcomes, activities, and assessment practices. Suri stated that it was always an easy conversation, as Cynthia had done sufficient background work. Cynthia outlined rationales of why and how this game would be used. There was never any notion that students were playing a game that was not connected to the curriculum. Suri was well-informed and prepared if she would be approached by any parents with doubts.

Cynthia had been working closely with IT and other staff to ensure that the games used in class would be within the parameters, which accounted for Suri's faith in her. When Cynthia planned to use any new games in class, she sat down with IT staff and provided them with what would be needed. It was IT's responsibility to ensure the network security of the school. If there was any potential of bringing in viruses or risks of the school being attacked, Cynthia's proposal would be aborted. She respected the decision from IT and went one step backward to either use other approaches or PS3 to keep the games local. Suri admired Cynthia's teamwork which in turn enhanced her trust towards Cynthia as well.

Second, it was the notion of using low budget to support gaming. It was not difficult to anticipate that Cynthia may have needed support with purchasing the games that she had used in her class. Suri mentioned that Cynthia asked for very little. Cynthia managed to acquire hardware from her online community or people who were willing to

donate their old devices. In terms of software, Cynthia purchased some from her own pocket and the school purchased copies or licenses for her as well. Both Suri and Cynthia admitted that there was a small budget for purchasing resources like games, but Suri had been supportive as long as there was a need in Cynthia's class.

Third, it was the value of professional development to support the teacher. Suri financially supported Cynthia to attend gaming related conferences and PD sessions. As long as Cynthia expressed her expectation of pursuing PD opportunities that were important for her teaching, Suri always managed to make it happen and encouraged her to connect with professionals in the gaming field. She described how she supported Cynthia:

[S]he (Cynthia) said "Would there be money in the budget for this particular thing because it's training teachers how to build these games?" I said "Okay, that sounds good." She paid for it and we reimbursed her, and that kind of thing. For me, she needs to be motivated, and she is, to be able to say, "Okay, I need this because I have to do that."

Cynthia's comments corroborated Suri's statement. Her principal had been supportive when there were any PD opportunities that would help her build a network in gaming area or would be a chance for her to gain or share related experiences. Cynthia shared another support example from Suri: "I went to the Games Learning and Society Convention in Wisconsin a couple of years ago, and they were quite supportive of me, especially since it happened to be right on top of the provincial achievement tests."

Suri also encouraged Cynthia to present at their divisional PD sessions. Cynthia had facilitated two PD sessions for her school division and one presentation for Southwestern Alberta Teachers Convention. Both Suri and the director of curriculum coached her in terms of what the pedagogical piece was behind using the game, how the game related to the curriculum, and how it was meeting the learning outcomes. They wanted Cynthia to understand that passion and engagement were not enough. When Cynthia offered to present for the school division's PD day, the curriculum director and Suri had an open discussion with her in terms of mapping out what she would do and where the session would fit the best. However, they did not believe that was what the school was trying to seek at the moment. In other words, the content of the session was a little bit ahead of time. Cynthia took their advice and went in a different direction, exploring more in order to meet the curriculum goals. By reflecting on the feedback from Suri and the curriculum director, the second PD was successful, and teachers from other schools contacted Cynthia to ask for more information on how she used games to enhance teaching and learning. The principal and curriculum lead offered guidance to encourage Cynthia not only to keep her passion of gaming but use and design curriculum-oriented games.

Fourth, the teacher needed to be able to ask for feedback in order to ensure that she was using the right tool for the right audience. Although Cynthia believed that gaming worked effectively in her class, she sought feedback from both her students and principal to ensure that she was on the right track. For example, she provided a workbook containing comprehensive questions for the game *Professor Layton and the Curious*

Village, with questions such as, “What do you think of the game so far?” “How is this game helping you?” and “Have you actually been reading the words or are you skipping them all?” From the students’ group interview, students reflected that not only did they provide feedback in the workbook that Cynthia developed, they also rated the quests on 3D GameLab and wrote comments. The feedback from students played the role of formative assessment for Cynthia in terms of whether the game enhanced students’ learning and whether they really enjoyed it.

When Cynthia used games to teach, she invited Suri to supervise her class. She was hoping to receive constructive feedback from her principal. Based on Suri’s comments, she had done in-class observation a number of times and was glad to get the opportunity to know what Cynthia’s class really looked like and what the students were doing with games. Suri stated, “It’s pretty neat. It’s really quite cool.” As it was mentioned earlier, Suri had provided coaching to ensure Cynthia used appropriate games that were curriculum-oriented. After the in-class observation, she asked Cynthia, “What is this particular goal?” or “What did they have to do with the game?” With Cynthia’s game design class, Suri asked to look at the plan in terms of what the outcome of the game held. Because she was able to observe Cynthia’s class and receive first-hand information, Suri was also able to ease parents’ doubts when they questioned Cynthia’s gaming approach.

Fifth, as part of the support and professional growth the use of an online community was crucial. When Cynthia was asked about whom she would contact when she had any challenges on using or designing games, she said she had a strong

professional learning community on Twitter. Although there was almost no one in her school doing DGBL, she had plenty of support from her online network. For example, she put out a call on Twitter regarding who else had taught game design courses. A woman from the network provided suggestions based on her previous experience. Cynthia admitted that her principal had been supportive of her, but “in terms of video game knowledge I’m pretty far past most of the people here.” The main gaming resource for Cynthia when she needed help was her Twitter community.

Challenges. Both Cynthia and Suri shared their thoughts regarding challenges when using and designing games in class. Suri was concerned about teachers using too much time in selecting appropriate games and designing games on their own which might inevitably affect their family and other commitments. Although Cynthia did not express her worry on the potential work/family imbalance, she commented that the time she used to explore and look for content appropriate, curriculum oriented, and fun games for her students was uncountable. For example, Cynthia spent her whole Easter break to design the adventure game for her social studies class.

After she shared the rationale of why she designed games for her students, Cynthia expressed her yearning to do more digital game design. However, she stated, “[I]t’s very complicated if you don’t have a programming background.” Again, Cynthia was against the idea of “chocolate covered broccoli.” She was determined to design games with complex storylines, quests, and design. Without formal training in programming, it was challenging to accomplish this goal. Hence, she indicated the necessity of enrolling in a class either online or face-to-face to learn programming. However, she found it difficult

to complete the class while having all the other commitments. She stated that, “[Learning programming] is kind of always in the back of my head; that I should just learn to program and then I could do some of these things [designing games] myself.”

Summary

Case one identified that Cynthia’s passion for gaming had an impact on how and why she decided to explore and use games in class. She believed that digital games had great value and positive impact on students’ learning. Case one also found that games could motivate student learning and create an engaging learning environment as well as allow incidental learning while students played. Also, games allowed students to freely “fail” while playing yet not feel frustrated.

Both Cynthia and Suri described that guiding principles were crucial when using and designing games for students. They emphasized that the games used in class had to be age-appropriate, curriculum oriented, and pedagogically aligned. Also, a supportive working environment was important to provide teachers with a platform to grow and pursue their dreams. Lastly, there were also challenges while using and designing games in class. Suri was concerned about how much time Cynthia had been investing on gaming. It was a time-consuming task to explore and find appropriate games for students. Because Cynthia was interested in designing more games, she had looked for PD opportunities to learn more programming skills. Upon grasping this skill, she believed that the game she designed would be more tailored to students’ needs and more playable.

CHAPTER FIVE: CASE TWO

Case Context

This case involved a K-12 bilingual school in southern Alberta. A grade four teacher was recommended to me by my colleague. The teacher had been using and designing digital games in her daughter's class. While I was contacting the class teacher, another grade six teacher working with her at the same school was recommended to me. Neither of them was gamers, but both of them were passionate about using digital games in their classes. After contacting them, both class teachers agreed to participate the research. I managed to complete one in-class observation in each class as well as conduct interviews with the class teachers, their students, and the school leaders.

Overall, parents played an important role in the decision making process in this school. They were involved in various projects and were given permission to veto activities or materials used in class if they were not comfortable with the items. According to the interview with both the principal and curriculum lead, there was a willingness in this school to invest in technologies that have the potential to foster students' learning.

Participant Profiles

Grade four class teacher. Sophia (pseudonym) had been an elementary class teacher for five years. She taught French, math, science, social studies, and health. She did not consider herself as a gamer and did not play video games, but she had been using and designing various digital games for her class. She had also taken a workshop regarding creating games and SMART Board activities between the year of 2013-2014.

Grade six class teacher. Mme MCC (pseudonym) had been working as a teacher for 16 years. At that time, she was teaching all the subjects of grade six. She mentioned that she had been on and off as a gamer for the last several years. She did not have any professional development experience of gaming or DGBL. Based on her interview, she expressed her desire of using games to enhance engagement and interactivity in her class.

School leaders. Two school leaders participated the group interview. Noelle (pseudonym) was the principal of elementary school division. Mary Lou (pseudonym) was the Curriculum Lead and the grade three teacher at that time. Both of them supported using and designing digital games in class. However, they also emphasized the importance of balance. They believed that digital games could bring various benefits to class, but it was important to not overuse or misuse them. Their perspectives towards game using and designing will be presented below.

Students. During the trip to the bilingual school, both classes were observed. In the grade four math class, students (n=14) were divided into five groups while they played the *Jeopardy!* game on the SMART Board. Each group took a question and received points accordingly when they answered the questions correctly. The group interview (n=6) from grade four class was undertaken while the rest of the students were in their next class.

In the grade six math class, students (n=15) started with game playing as well. They were sitting randomly at different tables and working on different games and gaming platforms which included *Mathletics*, Kahoot!, Spellodrome, and Mangahigh. Spellodrome was a gamified platform that tested students' math concepts and the other three were math games/platforms focusing mainly on the topic of division. The group

interview (n=15) happened during break time after the math class was finished. All students participated.

Findings

Data in this case were gathered from interviews conducted with both class teachers, students from two classes, the principal of elementary school division, and the curriculum lead. Additional data were collected from class observation, one teacher designed game, and one online survey from each class teacher. From the analysis, the following main themes were identified: 1) advocate games for learning; 2) impact of games on student learning; 3) guiding principles; 4) supportive environment; and 5) challenges. Each theme may contain the data solely from interviews or from all data resources. Data from class observation and online surveys were also used to describe participants' profiles.

Advocate games for learning. Two class teachers identified different reasons regarding why they used digital games in class. Sophia mentioned three times in the interviews that she liked the involvement of her students when they used games. "The key factor, I think, is the involvement of the kids. The main thing is kids being involved in their learning." She believed that the reason why students were involved was because of some of the traits of games: fun, interactive, and competitive. When students were involved, they would be keen to learn or at least they would be willing to learn.

Mme MCC held a different perspective. She wanted to use digital games because she wanted to "see them (students) learning." She wanted to see their processes when

they were trying to solve problems. Therefore, she was able to see where they got stuck or what kind of mistakes they were repeating. Here is a quotation from Mme MCC:

I can kind of be a fly on the wall and watch them do that (play games), watch the process in real time instead of waiting for them to hand something in and then marking it and then giving them feedback on it.

Both of them also identified one common area regarding why they used games. They believed that digital games worked more effectively for the digital generation. Both Sophia and Mme MCC thought that most of their students were visual learners. The packaging of digital games was “flashy and fun,” so they kept “their (students) attention.” For example, Sophia commented,

It (a digital game) is something children nowadays grew up in. I think it’s really important that we introduce it into the classroom because I think it’s keeping them engaged. It’s the reality of today. If we don’t, I think we are just passing aside something that is their reality. If you want to engage them I think that’s one of the best ways to do it.

Sophia believed that students’ skills were enhanced if they could explain the process rather than simply memorize the concept, so she used the visualization in games to help students enhance their verbalization skills. Because of the visualization in games, it was easier for students to transfer the concept or the knowledge into another situation. In other words, games are more meaningful for them.

Mme MCC agreed with Sophia’s comment regarding this generation. She articulated the importance of meeting their needs:

My rationale behind using a lot of things that I use is how can I make it more visual, more stimulating, more colourful, more livable, where there's just more transitions and things like that. They seem to require things like that, this generation.

Sophia raised another reason why she believed that digital games could be a powerful tool of teaching. In Mathletics, teachers were able to track students' progress in the system. For example, how much time students had spent in the game or on a specific question, how many points they had achieved, and how many times they played with a certain activity. From all the data behind the screen, she had a comprehensive understanding regarding not only what individual student was having difficulty with and what his/her strengths were but also the learning pace of the whole class. In her own words, "You get the results and it classifies the trends and the weakness of every child."

Impact of games on student learning. Sophia, Mme MCC, and the students all emphasized what the influence the games had brought to class. The whole group provided their feedback from a positive perspective. In the analysis of the interview data, the following themes emerged from information concerning the impact of games on student learning: 1) engagement, 2) motivation, 3) incidental learning, 4) instant feedback, 5) allow to make mistakes, 6) collaboration, and 7) customized learning.

First, engagement was a theme that remained constant from the interviews with teachers and students. It would be difficult to overlook this trait of games. In both class observations, students were fully engaged in game playing. In the grade four math class, they were divided into five groups based on their interest of partnership. There were no

mixed gender groups. The *Jeopardy!* game was designed by Sophia with the program Notebook and was presented on the SMART Board. Each group took a turn to choose a point card which had a math question on the other side. The higher the points, the more difficult the question was. During the 15-20 minutes, students were keen to participate and tried to answer questions correctly to gain points for their teams. No one was distracted or seemed bored. Group members worked together to solve each problem instead of working individually. They seemed to enjoy collaborating with their peers. The grade six math class was fairly quiet compared with the other class. Students sat with each other at five tables and were working on different digital games. Most of them worked on games by themselves. During the class, a few students discussed the puzzles in the games with their neighbours. Mme MCC also approached them to check on their progress. The math class lasted 30 minutes. No one became distracted or seemed confused.

Both teachers indicated how students were engaged while playing games, as illustrated by these quotations: “They really like it (game) and they’re engaged.” “They’re really engaged, and they want to participate, and they want to make points for their team.” “They love it. The first time I did it (designing a game in Kahoot!). With any group I’ve ever done it, as soon as that first game is done, they want another one.” It was clear that students were engaged and motivated, and the teachers were excited about it.

Second, it was believed that students were more motivated in a learning environment with digital games. Sophia had been using *Mathletics* in her math class, which was an “online math learning space” providing students all over the world to learn

and practice math. During our interview, she shared that her class was the No.1 class in Canada based on the points they had gained. Her students were excited about their achievement which motivated them to play more and solve more math problems. Sophia stated,

Students are so involved in games because they've got your words right away, they've got encouragement, they've got all that things going on while they play. They're really into it and they want to keep [getting] better. I think by using games in class, their motivation improves.

Comments from Mme MCC also demonstrated the same confidence. "It was just so motivating. The platform, they're all playing at the same time and they pick a funny name. There's a leader board that shows their results." She designed a game on Kahoot! for students to compete with each other. Because everyone wanted to win, they were motivated to solve various puzzles and tried to answer them correctly in order to gain points.

During the interview with Sophia's students, they constantly spoke of how motivated they were while playing games. Four out of six participants commented that they wanted to explore and learn more in a game.

When you're not playing games everyone is thinking, "Well, it's not a game so I don't want to do this work." When you tell them it's a game, then they're focused more and they don't want to remain...they want to do the work even though it's just as hard as the stuff as we're doing right now.

Third, another trait they had been discussing was incidental learning when using games. Students did not realize they were actually learning while playing games. Mme MCC had students play one game which covered new math concepts. She did not tell them which level they could go up to and just told them to play as far as they could. Whenever they were stuck, she provided support. In fact, level six was the level for grade six students. However, most of them achieved well beyond level six and several of them arrived at levels nine and ten. Students were not aware of how much progress they had made, and they did not know that they have reached the level for grade nine and ten students. Afterwards, based on Mme MCC's comments, it was just a vocabulary lesson. "Okay, in this part of the game, when you did this move, what is that called? We actually call that a reflection." When students were engaged with the games, they grasped some of the abstract math concepts. Her students shared the same thoughts. One student noted: "It (playing *Mathletics*) was really fun and doesn't feel like we are doing any work."

The fourth theme of impact on student learning was that both teachers stated that instant feedback was another feature of digital games that enhanced students' learning. Both of them believed instant feedback was valuable, especially in math class, because it would not interrupt the learning flow of students. Although students may have answered certain questions incorrectly, the instant feedback built into the game provided the correct path right away. And if they successfully solved the puzzles, the positive feedback worked as a reward to encourage them to explore more and move forward. Sophia stated, "What I like about them (games) is the feedback also. They have it right away and you can

build on it and learn.” Mme MCC commented, “It (the game) gives them (students) instantaneous feedback which is really valuable.”

Fifth, another interesting theme emerged from the interview with the students was that they were not worried about making mistakes when playing games. Students said they felt less stressed although the content was no different than a math quiz since in a quiz they were not able to do the questions again if they answered them wrong. The following quote illustrated the theme:

[In] a game, you have more than one try and after you try once, you know that you made a mistake. Of course you’ll feel a bit discouraged but now you know that wasn’t the right answer and you can try again.

Sixth, the notion of collaboration was identified during students’ interviews. Students were passionate about sharing their perspectives on using games in class. In Sophia’s class, two out of six students indicated that classes with games were more fun as they provided opportunities for them to work together. One student noted, “Most of the time you have a partner and you can share. It’s just more fun. When you’re in your book you would normally be just with you and it’s not that fun.” Sophia articulated a rationale for the benefits of student collaboration:

When they work together sometimes they are going to have ideas, and the other will be, “No, that’s not how you do it.” I also want them to exchange [ideas]. How do we solve problems or how do we do it? It will open them to a new way to solve problems or a new way to do the activity.

Seventh, customization was a popular keyword constantly appearing in the interviews with both students and teachers. Both Sophia and Mme MCC stated one rationale behind the games they selected was that teachers could customize the content or the level of difficulty within the games since each student had their own pace of learning. If a game was too difficult or too easy, students would either be overwhelmed or bored. Both teachers preferred customizable games because they could embed curriculum objectives into them. For example, Mme MCC stated, “So with Spellodrome, I can customize the list to reflect our novel or reading.” In Sophia’s class, she used *Mathletics* for students to enhance their math skills. They used it as in-class activities as well as homework. All the *Mathletics* activities Sophia used were based on Alberta’s math curriculum. If students did not finish their homework, they were blocked from accessing other activities in *Mathletics*. She also noted that she could customize the level of games to meet different students’ learning needs. The following quote illustrates how she tailored the game:

What is good about it (*Mathletics*) is that we can do differentiation with it because there are different levels. How it works is that each student you will assign five tasks for instance. I have a student that is really good. She’s (a grade four student) doing grade five math. And I have one that is not at grade four level. She’s doing grade three and grade two math on *Mathletics*. It’s at their level, so it’s great for that.

According to both school leaders, Noelle and Mary Lou, they also commented on the customization in digital games. Mary Lou was also a grade three teacher who used games

for her class. She appreciated the customization feature built in the game, *FunBrain*, in her math class, again, to meet different students' learning needs. She stated:

You can differentiate within the game. You've got some students doing basic math of $4 + 3$, others who are doing $458 + 746$. There's a differentiation, but the students don't necessarily know that because they are all playing the *FunBrain* game. That's what to have to look at, for sure, as teachers.

Noelle wholeheartedly agreed with that. She mentioned that *Mathletics* was a pilot project when they started. The school leaders and teachers saw the potential of practice and differentiation that Noelle referred to while they explored it: "It's a tool for teachers to be able to plan accordingly for each individual student. Not everybody in *Mathletics* is on the same program."

Sophia's students commented on customization as well. Interestingly, they shared their thoughts from a different perspective. Considering their teacher, Sophia, also designed digital games for them, they were asked what the differences were between online or commercial games and the games that their teacher designed. Two out of six students spoke of why they enjoyed their teacher-designed games more. Although online or commercial games were more fun, they could be too difficult for students. However, students felt less frustrated when playing teacher-designed games because the game's levels were set at their learning pace. One student shared the following:

It seems more fun because it has more technology but it's just always a little bit too hard on the internet. Whenever you can come out and do a card game, usually it's a different card game that my teacher made, they're different types of hardness

and easiness...With the game on the internet you can't do that. You can't say, "I need it easier. Change the question."

Guiding principles. Part of the purpose of this research study was to yield a deeper understanding of internal and external factors to support teachers to use or design digital games in class. I was intrigued to explore what guidance the school leaders could provide to build teachers' capacity of game use and design. The following guiding principles of using games in class were clearly implied in the interviews with class teachers and school leaders.

First, both teachers and school leaders shared the significance of curriculum-oriented games. Mary Lou emphasized the importance of using curriculum-related games, as it would be meaningless if teachers lost the focus. She provided an example of her own class:

Today, we were on *FunBrain* for math, so it will have to be in relationship to addition that we were doing and to make it not only from easy to hard, but it has to pick an area of the game that has something to do with our objective of the day.

I think, just going on the computers to play is something they can do at home. Noelle articulated this guidance from a different perspective. She believed that students already had enough screen time both at home and at school. If they needed to have screen time here, "[I]t's because that is the best way to meet the objective."

Sophia was certainly on the same page in terms of the first guidance. One of the reasons why she was passionate about using *Mathletics* in class was that this game was embedded curricula of countries from all over the world. One of the built-in features was

that students earned up to 100 points when completing curriculum-based activities but only five to ten points when playing others. The feature saved Sophia lots of time in terms of preparation and planning. In order to ensure the games that she used in class were closely related to Alberta's math curriculum, she also designed a *Jeopardy!* game by using the SMART Notebook program. The questions were about multiplication and addition at the level for grade four students.

Second, the other important guidance of using and designing games in class was that the games need to be age appropriate. By analyzing the interview of the school leaders, both of them did not allow any inappropriate content to appear in the game or other materials used in class. No matter how the game would be related to the curriculum outcomes or how effective the game could enhance student learning, there would be no possibility to make it happen in this school. The following quotations illustrate the opinion towards inappropriate content in games: "Violence is just not acceptable." "It would just be no. Absolutely not. Teachers wouldn't even ask because they know it would be no."

Third, although games bring fun elements into learning, both school leaders said that a game is not the only approach to engage students. They emphasized that teachers should adopt an array of teaching approaches in class. They explained it from the stance of both teachers and students. They did not think it was wise and effective to overuse games in class. Mary Lou articulated the importance of using a balanced approach in class: "You don't want it to simply [be games] every time there's math or English, or whatever it is, that they're doing games and games and games." She added that it could be

challenging and frustrating for teachers who were not feeling comfortable with technology. “We are all different. We all have our different passions. We all have our different comfort zones as well. It’s finding balance in all of it and trying different things.”

Mary Lou and Noelle’s supported teachers to use and design digital games in class. However, both of them constantly stressed a game was only one tool in terms of teaching and learning. Mary Lou stated,

It’s a tool is what it is. It’s not the only way of teaching. It’s a wonderful tool because it’s a little competitive, which the kids like. It does reinforce the objectives. However, I still believe, and many parents believe, and I think many teachers believe that can’t be the only thing.

Noelle strongly agreed with her. Mary Lou also shared her concern regarding using games. She compared games with TV as they could be used positively in terms of learning but become negative very quickly: “It (a game) works like a TV at home. If we just allow the TV to be the babysitter, I think we’ve lost the purpose of why we are watching it.” It was obvious that both of them did not want teachers to overuse and misuse games for students.

Supporting environment. During the trip to the school, the support from school leaders to teachers was encouraging and positive. The support was coming from different perspectives including finance, coaching and guiding, nurturing teachers to grow, and motivating community building.

First, it was important to have financial support from school administrators. The pilot project with the use of *Mathletics* required school license purchasing. During the

testing phase, school leaders and teachers were convinced by the effectiveness and engagement the game could bring to class and did not hesitate in making the investment. Based on the interviews with both teachers, they also agreed that the school had supported them whenever they requested purchasing a game. Without a doubt, the games had to be both age-appropriate and curriculum-oriented. Sophia emphasized the importance of getting the request approved by the administrators. Once it was done, the financial part would be allocated. Mme MCC also mentioned that the school had been supportive of meeting her requests regarding purchasing programs or site licenses. However, she was hoping to receive more support in terms of programming training.

Second, teachers commented that it was crucial to have PD opportunities to support their teaching. It seems there was a gap between what school could offer and what teachers need in terms of PD. Mary Lou, the curriculum lead, connected people after she went through teachers' professional growth plans. She encouraged them to observe another teacher or even work with another school. The school leaders believed that they had provided PD opportunities for teachers by having them pair up with people who had a similar professional growth plan and showcased what they had achieved at the end of the semester. For example, what games were used in class and how they used them to support learning and teaching. Both school leaders had confidence that the PD program had been successful, and all teachers had learned from each other. Mary Lou also had information about conferences and workshops at local consortiums. When teachers wanted to go to certain conferences, they requested it to Mary Lou, and she

provided opportunities for them to go as a team. They came back and shared what they had learned with their peers.

While Sophia and Mme MCC were asked about their experiences of PD, they commented on what they wanted to learn but may have not been given the opportunity to do so. Both of them discussed the need for more PD chances on how to teach with certain games and designing games for students. When Sophia was asked if she still planned to use or design games for her students in the future, Sophia answered “Yes...but I would love to have PD to be honest to help me, because if we have more PD that show us more different things we can do, I would love it.” She also shared her PD experience while she was working at her former school district where the teachers were pulled out of classes to attend sessions teaching them to create activities and games for students. Those opportunities were valuable for her as she was able to learn different approaches and techniques in each session or build on what she had already started. Mme MCC’s quotation illustrated her needs in this area: “I need more PD. I feel like we need more PD to be able to use it (games) fully.”

Third, the school administrators provided coaching for teachers to ensure that proper procedures were followed. Noelle believed that as a school principal one of her roles was to support and encourage teachers to follow their dreams and motivate them to lead pilot initiatives. Even though not all the initiatives could meet their objectives, she still believed that was an achievement as the experience could be shared with the team and adjusted for future teaching initiatives. However, the most important role for her was

to “make sure that the safety and security of the students [are] met first, and that they are doing it for the right reasons.”

Mary Lou shared a similar experience in this area. She mentioned that, for example, we used different games in various subjects or for different tasks, but it did not mean they worked all the time. However, “[I]t’s never a failure.” It was as same as teaching. With the same teaching approach, trying different games may work well or not work at all in different situations. She suggested that it was an opportunity to reflect. “Was it the best approach I could have done at this time? Or was it simply a tool to entertain the kids? What was the purpose behind it? Is that the best practice?” Mary Lou encouraged teachers to reflect on their experiences since she considered experiences made a positive change in students’ learning.

Challenges. Both school leaders and teachers shared the challenges they had been experiencing while using and designing games in class; both school leaders and teacher also shared their concerns regarding privacy issues of games during the interviews. When Sophia was asked about her game preference, she said that she was interested in using Edmodo, an online platform where students, teachers and parents share resources. However, her idea was vetoed because there was a risk that students may have a chance to interact with outsiders who could share inappropriate information. The decision was made not just by the school administrators but parents as well. Considering this was a private school, parents’ opinions were taken into serious consideration. They were involved with various decision-making processes. If they were uncomfortable with using certain technologies, school would not proceed to next step. Mme MCC shared a similar

experience. She noted that one application was brought in without any consultation or providing any information to parents, so they filed a complaint to the school and ended the pilot project. Therefore, whenever she used any online games or application, she always sent a letter home explaining, “What is it; who is the company; what do they do; what is it for me; what is it for students; how are they going to use it; how can they use it as parents?” She would not take actions before she received parental approval first.

Mary Lou and Noelle shared the Edmodo example as well. Noelle mentioned that it needed consent for ages 13 and up. That would not be something a school would endorse for younger students. She emphasized, “Even though the teacher might really want to do it. In that case it would be no. There is a reason why it’s 13 and up.” She also added it was the same as Facebook and Shutterfly. Although either of them could be an educational tool, it was not ethical for the age. She noted, “Sometimes that’s a step that the teachers might overlook because they’re so excited and engaged about want to do something. We also have to take a step back and go, ‘Okay, let’s look at this.’”

Another challenge regarding using games for teaching and learning was that there was a risk that students may have spent too much time gaming even though they were also doing math at the same time. Mary Lou shared that her daughter was in grade four and she only allowed her limited time to play games per day. When her daughter was engaged with *Mathletics*, she stopped her and wanted to interact with her in person and discuss math. She was worried that at a certain point “we’re losing the whole aspect of the objective. Now, we’re just playing for the game’s sake.”

Summary

In this case, it was found that teachers were motivated to use games because they believed that games could transfer their class into a fun zone where students were engaged with learning while playing. Teachers also believed that digital games had a great impact on students' learning in various perspectives. Students tended to be more engaged and motivated to learn when games were an element in class, and games also allowed for incidental learning, provided instant feedback, and students were able to make mistakes without feeling stressed; games also promoted collaboration and customized learning to meet students' individual learning needs.

Guiding principles played an important role in ensuring teachers to follow the proper protocol and process when using and designing games. The content of the games had to be age-appropriate and curriculum-oriented. In addition, a supporting environment is an important factor for why teachers were inspired and motivated to use and design games. Challenges would inevitably take place when using any innovative approach under any circumstances. Class teachers expected more PD opportunities from school. The other challenge was regarding the ethical and privacy issue of online games.

CHAPTER SIX: CASE THREE

Case Context

This case involved a Catholic high school in southern Alberta. A teacher who taught social studies and communication technology was recommended to me by one of the students in the class where I worked as a teaching assistant. The teacher had been using and designing digital games for his class. He also called himself a lifelong gamer. He had been using various digital games and self-designed games to teach both his social studies and communication technology classes for grades 9-12. He used Classcraft (www.classcraft.com) to gamify his class. The teacher approached me after his colleague introduced him to my doctoral research project. He had always been interested in using digital games in an education setting, so he wanted to be involved. I managed to complete one in-class observation in his communication technology class as well as conduct interviews with the class teacher, his students, and the school principal.

Participant Profile

Class teacher. Kameron (pseudonym) had been a high school teacher for seven years teaching social studies and communication technology. He considered himself as a lifelong gamer and said he received his first Nintendo when he was four and started designing games when he was in grade six. In his own words, “I am passionate about it (gaming).” He used games that his students selected and purchased themselves and couple of self-designed game to teach the media module in his communication technology class. This module “is an introduction to the interdisciplinary study of video games as texts through an examination of their cultural, educational, and social functions

in contemporary settings.” In this class, students were expected to “use/play and analyze video games while researching perspectives and theory from a variety of sources in the sciences, social sciences, humanities, and industry.” Kameron did not have any professional training experience in gaming but had taken programming courses in college.

School principal. Peyton (pseudonym) was the school principal. He did not have much experience in gaming but held a high expectation regarding gaming. For example, he did not consider *Jeopardy!* as a game but an engaging activity. Overall, he was supportive of using and designing games in class. However, he was strict with following certain procedures and protocols while using them for students.

Students. The media class was observed during the first trip to Kameron’s school. During the in-class observation, all students were working on different modules individually; two out of 16 students were working on the sub module, New Media: Video Games in the Media Module. It was not clear who was working on what content specifically until those two students were identified by the teacher. The male student was playing both teacher-designed game and a commercial game *Civilization*. The female student was working on creating a poster to introduce the game *LEGO Harry Potter: Years 1-4*. In order to earn the credits of the module, they were expected to complete six module assignments by publishing a new blog post and three gaming assignments in the format of a journal, postcard, video, or ranking. The group interviews were conducted during the second trip. Four students participated, which also included one student who worked on the gaming module in the previous year and one new student.

Findings

Data in this case were gathered from interviews conducted with the class teacher, his students, and the school principal. Additional data were collected from class observation, the teacher's blog, student assignments, and one online survey from the class teacher. From the analysis, the following main themes were identified: 1) advocate games for learning; 2) impact of games on student learning; 3) guiding principles; 4) supportive environment; and 5) challenges. Each theme may contain the data solely from interviews or from all data resources. Data from class observations and online surveys were also used to describe participants' profiles.

Advocate games for learning. Kameron claimed he was a lifelong gamer. He loved playing all kind of games with his first Nintendo but he was always drawn to ones with elaborate stories and strategies and involved more thinking in them. He also enjoyed talking about games with his friends and shared tips with them. Kameron believed that he was talented in this area, as he was able to pick up a new game and quickly be very good at it. More importantly, he believed in games. He said, "I think it (a game) is valuable. I think it's something worth pursuing;" "It is something I want to do with students;" "I want to share my passion with other people and the students in particular;" "I think there is a lot to be learned from games and games can help us learn and grow in a lot of different ways too."

Kameron was also convinced that a game could be a tool to reach and understand the current generation. He felt that current students had all sorts of information readily available for them. However, they did not "process, disseminate, or try to really think"

about it. He believed that students needed more opportunities to get involved and that means the opportunities need to be more hands-on, fast, and practical. Compared with other media, such as movies or TV, children were more involved during game play because of the interaction between player and game.

Kameron also used Classcraft to manage his class. By providing rewards in a gaming platform, he was able to collect data regarding whether or not students were “hardworking,” “involved,” “working with their studies,” or “learned something from the curriculum.” This evidence was not easily captured by observing or grading students’ assignments.

Also, Kameron wanted to use games to explore more. In his communication technology class, he wanted to use games as a way to help students understand media. After looking at the curriculum, he found that there was an opportunity to fixate on one medium as opposed to looking at all forms of media. He considered it as a more effective approach to “discover the impact of the media and develop fundamental skills to relay a message effectively” (Alberta Education, 2010). By introducing, playing, articulating, and analyzing different games, Kameron wanted to learn what students chose and was hoping them to articulate to him why they chose the game. While they played the game and accomplished the goal, he expected them to explain, “How they did it? What choices they made? Why they made those choices?”

The other reason why Kameron was interested in using games in class was that he found a significant difference in performance between the average female and male students at the high school level. Girls seemed to be able to want to stay on tasks; they

not only completed them better but faster. They cared more and were involved more. However, it was difficult to see the same level of attention from male students unless it was something they were excited about. Kameron mentioned, “On average typical male students in the school have a whole lot more hard times staying focused, motivated, and engaged than the girls do.” Therefore, he used games to help engage male students in class. Kameron noticed that “the boys seem to like the Classcraft more. They like the achievements more. The gamification model seems to appeal to boys.” He wanted to use games to attract male students and help them be more engaged in class. The following quote illustrates the rationale for why he particularly wanted to use games for male students:

[I]f it’s something that they are not interested in; something they can’t relate to; something that they can’t manipulate at all for their own personal gain; I think they are far less engaged or far less willing to do it.

During the in-class observation, the only girl in Kameron’s class was also attentive to the gaming project she was working on. Based on the interview with Kameron as well as the students’ focus group interview, it was indicated that she was into all kinds of online games. Kameron also stated that he found girls were more interested in mobile games as opposed to online or console-based games.

Kameron believed that games could enhance a student’s higher thinking skills, including critical thinking and evaluation skills. While his students played different games, they were expected to write essays that presented their evaluation and analysis of

the game. The whole process showed him what they were thinking, what strategies they used to evaluate, and what they have learned from the games.

Impact of games on student learning. Kameron, Peyton, and the students all provided feedback on the influence of games in the classroom. In the analysis of the interview data, the following themes emerged from information concerning impact of games on student learning: 1) engagement, 2) interactivity, 3) ownership, 4) connect to learning outcomes, 5) allow to make mistakes, 6) collaboration, and 7) customized learning.

First, all the class teacher, the principal, and the students identified that games helped with engaging students in class. The students referred to the traditional learning as “boring.” The following quotation from a student illustrated this opinion: “It (a game) helps keep you into it rather than just handing a textbook and being like, read this page to answer this question. Let’s face it. We’re all students and we all don’t want to do that. It’s quite boring.” Another student commented:

It’s (a game) like a book...You’ve got your rising action, your climax, and then your falling action and then your conclusion. That’s what I feel like gets people engaged is that little twist in the game. You just want to keep going.

Another student compared their communication technology class with other class in terms of the engagement level in class:

If our brain is so engaged in something, and we’re actually learning stuff but we’re not even noticing and we’re having fun, then you’re learning and you’re having fun

at the same time, which doesn't really come in during English class or social [studies] or any class that you're just sitting there listening to a lecture.

Kameron's statement supported these themes as well. While he was asked what made him want to use or design games in class he answered, "Engagement especially for the boys." Peyton agreed with Kameron. He believed that games engaged students because they were not in the traditional sense of "I'm sitting down and memorizing knowledge and content." He also noted, "The high level of engaging that comes along with it with a good game." However, "It has to be high enough quality that it's going to capture the student's interest and [they] want to play."

The other perspective of engagement shared by Kameron echoed why he used games the first place. He stated:

Boys are more interested in video games...I've been looking for a way to tap into them to get them more interested, to give them something that they like to do already, but potentially have some learning outcomes attached to it as well.

That would be the most important benefit of using games in his opinion. He believed that when students were engaged, they would be willing to do more. Kameron also referred to a teaching convention he attended regarding the challenges of teaching boys. The speaker discussed using various approaches, for example, games, competitions, more hands-on activities, for male students to "hit on so many things that the male mind gravitates towards."

Second, another impact of games on student learning is regarding interaction. Two out of five students spoke of how they enjoyed the interaction while playing games in

class. The female students noted, “When you involve a game, I get more interactive. I want to involve outside of school as well so I learn better.” Kameron also identified the importance of having the interactivity element in games, as the two-way communication between the players and the game encouraged students to actively think, get involved, and analyze instead of passively receiving the knowledge from their teacher.

Third, ownership was a common theme from the interviews with both students and the class teacher. One student commented,

It also let me express who I want to be in the game. Like Skyrim, I can make the character how I want him to be and I think that’s pretty cool. Rather than just, here, here you go. This is what you do.

More choices while playing games meant he enjoyed the ownership of making decisions himself instead of listening to a lecture or being told what to do. Kameron articulated his sense of how ownership impacted students’ learning:

I love the agency in the game where people can make choices, they get to decide. I want to do this or I want to look at this. If you give them ownership I feel their interactivity and the engagement increases significantly too because they feel like they’re more involved in it now and they now have a piece of ownership over it too.

Fourth, digital games also help connect learning outcomes of different subjects. All students commented that playing games provided opportunities for them to think more about what they had learned in different classes. They were able to connect their learning activities (playing games) with the learning outcomes. Kameron designed six writing

assignments for students in the media module to help them understand the key concepts of gaming: Motivation for Gaming, Rules and Cheating, Agency in Gaming, Immersion, performance, and Values (Kameron, 2014). Three students found it was helpful to help them understand games by playing games. One student noted, “It taught us what makes a gamer tick. Why they’re involved. Why they are interested. And what games are better at this and how they are better.” Another student commented: “All of us are more interested in finding out different types of games and all this information instead of just playing games. We want to see a variety of games and we want to see all of it and we want to know a lot about games.” The third student stated:

It’s also kind of teaching me the different aspects and almost like the different values of the game. Sometimes I’ll be playing, and I’ll think, why did the developer do this? I’ll think through it and think on it while I play.

Student comments were exactly what Kameron expected his students to achieve in this media module. Their testimony approved that they not only accomplished the learning outcomes but also enjoyed the learning process.

Students were also able to make a connection with other classes as well, for example, social studies, history, and math. The following quotation illustrated this theme: “It’s (a game) pretty much incorporating everything I’ve learned...it just gets me in the head. It’s cool how that works.” One student stated, “Building your own empire, you become this awesome dictator. It related history of actual countries.” Another student connected the game *Call of Duty: WWII* to her social studies class as they were studying World War II and the game helped her understand the history.

Impact of games on teaching. Playing games enhanced students' learning in various ways. Teaching with games also fostered the teacher's growth. Using games was not practiced widely by the majority of teachers, but Peyton believed that there was an opportunity to inspire other teachers who had innovative ideas about how to use games to improve their teaching. This idea is illustrated in the following quotation from Peyton:

If teachers are excited and engaged in creating exciting purposeful lesson plans, just as kids, when they're engaged in learning that, it's a win-win scenario. Then, the assessments or the issues that arise from teacher administration seem to decrease. Teachers care. They want students to learn.

Peyton also believed that it allowed other teachers at school to learn from each other. Using or designing games seemed ambitious since it required teachers to develop skills in other fields; the project also provided teachers with a chance to explore and learn other programs or applications which could be used for teaching. In the meantime, other teachers might be interested in the same idea while they saw "students having fun and they are learning." They would want the same level of engagement and student involvement in their classes. The teacher who piloted using games in class could be the "support person for others wanting to come through and tap into gaming." This possibility would offer PD opportunities amongst all teachers at school.

Guiding principles. Part of the purpose of my research was to yield a deeper understanding of internal and external factors to support teachers use or design of digital games in class. I was intrigued to explore what guidance the school leaders could provide to build teachers' capacity of game use and design. The following guiding principles of

using games in class were clearly implied in the interviews with the class teacher and school principal.

First, it was the notion of using curriculum-oriented games. Although Peyton was supportive of Kameron using and designing games to support teaching and learning, he was very clear about meeting the curriculum outcomes; the games used in class had to be meaningful and purposeful. He stated, “It has to follow program studies. There’s got to be a purpose for it. If they can deliver that to me and sell it to me that way, then yes I’m definitely in support.”

Kameron shared his teaching process with his colleagues to ensure that he was on the right track. He admitted that he was passionate about and had a strong faith in games, but he had been cautious when using games in his class. One thing he had been trying to avoid was to jump into a game without thorough investigation and exploration. He noted, “I guess the most thing is...I do start with the outcomes of the class. If I see an opportunity to teach something or deliver information in an engaging way...that’s the first thing.” He explained further: “That’s kind of the process I would use. Would it fit in the curriculum? What exists that could fit there?” He also articulated how he selected games for his students in the following quote:

There was a particular game that came out recently...it fits very well with Social 20. The whole game that is centred around the French Revolution...it’s called *Assassin’s Creed Unity*. I thought that would be a perfect type game to use and it would have to be set up appropriately. As a teacher, I would play through the game

myself first to understand what's going on, find an appropriate part of the game that I feel like teaches the curriculum, but gives the kids a little bit of a hands on. He also shared that the game was historically accurate, including the location and the way that the city looked. He believed that it would be an effective way to get students involved and see something like that. Kameron also spoke of his dream game design to help facilitate his Social 30 which was driven by curriculum outcomes: "[Students] would have a character that they would walk around, and they would be asked questions from the curriculum, and they would be rewarded in the game for doing so." Curriculum orientated content was an important guiding principle for Kameron when he used and designed games for students.

Second, both Kameron and Peyton spoke of using appropriate materials in class. Considering both Kameron and Peyton emphasized the importance of using and designing curriculum-oriented games, I was curious about what if the game was right on target in terms of meeting the learning outcomes but contained a certain level of violence in it. Peyton, the school principal, did not veto right away but identified that, "it depends on the level of violence." If there was shooting a target involved, he thought it was acceptable. However, if it was centred around "delimbing human beings," it would be a "no-no." He also illustrated his opinion by using the example of the movie *Saving Private Ryan*: "There's a lot of rich information you can pull from there too, but there's some pretty gory scenes in there that you have to be careful of what you're showing." Peyton also identified that it was obviously not appropriate to show violence in the game, but more importantly, the information could not be "anti-Catholic," as "that's a no brainer for

us. It's not happening." The anti-religion content was far more inappropriate than a violent element in a game within this school context.

Peyton also identified the issue of language, images, and other content in games. First of all, he was worried about profanity. For example, when somebody was shot in a scene, any inappropriate words may follow. Secondly, some visuals could be harmful to students as well. While students played the game, sexuality could be exposed to students. He illustrated the possible problem in the following quotation: "We are an inclusive environment, and that video game has to be inclusive to everybody. If you have the blonde bimbo that has a perfect figure all the time and skimpy attire, well...then that's going to be an issue."

The third theme regarded the notion of using a balanced teaching approach in class. Both Kameron and Peyton considered multiple teaching approaches would be a constructive way to support teaching and learning. In spite of the fact that Kameron used games to teach students media, he also incorporated other approaches in class. He stated, "I try to mix it up as much as I possibly can." And Peyton also identified that gaming may not work for everyone: "[I]t has to be at the professionalism of the teacher to deliver that to who would benefit from such a tool." He also emphasized, "[I]t is just one tool in your tool box that you're trying to use to help kids learn."

Kameron explained this theme from another perspective. He identified that each student was unique with different learning styles. Getting to know and understand the students to come up with the best teaching solution was important. Before he decided to apply any approaches in teaching, he asked himself "What do they like? What do they not

like? How do they learn?” He believed that interacting with students and building that relationship would be helpful to understand what the problem could be and how he could help. The following quotation illustrated the importance of knowing your students:

Obviously, I’ve been teaching for seven years now so obviously [I have] a whole garment of different strategies and different things. The big thing obviously depends on students too. Like, I mean some of them love to read...some kids want nothing to do with reading, so you need to reach out to them too.

He was apt at balancing different teaching approaches to enhance his students’ learning. For example, he enjoyed reading, watching movies, and playing games, but he found “games were always left out and wanted to bring them into education and offered them another potential opportunity.” He asked himself, “[C]an the kids find meaning in it and is it meaningful to them in any capacity?” Kameron believed in the positive impact the games can bring to his class, but he was not obsessed with only using games for teaching.

Fourth, although Peyton encouraged teachers in designing their own games and would love to provide both financial and PD support, he wanted the teacher to ensure that the game design was “not a one-time thing.” He emphasized that “if we’re going to move this way, this is going to be sustainable or we are going to build on it for the future.” He added:

If we’re going to move forward in gaming, I want to be able to make sure that in the years to come, other students have the availability to use this as well. The teacher also needs to have the ability to improve on it, just like our lesson

plans...We're revisiting. We're adding. We're modifying. That's what I want to be able to do with this gaming.

Kameron agreed with his principal in terms of designing games. He always investigated existing games first to see what the potential could be for designing a game for his students or to solve a particular teaching challenge. He noted:

Is there already a game that exists, so I could potentially show part of it or use or is it appropriate to try and design a game. If I was going to try and design a game, is it large scale? Is it just something for one class and that kind of stuff. I would rather design a game that's going to fit with a large percentage of the group.

Supportive environment. It has always been encouraging to see and feel the positive and supportive environment that teachers grow in. During the interviews with both Kameron and Peyton, both of them referenced their trusting relationship and promising communications between them; they also described various supports offered to teachers from other areas.

First, Peyton expressed strong trust towards Kameron during the interviews. During our 40-minute conversation, he spoke of their trusting relationship six times. He believed in Kameron's professional capacity and judgment in terms of selecting curriculum oriented and content appropriate games. The following quotation illustrated this theme:

With Kameron in that position, yes the element of trust is there. If there had to be somebody else in there, then I would have ... It depends on the relationship I had with that person and the skill set they presented with.

Because of the trust between them, he was very comfortable with Kameron and the judgment he made with the games in his class. Therefore, he also mentioned that he did not think it was necessary for him to assess what games Kameron was using in class unless he was approached when Kameron was unsure.

Second, in terms of using and designing game, finance is an unavoidable topic. It was interesting to learn how the school and teacher allocate a budget in order to run an appropriate game for students, considering not all of the games used in class were free. Kameron mentioned that although he offered to provide his own games for students to play, they insisted on purchasing the games themselves. His role was to ensure the games that students brought to class were meeting school protocols. Kameron was also cautious about asking for money to purchase any game licenses: “I know there is a limited budget if I was going to go that way, so I want to make sure I’m very confident with what I am doing before I ask for any money.” Peyton further added:

We have to have a discussion. There has to be a connection to the program of studies. Then, obviously, the cost. Is this a one-time cost? This is what we look into. Is this a one-time purchase that would be sustainable in years to come?

Third, both Kameron’s colleagues and students provided feedback regarding games used in class. Kameron was the only teacher using and designing games in class at his school and one of the few in his school board. Hence, he did not have much technical support. However, he still contacted other teachers to share and discuss his thoughts and look for feedback from them. Whenever he had an idea regarding either gaming or other projects, he wanted to know what other teacher thought: “Do you think this will be

valuable? How would you go about doing this or what might you think about it?” Other perspectives could help him see whether there was a flaw that he had not considered. As he said, “no one is directly supporting me in doing any of these,” but he believed that the “brief conversations would encourage ideas bouncing around,” which was “valuable” to him. His colleagues were supportive in discussing his gaming ideas and providing him with constructive feedback.

Kameron also reached out to his students as he believed it was important to listen to their voices. He asked their opinions regarding what games they wanted to play and how to use them in class: “How do you think this could be meaningful? How do you think this could be useful? What is it that is appealing to you that we’re playing a game or that we’re doing something meaningful with the game?” Those conversations helped Kameron understand what worked and what did not. When his original plan did not work based on students’ feedback, he discussed ideas with his students about how to make it work. He believed that it was worth it to “bash his head against the wall looking for a way to engage the students” because “they want to be engaged and they are telling us how they would like to be engaged.” Kameron admitted that he had learned a lot from both his colleagues and students’ feedback.

Kameron reflected upon their feedback to edit and tweak his original plans. He looked at them as an opportunity to evaluate his own work to come up with new strategies. If he received negative feedback from his students, he asked questions like “[W]hat have you done in the past that makes you dislike it so much?” He was not afraid

of making mistakes. The most important thing was that meaningful feedback from his students could correct his lessons.

Fourth, Peyton articulated the possible support for a potential pilot project. Kameron was keen to design games by himself, but he discussed that he might need some PD support. He felt challenged because it involved time and money factors. During the group interview, Peyton articulated his plan that might be able to help. He stated that he could have Kameron's goals fall underneath a pilot project. What Kameron needed to do was to implement a time frame; if they planned it out as a three-year project, that would help with the time stress and the time constraints that Kameron talked about. Peyton noted that gaming was one component of teaching; if Kameron put too much time and neglected others that would affect the balance of his life and his work. With an implementation period under a pilot program, the plan and time frame could be adjusted. That would be "the route if they were serious about moving forward with gaming in all classes."

Challenge. Making classrooms playful would be a great way to engage students. However, it was also not difficult to predict there would be challenges when applying this teaching strategy in class. Both Kameron and Peyton shared the challenges as well as some issues they had been experiencing. From the analysis of their interview, the following themes were identified: 1) budget, 2) design related, 3) addiction, 4) finding the right game, 5) online and educational game, and 6) biased stigma.

First, Peyton confirmed that he would love to financially support Kameron with PD opportunities and game license purchasing, although Kameron also shared that he

had been cautious to ask for support in this area. Because Kameron was unsure about the safety of online and educational games, he had been using console games to keep them local. He had been bringing his own consoles to his communication technology class, as there were only two to four students participating in that gaming module. Therefore, he found that it would be expensive to implement a like strategy in his regular social studies class since there were 25 students.

Peyton discussed the budget factor as well when asked about what challenges they have had in terms of using and designing games in class. He mentioned that having user fees could limit students' opportunities to participate in the course. He emphasized that, "[W]e have to find the balance of what are we trying to achieve with gaming, where or how many, what financial supports can we be maxed out at for you to move forward." He also suggested looking for community donations to support the potential gaming project.

Second, Kameron also shared some challenges of designing games from his perspective. He said that time was a huge factor especially when it came to designing. In addition, tracking down an appropriate game that would fit the curriculum and was used properly was time-consuming since he needed to play through the game himself and there were always new games coming out. Although he said he was willing to use his own time to do the work, it was still a factor that affected how well he used or designed games for his students. In terms of designing games, he was aware that there were always new tools for game design and he was interested in making them work for his own teaching. He was curious which tools could help him deliver the games easier and quicker.

Another challenge of designing games was regarding Kameron's graphics skills. While designing games, Kameron did not want to "lower the expectations" of teacher self-designed games. He aimed at delivering vivid and appealing visuals in his games to his students, especially to the ones who were involved in games. However, he stated, "it was very difficult in a non-profit organization."

Third, Both Peyton and Kameron brought up another potential issue: video game addiction. Although it would not be the problem with Kameron's class' games, it was a real issue from which some of the students suffered from. Therefore, whenever there was a game related assignment, Kameron was explicit about how much time students should have spent on it and ensured that parents were fully aware of the expectation of the gaming assignment. When one student approached him to discuss what games he wanted to play at home, Kameron asked details about the game to ensure that he measured the amount of time the student spent.

Fourth, another challenge was regarding finding the right game for students. During my whole trips to Kameron's school, Kameron was very clear about why and how he used and designed games to enhance students' learning. Although he had been a lifelong gamer, was passionate about gaming, and believed the value of gaming, he was not biased about using only games in his class. He had been struggling with finding the appropriate games in all his classes and making them meaningful for students. For example, he was wondering about using a war game in his social studies class. Again, he was hesitating about what meaningful message the game could convey:

If it's not academic enough; if it's not actually used for teaching, I don't know...I don't see the value in the class...It's got to have some sort of purpose, and if I can't figure out what the purpose is then I wouldn't use whatever it is, whether a film, a game, or a novel...

He also mentioned that although students loved playing games and it was appealing to play a game, "[I]f you don't get anything out of it then it's not a good educational tool. And I think it's tough for some students to accept that." Kameron did not want students to play the game simply because games were engaging but rather to learn something meaningful from them.

Fifth, another concern from Kameron was that he was not comfortable with online games simply because he was unsure who the students could interact with online. He considered that as a "huge red flag" because he doesn't "want kids interacting with people outside of the school that they don't know." He noted that online games could be a "really powerful meaningful educational tool. [But] it's abused too often, it starts becoming a problem." That was why the online game is "scary" to him "to use as an educational thing." He said that he might feel more ensured if he could "control who can access" the game. He saw the benefit of collaborating with others in a meaningful way when students played online games, but he did not have enough information to find out what games might work. Kameron also discussed the possible challenge of using educational games. He found that a lot of good educational games were directed at a younger audience. He had tried to use them for his older students, but he did not know "if they are going to get the same kind of meaningful [experience]."

Sixth, the last emerging theme regarding challenges was about the negative stigma around games. The public viewpoint tends to look at the violent element embedded in some games and consider playing games as time-wasting. Kameron recalled that when he was younger, his parents looked at him playing games as a waste of time. He stated, “[O]ur society has come a long way in the last 15 years, but [gaming] is still viewed by so many as just a huge waste of time, when it definitely doesn’t have to be.”

Summary

In this case, Kameron shared that he had been passionate about using games because he had been a lifelong gamer and had a strong faith in the values that games could bring to his class. Based on his experience, male students tended to have more challenges in learning or concentrating in class. By implementing the platform with which they were already engaging, gaming could be a powerful tool to solve this problem.

Games also brought various benefits to students in terms of enhancing their learning in class. With the appropriate use of games, students managed to control their own learning by having more choices and setting up their own learning pace.

Guiding principles were important when using and designing games appropriately in class. They ensured that the content and activities around games were on target. One common theme from both Kameron and Peyton was that the games had to be curriculum oriented and outcomes directed. In terms of the content, violence and anti-Christianity content were not allowed in games used in class.

This group shared various challenges they had or may have had in terms of using and designing games. Especially with game design, Kameron was concerned about the

time that he would love to but may not be able to put into his dream plan. He also struggled with his graphic skills which were crucial when designing games. Having more PD opportunities could solve those two challenges.

CHAPTER SEVEN: CASE FOUR

Case Context

This case involved a grade five to nine public middle school in southern Alberta. I invited a grade eight teacher at this school, who used to be my colleague in a master program, to participate my research. The main reason why he was invited was that I was aware that he had been using and designing digital games for this class. He designed a card game to teach grade six student Greek history in one of his master program classes, Digital Game-Based Learning. The teacher has been a lifelong gamer. He had been using various digital games and self-designed games to teach his math class. Also, he was teaching Design Thinking/Computer Science and Performing Arts as one of the after-school classes. In addition, he designed *Student Quest* to gamify his class. He agreed to participate right after I shared the purpose of my research. I managed to complete two in-class observations in his maths class as well as conduct interviews with the class teacher, his students, the school principal, and the learning lead.

Participant Profile

Class teacher. Sawyer (pseudonym) had been teaching for 21 years. He considered himself a lifelong gamer: “I started playing arcade games and games on the TRS-80 in the early 80’s.” He had played various digital games, such as *Sim City*, *Rogue*, *World of Warcraft*, *Masters of Orion*, etc. In his class, he had been keen to use both online and self-designed games to enhance students’ learning. For example, he designed a card game to “help with the study of Sparta and Athens in the ancient Greece unit” for grade six students. At the moment, he was using *Lure of the Labyrinth* to help teach proportion

reasoning. He also designed *Student Quest* to track and monitor students' in school behaviours. Sawyer was currently working on his master program in educational technology. He was also taking a graduate course, Digital Game-Based Learning.

School principal. Juliana (pseudonym) was the school principal. She held a Ph.D. in education and did not have much experience in gaming. Due to her strong background in educational leadership, she thoroughly explained her thoughts regarding using and designing games to support students' learning. Juliana was cautious about the idea of gaming, as she supposed that too much screen time may not be helpful for knowledge retention unless it was the best teaching strategy to learn a particular skill.

Learning lead. Jonathan (pseudonym) was the learning lead at the school. He provided teaching and learning support and monitored technology. He used to play digital games. Although he did not consider himself a gamer, he passionately described the games he played and was playing. He was interested in gaming and using gaming in class. Overall, he was supportive of using and designing games for students and he especially encouraged teacher-designed games.

Students. Both Sawyer's grade eight classes were observed, and eight students participated the group interview. In the first round of observation, students were given the opportunity to freely play the game *Lure of the Labyrinth* without being told the connection to the curriculum. In both classes 8A (n=27) and 8B (n=26), students were divided into groups while playing the game. Most of them started the game by building their avatars and selecting pets. Once they started, some students were stuck and confused. One student asked, "[W]hat's the point of the game?" Some of them

commented “It’s so hard;” “It’s frustrating;” “It’s killing me.” They either asked their peers sitting next to them and discussed solutions in a group or they directly asked for help from their teacher. Sawyer also approached to students when he felt that they needed help. Students from Class 8B were more advanced than ones from Class 8A. In Class 8B, some students figured out the game was a math game, although they were not so sure. “I think it is math.” One student seemed good at math, so he acted as a tutor to help his peers solve puzzles. Sawyer also encouraged students to ask each other for help. In the entire hour, some students were struggling with how to pass certain levels or solve certain puzzles, but none of them were distracted or stopped working.

In the second round of observation, Sawyer gave them a mini lesson regarding proportional reasoning first and had students play the game *Lure of the Labyrinth* again. During the whole mini lesson, no one in both classes made the connection between the game and the lecture. However, students seemed more confident while playing games. Less students complained about how difficult the game was and enjoyed playing the game more. Another interesting finding was that students were more willing to ask for help from their peers instead of trying to figure out the solution on their own.

Findings

Data in this case were gathered from interviews conducted with the class teacher, his students, the school principal, and the learning lead. Additional data were collected from class observation, the teacher’s self-designed game, and one online survey from the class teacher. From the analysis, the following main themes were identified: 1) advocate games for learning; 2) impact of games on student learning; 3) all about *Student Quest*; 4)

guiding principles, 5) supportive environment; 6) challenges; 7) teacher-designed games for learning; and 8) implication. Each theme may contain the data solely from interviews or from all the data resources. Data from class observation and online surveys were also used to describe participant profiles.

Advocate games for learning. Sawyer was passionate about gaming and has been a lifelong gamer. The following quotation illustrated that point:

I've been playing games pretty much my whole life. There's somebody who talked about there are being digital natives and digital immigrants. And I like to think of myself as being in the group that in the middle, the digital pioneers. I was there before all the immigrants came and I was kind of that foundation and then they came and they kind of took over my internet.

He listed the arcade games and digital games he had played through his childhood. He was passionate about sharing those games and how he practiced those skills.

Sawyer not only played games, but he also had programmed games since he was eight years old. At that time, he went to the public library and used the computer to type the code. "You'd spend four or five hours copying it (code), and then trying to debug it." He saved the game that he coded into a cassette tape and played from there. He tried to "transcribe the code and figure how things work."

One anecdote regarding his programming experience was interesting. When he was 11 years old, he discovered that the game called *Lemonade Stand* had basic coding. A boy named Drake had been bothering him at that time. Because of his programming background, 11 year old Sawyer made some changes of code so that Drake could not win

the game. He said, “Instead of playing *Lemonade Stand*...I could see the relationship between the price of lemonade and the weather. I just made it so that he (Drake) always had bad weather.” That was when Sawyer started programming his own games. He started with modifying existing games and finding gaming ideas that he saw if he could decode them himself.

Another factor why he was always keen to gaming was that he had a positive gaming experience with his previous teachers and his family. He described that his logic class teacher used some commercial games as well as board games in class. However, those games were not really strategy games but seemed mainly for entertaining. As a student, Sawyer still preferred the classes where they were given a chance to play digital games simply because it was engaging.

He also shared his gaming experience with his family: “I grew up in a family that the game life was something that we always did. We always had a board game on Saturday and we always had a card game with my family.” He believed that these experiences motivated him to use and even design games for his students. Sawyer articulated how playing games when he was a child impacted his way of thinking:

For me the seeds of probability and my understanding of probability and proportion and that critical thinking definitely was planted in a field that was set by back when I was playing games since I was five from old maid and go fish. Due to his memorable gaming experience and how those games impacted his way of learning and thinking, he was inspired to use gaming in his teaching to enhance his students’ learning.

Sawyer encouraged his students to play *Cribbage* with their parents to work on their math because he believed that it was a good way to practice higher thinking skills, for instance, problem-solving and critical thinking skills. He also believed that playing games with his students could be a way to get to know them and connect with them. During lunch time, Sawyer invited his students to play a card game called *Killer Bunnies*, but the entire game was “very logical, very balanced, very well laid out, but the end of the game is so random that none of your logical strategizing really helps.” When Sawyer saw students playing games on iPad or smart phone, he plugged the devices into a big screen and sat with them to play together. His students were worried that they would be punished while playing games during lunch time, but Sawyer assumed that it was allowed and in his world games are not that bad at all. As he shared in his interview, “I might not like of the themes and I might choose to not play in certain genres...but I like games in general.”

Jonathan shared why he considered gaming could be a powerful tool for students as well. He noticed that lots of students in his school were involved in gaming that was not related to education. Any way a teacher could tap into the interest of students’ learning would be beneficial. Because the current generation played the games a lot at home, they provided an effective platform that students understand.

Impact of games on student learning. Sawyer, Jonathan, Juliana, and the students all emphasized the influence that games brought to class. The group provided their feedback from a positive perspective. In the analysis of the interview data, the following themes emerged from information concerning impact of games on student

learning: 1) engagement, 2) working on your own pace, 3) allow to make mistakes, 4) collaboration, 5) incidental learning, 6) motivation, 7) differentiation, 8) practice tool vs. evaluation tool, 9) instant feedback, 10) responsive, 11) progress tracking, and 12) shared experience.

First, in the student group interview, students constantly emphasized how fun and engaging their gaming class was. One student identified that in his math class was “fun, but on the side you learn.” Students did not just seek for pure pleasure but had the desire to learn through games in class. Another student pointed out the fun element in gaming classes as well. Another student noted, “It’s not as boring, I guess, which makes us want to do it more.”

Jonathan’s comments echoed this student’s reflection: “I do know his (Sawyer’s) class of students are engaged in whatever programming he’s doing. Could be video games or gaming or his regular classroom routines.” Juliana shared her thought from this perspective as well: “Certainly it’s an engaging activity for many of our students for sure, and it’s a way to get reluctant learners and support them.”

Second, students also identified another learning impact of using games during their group interview. They commented that they were able to work at their own pace while playing games. One student mentioned: “Like the *Lure of the Labyrinth*. You’re at your own pace and your own speed. You can choose to redo levels.” However, in regular classes, she felt that she had to work the same pace as the rest of the class because she was not given other chances.

Jonathan brought up the same attribute of digital games. Considering each student is unique and has their own learning pace, he said that “[Games] would give them (students) just enough to move them forward but wouldn’t be too challenging that they’d get stuck, so it sort of helps you move along at a nice pace. That’s how digital games are designed.” He appreciated how games could accommodate a student’s individual learning need and styles.

Third, Sawyer also indicated that games provided a platform that allowed students to make mistakes without being afraid of being punished. He used one example in his class. He put a problem on the board and the students did not get it right away; they were disheartened because it was a class assignment and they were required to provide the solution. However, he found that students normally did not show a sense of failure when they played games. The following example illustrated how students kept trying while playing games:

They’ll just hit the replay button and they’ll try it again. Then for the most part they’ll do that 4 or 5 times in a row without getting disheartened...but they get disheartened instantly if the problem on the board isn’t done.

Fourth, both students and Sawyer reflected that games may enhance collaborative learning and interaction in class. Students mentioned that “it’s more fun when you have your friends with you and you’re more interactive.” In Sawyer’s math class, he always encouraged students to work together or ask for help from their peers. In the game *Lure of the Labyrinth*, students were required to work in teams and were motivated to share

their solutions as well as confusions on a discussion board or in class. The purpose of assigning teams was to allow collaboration on problem-solving.

Fifth, incidental learning is another emerging theme in the interviews with students as well as with Sawyer and Jonathan. Jonathan identified that digital games could be “an effective way to deliver or to learn,” as “you are actually learning when you’re playing video games.” When Sawyer was a student, he tended to learn knowledge in different areas from different games. He used to play a game called *Atom* to learn and memorize the periodic table. He did not know *Atom* was a learning game, but it was both fun and educational. Sawyer believed that it was a valid way to enjoy games because he was simultaneously educating himself and being entertained.

Based on Sawyer’s comments, his students had been telling their previous teacher that the grade eight class was not that difficult since they were playing a video game in class. He found that students tended to be more successful at the game. He noted, “Every single student was more successful like they had the tool to answer.” He found it was fascinating that students were able to solve the puzzles in the games by applying what they had learned in the lecture but did not realize that the game was connected to the math knowledge points that they were just discussing. Students also commented on the same theme. One student noted, “The game is kind of hiding the fact that you’re actually learning, but you actually are.” Students were aware that they were learning even though they were also playing games.

Sixth, all stakeholders spoke of how games motivated students to learn. Juliana, the school principal, said that game use for some students was “terribly motivating and it

was something they know and do well.” They were trying to encourage students to be more involved and active in school through using gaming. The school had an after-school video game design club that was “very highly attended,” said Sawyer. He also believed that the gaming portion had the potential to motivate students as it really spoke to something meaningful to them.

During the student group interview, four students discussed how digital games motivated them in learning. One student made a comment on Sawyer’s self-designed game *Student Quest*: “[I]t kind of pushes yourself to work harder.” Another girl made a similar comment that— the *Student Quest* pushed her to learn and do more. The third student mentioned that she constantly checked on her *Student Quest* to see if she had new badges. Another boy noted that they need to nominate themselves and take the initiative to ensure that Sawyer granted them badges and points based on their performance.

The seventh theme of impact on student learning was that of differentiation in learning. Jonathan, as the learning lead, emphasized the importance of differentiation in learning, as students had different learning needs and skill levels. He noted, “Within clear expectations, clear criteria, tech points, there’s room for differentiation or different skills levels or different knowledge levels or ability levels so we call that multiple entry points or exit points.” In Sawyer’s class, there were two students with severe special needs. When he was exploring games, he ensured that all students were able to interact with the game considering he had students with “multiple levels of abilities and disabilities.” He said,

“The game has to be something that when we’re using it, everybody can interact with it at an equal level...so that my students all feel successful.”

Eighth, Sawyer articulated that he was “not using the game as an evaluative but a practice tool.” It was approved in in-class observation and the students’ group interview. Students were mainly using the game *Lure of the Labyrinth* to practice math skills for students to grasp certain math concepts instead of using it as an assessment tool. Through passing different levels and solving puzzles, students were able to work on the knowledge introduced previously to enhance their understanding and learning process. In terms of *Student Quest*, Sawyer used it to acknowledge student achievement and performance. He granted digital badges and points according to what they have accomplished behaviourally at school. In this case, the game was more focused on evaluating students’ performance and acknowledgment of their achievement.

Ninth, Jonathan emphasized the importance of providing instant feedback to students three times in the interview. He believed that digital games had the potential to enhance students’ learning, as timely feedback could offer feedback right after students submitted the answer. According to Jonathan’s comment, students not only were aware whether they were on the right track but were also able to refine their decision in order to succeed next time based on the feedback provided in the game. The game worked as a formative assessment tool for students to improve their work and deepen their understanding.

The tenth theme of impact on student learning was related to responsiveness of digital games. Jonathan’s thoughts on responsiveness of digital games are that when

students are playing, games could “adjust to the level of the child right away” since “they have got those sort of inner mechanisms.” Digital games had the potential to reach all students including those with various “abilities and disabilities” as noted by Sawyer. In the meantime, students would not feel that they were treated differently since they all were playing the same game. According to responses, solutions, and learning pace of students, the digital games were able to offer different activities and puzzles for them to fit their skill levels.

Eleventh, one feature of some digital games was that students’ progress could be easily tracked in the system. The learning analytic was able to provide details of each student’s learning process: how long they spent on one particular question, how often they log in and play, which subject/topic/activity was hit more frequently, where they tended to get stuck, etc. Sawyer provided an example regarding how he tracked his student in the game *Lure of the Labyrinth*:

On the website with the game I get data on each individual student: how long they play in each puzzle, and how successful they are. I can see that in the cafeteria (one puzzle), they played the cafeteria for 45 minutes. They never managed to solve it correctly once, or they solved it three times and they took 28 minutes in total playing time. I get a puzzle by puzzle breakdown that way.

Sawyer was able to track all the data in his educator account which helped him observe what was happening behind the screen. Those details were important for him to make customized individual teaching plans for each student.

Twelfth, one of the rationales of why Sawyer was keen to use digital games in class was because he felt that games had the potential to provide a “shared experience” for the lesson, so students could have a common ground to “make the connection between the game and what they were doing.” Considering everyone had diverse experiences, it would be “easier to use a shared experience as a launching point, and the game can provide a motivating shared experience.” He shared one specific example:

If I start the proportions lesson by saying, I want to talk about the cafeteria game, everyone encounters the cafeteria game really early on, and they’ve all played it...I can say, this is the shared experience. Tell me how this is related. How are these two things related? Then from that shared experience they can have an equal conversation that’s not dependent on, I’ve been there, or I’ve done this.

By playing the same game and having a shared experience, students were allowed to build their knowledge by connecting that knowledge and what they had explored in the game.

All about *Student Quest*. Sawyer spent more than 20 minutes in the 80 minutes interview to discuss his self-designed game *Student Quest*. He was passionate about sharing the rationale, design, and the result of this game. He also defined *Student Quest* as a teacher-designed digital game. Sawyer claimed that whenever he spent time and money to design a specific game for his students, he wanted to ensure that it would be able to “enhance student learning” and it would be “best bang for my buck” since he used his own money to purchase the domain name and related add-ons.

What is *Student Quest*. Sawyer spent his whole summer working on *Student Quest*, believing that it would be a way that he could gamify his students’ school

experience which was something that needed to be done. *Student Quest* awarded students points and badges for completing tasks that he designed or set up. Sawyer noted, “there are perks to go with winning the game...and you do get the sense of accomplishment that comes with completing a quest.” Students were excited when they received their badges. They took the points and digital badges seriously and even would constantly “bother” Sawyer if they did not get their badges on time.

Why *Student Quest*. Sawyer used *Student Quest* to assist students to succeed in school and get ready for the real world in the future. He said, “I would say it’s a teacher designed game. It’s just not particular. It’s a game that’s got a foot in the real world and a foot in the virtual world design.” In terms of why he decided to design such a game, he shared, “policies in education and outcome-based assessment model...students can get really good grades for really bad habit.” For example, when students were working on the Pythagorean theorem, he was not supposed to grade them on whether they turned in their assignment but on whether they understood the theorem. In other words, if students managed to show their teacher that they understood the theorem, the teacher could have given them a grade that showed they had achieved the curriculum goal as it was required. However, in the real world, it would not be a winning strategy if someone did not do what his/her boss asked him/her to do based on Sawyer’s comments.

Therefore, Sawyer needed a way to “show students and reward students and their parents see how to be successful in school.” It had been too long that “students can get top marks without ever turning in an assignment, with turning in assignments very late, without attending, without all of those students’ behaviours that are necessary once you get into

other positions.” Sawyer stated that he had “a way to show the kids exquisitely how they were doing academically but he did not have a way exquisitely show the student how they were doing behaviourally.” He wanted to show them “how to be an all-around student.” That was why he developed the *Student Quest*.

How Student Quest works. Sawyer designed various quests in *Student Quest* for students to complete. He also used it to subtract points, so students knew what behaviours were inappropriate and why. He used one example to illustrate how he used *Student Quest* to give his students a lesson: he caught one student eating soup in the back corner of the class, but the student did not admit that he broke the class rules even though “the soup was near his mouth and his soup was open.” Sawyer took him and reviewed the class rules in *Student Quest*. He would not get a badge for lying to his teacher as that was “not a winning strategy in the game of school.” Sawyer told his students that “a young man getting ready to enter the world...when we do something wrong we’re like, ‘Yeah, sorry you’re right.’ We put it away and make a change, so it doesn’t happen anymore.”

Student focus interviews echoed Sawyer’s statement. Four students commented on how *Student Quest* motivated them to learn: “That kind of like sets like a thing in your mind that you have to do this to get this, like that pushes us to learn more, to do things.”

Why Student Quest was import. Sawyer also shared why he believed that it would be important to track and acknowledge students’ behaviour at school. He trusted that there was a correlation between students’ behaviour and their academic achievement. He used one example of the digital badge for turning in their lab early to

get feedback from their teacher. He always gave his students the option of turning in assignments early. Before he designed *Student Quest*, normally no one took the advice. When he introduced the badge, he also explained the benefits for turning in assignments early which was that they could “get a higher mark by getting the feedback from the teacher” because they could “redo the assignment by correcting the mistakes.” Therefore, students were able to “improve their marks” without having any penalty because the assignment was not yet due. The whole process made it obvious that “I offer a reward/badge for this behaviour and then when they engage in that behaviour, their reward shows up in their academics.”

Badges also helped students understand that involvement in school communities was important. For example, trying out for sports or being in a club does matter in a school. Sawyer believed that “when you’re applying for scholarships a lot of them are for all-around students who can show that they have done many things and they have volunteered service in their community.” However, none of those qualities were ever reflected in grades, so it would be difficult for students to understand the value of them. The goal of *Student Quest* was for students to pick 20 quests they were proud of and he would put them on a certificate. Under each reward, there was a description and students could put them on their CV when they go to the next grade and into high school.

Outcome. It was interesting to know how well *Student Quest* worked. One aspect of Sawyer’s quests was to ensure students received instant gratification the moment they submitted their assignments on time. Based on Sawyer’s reflection, there was a huge difference between his students’ behavioural performances:

Last year I have about the same number of students...I had given assignments like my first science lab and I got 35 or 40 of them on the deadline and I had 20 or 25 of them not turned in on the deadline. This time only two of them didn't turn it in. He also shared that he had a hard time when he was trying to mark the assignments and had to email everyone to let them know that he was not able to give students their mark by the initial deadline since he never had so many people turning assignments in on time. More importantly, he found that his students placed higher ranks in the system simply because "they turned in their assignments early and got feedback and used that feedback to get a better grade."

Guiding principles. Part of the purpose of this research study was to yield a deeper understanding of internal and external factors to support teachers use or design digital games in class. The researcher was intrigued to explore what guidance the school leaders could provide to build teachers' capacity of game use and design. The following guiding principles of using games in class were clearly implied in the interviews with class teachers and school leaders.

First, it was about the notion of using curriculum oriented games for students. While being interviewed with Juliana, she emphasized the importance of using curriculum oriented games in class seven times. She was clear that the instructional strategy had to be closely tied to a very specific curriculum outcome. Otherwise, it would not be considered effective. If any teacher would like to use games in his/her class, there had to be a connection between the game and the outcome; otherwise, it would just be a game. The following quotation illustrated her philosophy:

I am comfortable with the use of the game in supporting the curriculum because I'm confident that...1) it's tied to outcomes and 2) that he would monitor really carefully and that he would be ensuring that the knowledge students are gaining is being assessed and used to inform their learning.

Juliana constantly brought up the importance of connecting the activity to the outcome, as it would be meaningless if this rule could not be applied in teaching. She noted,

It has to be personalized so that the students are using it a way that makes sense for them. That it is tied to the program of studies; that it isn't just busy work. It isn't just a fun activity but there is a specific connection to the program studies.

Sawyer also emphasized that the content of the game had to match the curriculum. To him, he believed that it was his professional responsibility to "help the students learn the curriculum" to find the activities that enhanced students' learning. He explained that gaming was not just for fun but should have a purpose. For example, he used the game *Quest Atlantis* to teach water testing which is one of the curriculum objectives (water quality and water testing) for grade eight science. It was an important game selection because Sawyer ensured that he was always prepared to communicate with parents or school administrators regarding why students were playing a particular game.

Second, Sawyer, Juliana, and Jonathan mentioned that it was important to ensure the content in the game is appropriate. Sawyer specifically noted that he was not "a big fan of violence in the game unless it's like cartoon-type violence." Selecting content appropriate games is as important as selecting curriculum oriented ones. Jonathan shared

his concern regarding the damage of creating an unsafe learning environment due to inappropriate content in gaming or any other teaching strategies. Jonathan used the example of Paris attack in 2015. This topic was discussed with students in their social studies class. It was a violent situation, but any graphic images or description were not shown in class. He said, “[Y]ou would talk about the situation and maybe the motives behind it and maybe how to react to it, but you wouldn’t talk about the specific details of the actual event. So I think a game would be the same.” He emphasized that if a game dealt with these controversial issues, teachers would have wanted to deal with it with the same thoughtfulness. Juliana’s attitude towards violence or any inappropriate content was straightforward and simple: “It would be a no-go.”

Third, another important guiding principle shared by both Jonathan and Juliana was about authentic learning. Both of them stressed that gaming or any other teaching strategy had to enhance students' authentic learning experience. They also considered authentic learning and meeting the curriculum outcomes as inseparable principles.

Jonathan noted:

[W]hether it be traditional or paper and pencil or hands-on activities or even online or gaming you’d want to be really intentional on what the outcome is as well as looking at different various point, benchmarks or feedback points so that you can see if the kids are getting the material or they are understanding the desired outcomes.

When Juliana was asked about how to support the game use or design in class, she answered, “The ones that keep bringing around authenticity and connection to program studies and then we would figure out a way to make that work.”

Fourth, Juliana shared their decision-making process when it came to determine the application of certain teaching strategies, tools, tasks, or technologies. She normally relied on and consulted with the learning lead, assistant principal, and any of the other teachers who were the experts in the field. For example, if another teacher came forward to discuss gaming, she would go to Sawyer and have a meeting with him; Jonathan and the assistant principal would also discuss this particular game and its relationship to the curriculum outcomes. Juliana would ask them to research the game and the connection with the program outcomes and finally determine whether it would be a good choice for students. If the decision was positive, three of them would sit with the teacher to discuss the parameters of using the game and follow up with him/her after one year to assess the effectiveness and benefits.

Fifth, because of her educational background, Juliana researched thoroughly before making any decisions. In terms of gaming, she was convinced that she had to ask the questions, “[A]re we overdoing the whole video gaming?” and “[A]re there other strategies and ways of working with kids that can create more balance and actually invite them to read more?” Juliana discussed one research study regarding the different effects between children interacting with a screen and with a book. She believed that the current generation had already been exposed to digital devices a lot. They should have more time for reading. The following quotation illustrated her perspective:

What happens with the brain when you are doing something like a game...or Google searching or whatever it's less focused. It's snapshots. Kids are fast...I want to get this information, this information, this information and want to synthesize it. Those are all very good strategies and important things, but it doesn't create the longevity and the sustained attention that is required when you read fiction.

Juliana encouraged students to practice their higher thinking skills, for example, creativity, by putting themselves into the text. She believed that they could create the setting, plot, and images by reading instead of having everything shown to them: "Going back to video games, I wonder whether more of something that's interesting and compelling for kids is actually something that's giving them the broad depth of learning that they might need." Because the current generation is reliant on technology, school has been supportive of meeting the learning needs of students by providing digital devices and creating a "robust technology environment." However, Juliana wondered if "Doing everything digitally is that better because that's what kids do. Or is it better that we also have to introduce them to things that are part of our tradition and our culture, that may be lost if we don't."

Another perspective regarding balancing in class was about instructing and playing games in class. Juliana indicated that there were lots of math games on their school website that students were able to access. Most of the games were used in class promoted to parents and were educationally sound. However, she recommended that it would be better to play the games at home than at school because teachers "should be instructing." It was true that kids could learn through games but "somewhere a teacher has to teach, or

at least ensure that the students are learning what they need to learn. You can't just let kids go on a computer and say, 'Okay.'"

Sixth, Johnathan identified that differentiation needs to be one of the guidelines while selecting appropriate teaching strategies. He stated that it was important to ensure the game was able to include students from all levels to create a universal learning environment. The following quotation illustrated his perspective: "There's clear expectations, clear criteria, tech points. There's room for differentiation or different skill levels or different knowledge levels or ability levels so we call that multiple entry points or exit points." Sawyer emphasized the importance of differentiation in games as well which will be fully discussed later in this chapter.

Seventh, as a learning lead, Jonathan had the responsibility to help teachers reflect on what games they designed for students. If a teacher approached him regarding applying certain games in class, he would ask, "What is the purpose of this task? What outcomes are you wanting the kids to get? Is this the best learning tool for this specific student?" He noted that it was his role to help teachers be "intentionally thoughtful about what they're doing in the classroom." He asked the same questions if it was a traditional lesson.

Eighth, it was important to know how Sawyer selected games for his students to meet their individual learning needs. Because he had a strong educational background in learning sciences, he described four guiding rules to help him using and designing games in class: 1) feasibility; 2) interaction; 3) thinking process; 4) content.

First of all, the game needs to be functionally and financially feasible. For example, some of the games were not accessible due to the network safety issue. Even though he would be able to use some games for educational purposes, Sawyer may not be able to access them as the school-board programs blocked many applications. In order for students to access *Lure of the Labyrinth*, Sawyer needed to apply to get it unlocked and proved it was educational. He needed to go through the terms of use and privacy policy to get the website approved for use by students.

Sawyer also described the game *Quest Atlantis*. He managed to get it approved at the IT level and got through the terms of use and the privacy policy; however, he did not get it through ethics approval because the game was part of a research project. Based on their feedback, the whole process would be a lot different and would not have come under same ethics if it were a commercial game. Sawyer now always asked himself before using a game whether it was “feasible to make this work in the classroom this time.” Although he had some difficult experiences regarding the use of certain online games in class, he was still keen on trying different gaming approaches in class. He believed that “[A] digital gaming portion really speaks to something that motivates the students and their interests.”

Second, he looked at how students interacted with the game: “[I]s it mostly reading? Or is it mostly playing harder to interact with the game?” Sawyer had students with multiple levels of abilities and disabilities, and if a certain game was all about reflex, a portion of his students could never do it because they had physiological motor difficulties. When he selected games, he ensured that “[E]verybody can interact with it at

an equal level. There's an equal level intellectually." Sawyer was wondering can his students "experience success in the game or redefine success in the game for different students." In *Lure of the Labyrinth*, some students found that success was measured by how many beans they had collected; for others, success meant how many pets were rescued; and success also could be how many rooms they had closed for other students. The game had multiple levels so that all students felt successful. Sawyer stated, "I won't mind them feeling a little bit frustrated, especially at the start of the game, but I want them at the conclusion of the experience to have all felt like they've been successful." *Lure of the Labyrinth* also escalated in difficulty if players were successful. It presented easier problems to students that needed easier problems too. To Sawyer, "[T]hat's another part of that interaction to use technology [which] is its adaptability."

Third, Sawyer used games that encourage students' higher thinking skills. He noted, "I'm looking for games that are enhancing thinking processes rather than games that are a reflection of how quickly you can do a particular pattern combination." For example, one of the games he used in his math class was a card game called *Sets* which was a logical visual patterning game. He found some of his students were afraid of numbers and arithmetic. However, he believed that there was a large chunk of mathematics that had nothing to do with those. *Sets* would help students build up their confidence in math and practice skills in different aspects.

Last, Sawyer always looked for a game matching the curriculum. He had to be able to say that the game his students were playing was related to the curriculum objectives they needed to target. The games he used and designed in his math and science class

were all closely connected to Alberta Education's curriculum. Some parents had questioned why certain games were used in class and approached Juliana. Sawyer was prepared to go over the educational objectives that the game met and how he was using them in class.

In the end, Sawyer explained what made a good game. The guideline for him was "[W]hen you play a game what is skill and what is a chance, and how do those two relate to each other?" More specifically, what makes a really good game is a game "where there is a skill. If you have a skill you ...are making progress in the game. There is [also] enough of a random chance to the game that somebody with less skill kind of equalizes to make the game challenging." He described the game *Risk* which included "an overall strategy that you can use but the battles themselves are pretty much random." Compared with chess which is all about skill, *Risk* did not "guarantee that the person with a better strategy would win all the time because sometimes the random element makes the weaker player win." Sawyer stated that "[F]inding a game or creating a game where you're not on the skill end and then you're not on the random end, but there's something in the middle. I thought that was a fun thing."

Supportive environment. During the interviews and visit in Sawyer's school, both Juliana and Jonathan shared their trusting relationship and promising communications with Sawyer as well as described various supports to teachers from other areas.

First, the school principal shared her faith towards Sawyer in the interview. She did not have much experience in games, so she relied on Sawyer who had "a strong

understanding of games” to make main decisions on using or designing games in class. She stated, “I trust Sawyer that his knowledge around the use of technology with kids and gaming, and we’ve changed up one of our complimentary courses to support him in working with kids and design.” She also relied on Sawyer to be one of the resources if another teacher needed help and suggestions on gaming. Jonathan also trusted Sawyer’s judgment on games as well as he had been hearing positive feedback on Sawyer’s teaching and he knew that his class was “engaged in whatever programming he’s doing”. He said, “I know the kids speak highly of his teaching practice” whether he used gaming or his regular classroom routines.

Second, as a school administrator, Juliana had been providing support from different perspectives as well as relying on the team to make the final decision. She had offered financial and technological support to teachers who had any questions. She also helped provide access to a particular software they did not have. She was approachable with any questions and negotiation. Sawyer also commented that his principal had been “really supportive of innovative learning anyways.” In the meantime, she relied on the learning lead and assistant principal, who had strong backgrounds in technology, to monitor the school’s technology and ensure that all learning activities were “truly planned out purposely and thoughtfully,” so they could best make the decision regarding using certain games.

Third, during the interview with Sawyer, he noted that there was not much technical help from people around him: “[T]he problem [with] being on the cutting edge of innovation is that there aren’t a lot. I’d say my personal learning network through

Twitter is probably the biggest place that I go for outside supports or ideas.” Based on Sawyer’s experience, he asked his Twitter contacts for suggestions of teaching strategies with games as well as discussed how games were used in their classes compared with his. For example, if he had a question about how someone was using one of the puzzles in *Lure of the Labyrinth*, he would send out a request via Twitter and wait for what came back to him through the digital game network. However, he confessed that most of the time he just “beat my head against it till works.” Another outside support was the Scratch (<https://scratch.mit.edu/>) educators group. He had some friends through meeting them at the Scratch conferences. That was another gaming network he relied on to get feedback, suggestions, and connections on gaming.

Fourth, there was effective and healthy communication between teachers and school administrators. Although Sawyer did not approach Jonathan or Juliana regarding what games he would use and how he would use them in class, other teachers did seek for support from Jonathan with *Minecraft*. As the learning lead, he emphasized the importance of communicating and guiding with teachers. For example, in order to ensure the teacher selected the appropriate game with appropriate content for the target audience, he always asked, “[I]f this was the content how would you best approach it? Or this student isn’t seeming to be successful, what could we do differently?” This communication and guidance assisted teachers to thoughtfully reflect before they used digital games in class.

Fifth, Jonathan used to be gamer and was keen on playing various games he believed were educational since the games involved different strategies yet were

entertaining. Because of his gaming experience, he was interested in providing suggestions to other teachers. For example, he suggested the game *Minecraft* for a science class where students created the water cycle. Some students built a virtual world to go through each section of the water cycle. Although other students presented the final products in other formats successfully as well, Jonathan believed that the students who completed the task with *Minecraft* really enjoyed the process and successfully demonstrated their knowledge and understanding.

Challenges. Both the teacher and school administrators shared challenges while using and designing games for students. Games may enhance students' engagement but there were areas that were challenging for teachers and school to apply this approach in class. From the analysis of their interviews, the following themes were identified: 1) time consuming, 2) minority, 3) budget, 4) negative stigma, 5) making connections, 6) challenges from parents, 7) challenges of planning, 8) challenges from IT.

First, the school principal, Juliana, was concerned about time investment in using and designing games in class. The teacher needs to spend time on researching and playing the game that will be used; the activities and assessment practices designed around the game are arduous as well. Juliana wondered, "[I]s that time invested equal to the learning or is there some other way they could have learned that outcome or that expectation or objective that would have been a better use of the student's time and the teacher's time?" She shared her concern with teachers using games in class, but they were positive because students enjoyed the activity. However, she questioned about good time versus the learning outcome. Based on Sawyer's comments, he spent his whole summer

designing *Student Quest*. Designing digital games for students was certainly a time-consuming process.

Second, like Sawyer stated only a small group of teachers had the desire of using or designing games in class. Juliana was aware of that as well: “The number of individuals that have the level of expertise that Sawyer has is quite a small group of people.” Likewise, Jonathan said he had not seen many teachers designing digital games for students. It was difficult to find support regarding using or designing games in class considering there was only a small group doing it for their students. Like Juliana commented, if one teacher was interested in using certain games in class but had limited knowledge about gaming, a disconnection may arise between the use of games and effectively embedding curriculum outcomes into games.

Third, Sawyer had spent money on creating *Student Quest*’s website and purchasing necessary add-ins. He was allocated \$100 for his grade eight class each year which was not enough for 55 students. Therefore, he went to garage sales to buy pieces for his students to use. Although he had a tight budget, Sawyer never thought it was a problem since he was willing to purchase software and hardware from his own pocket. He spent \$1000 on 20 used PC laptops, so each of his students was able to have a device with which to play the game with. The budget also affected what kind of game Sawyer selected. He mainly used free online games, like *Lure of the Labyrinth*. He was interested in trying some educational and commercial games as well if he “had the money.”

When I asked Jonathan about what challenges he had when he worked with class teachers regarding gaming, he shared a very interesting example. He noted that it was

sometimes difficult for teachers to see the connection between certain technologies (i.e. gaming) and a student's learning. He believed that, "[T]here's a little bit of resistance among some teacher around those types of platforms." Some teachers' comfort level with technology ended at "productivity type," for example, PowerPoint or Microsoft Word. When talking about technologies with which they were not familiar with (like gaming, programming, or coding), teachers tended to become anxious about using them.

The other reason was that some teachers did not believe in gaming at all. Jonathan used the experience in a PD session where school invited a well-known guest speaker who talked about the importance of providing students with timely feedback. Games do a great job of giving students the feedback promptly. A group of teachers were "annoyed" by this concept and asked, "So you're trying to tell us that gaming is okay for kids? You're saying we should encouraging kids to be gaming?" Although the guest speaker answered, "[G]aming is an effective learning mechanism for kids," the teachers were not able to make the connection. Jonathan said, "All they could see was the negative sides of the impact" and they were even "offensive when they heard the idea of using games in class." Jonathan believed it would be "a really hard sell" for teachers who did not grow up with games to understand the value that games may bring to the class.

Fifth, it was not only challenging for some teachers to make connections between gaming and learning but for students as well. Sawyer found that some students, too, were not able to make the connection between the knowledge building points in classes and the learning experiences in games. For example, he asked students, "Can anyone think of an example in *Lure of the Labyrinth*? Are there any puzzles that are related to this kind of

question?” Only a few students could answer and many of them could not relate what has been taught in class with the game.

Sixth, just as not all the teachers supported using games in class, not all the parents were on board either. Based on Sawyer’s experience, some parents were quite “upset” with hearing that their children played games in math class and complained to the principal. After his principal, Juliana, was approached, a meeting with Sawyer, Juliana, and the parents was organized to go over the educational objectives that the game had met and how he used them in class. He blamed himself for not communicating well enough. Now, before he launched a game in class, he sent emails to parents regarding what games would be used and why he was using them. Sawyer noted that he had to be prepared for being challenged and ensured that he “got everything lined up.” He avoided having students play games as part of their homework. Parents now had a good understanding of why he used games and his math program was “highly regarded” since students’ skills were greatly improved.

Seventh, planning a lesson with a game was not the same as planning a lesson around a textbook where everyone was able to look at the same page or the same concept. As described earlier, a game provided an opportunity for all level students to be engaged. The attribute of differentiation customized the learning experience, unique to each student. Because students on different levels worked on different puzzles, Sawyer needed to “plan around how the game presents the puzzles not necessarily the order that might make the most sense in terms of the progression of skills.”

Eighth, in terms of the potential support from IT, Sawyer mentioned that “it’s actually kind of an impediment more than a support group.” The school technician was a great support when the school was first opened. According to Sawyer, he “loved trying to find ways to get games to work on machines so that they wouldn’t violate the school board’s policy and at the same time it also ran.” However, the current technicians were not interested in gaming and did not think it was worth their time to make it work. If Sawyer was planning to install a commercial game, the whole process could take up to six months, as the tech installer needed to ensure the game was compatible with the school’s technology.

Teacher-designed games for learning. Both Sawyer and Jonathan discussed the potential benefits of teacher-designed games. Jonathan believed that teachers could bring a lot to the digital game design process because “they understand how to approach content in more of an engaging, authentic way.” He called some educational games “chocolate covered broccoli,” since most commercially designed educational games were not that engaging. Jonathan was positive about a teacher’s role in game designing, as he believed that people like Sawyer understood how commercial games worked. If teachers could “take how they plan lessons and tasks and apply it to a commercial video game,” it would be “a much richer experience” for students. Although commercial games are engaging, they are not personalized enough. Jonathan identified that teachers knew their students the best, so teachers could take the content and create something personalized for their students.

Sawyer had searched for a commercial solution that would meet his teaching needs but could not find one. That was one of the main reasons he created *Student Quest*; current digital badge systems could not be customized, and he wanted to create more badges to reward his students. One application was able to track students' behaviours but he found that it had such a large focus on negativity: Sawyer wanted to focus on what students had been done right. He did not like how students' points were taken away in the current application. In *Student Quest*, the points could be deducted as well but Sawyer would rather sit down with his students to have a meeting and show them why their misbehaviour was worth taking 50 points off. The ultimate goal was to help students realize why misbehaviours were not acceptable at school and eventually get improved. Based on Jonathan and Sawyer's experience, both educational and commercial games had their drawbacks that teacher self-designed games that may help solve.

Implication. Jonathan suggested that teachers who already used and designed games should showcase what they had done to their peers. For example, how they designed game; how much time it took them; and what were the outcomes that students had because other teachers may be interested in that information. Some teachers may find the work was engaging and be willing to put in the needed hours while other teachers may abandon the idea as it would be too much work for them. He suggested making the process transparent, so people could see that this was a possibility. Jonathan believed "if you don't know, you don't know what you're missing." It was important to introduce this approach to all teachers and provide an opportunity for them to try.

Summary

This case contained rich information regarding game use and design in class; both school administrators and the class teacher had strong educational backgrounds or gaming experience. Sawyer described his own guiding principles of selecting and designing games in class: feasibility, interaction, thinking process, and content. Based on those principles he not only found engaging and appropriate digital games for his students but also designed *Student Quest* to track and evaluate his students' in-school behaviours. Sawyer discussed the rationale of designing this game and the amazing outcomes of using this game in class. His self-designed game was able to be much more individualized than some commercial games and educational games.

Games provided opportunities for students to enjoy learning and enhance their learning experiences. Guiding principles were important to help teachers stick with the curriculum outcomes while using and designing games in class. Both Jonathan and Juliana emphasized that the importance of authentic learning experiences should be one of the protocols when using or designing games for students. Moreover, considering students had different levels of abilities and disabilities, a game should be inclusive to all students, so everyone could enjoy and learn at their own pace.

It was encouraging to have a supportive and safe environment where teachers had opportunities to grow and show their talents. The challenges were not new when applying innovative strategies in class. For instance, both the teacher and school administrators commented that selecting appropriate games and designing games in class were time-consuming. Sawyer identified that it was also challenging to plan the lesson

around the game as students were exposed to different levels while doing different puzzles.

CHAPTER EIGHT: CROSS-CASE ANALYSIS

This section will provide a cross-case analysis of the four cases presented earlier. Each case will be examined in terms of similarities and differences in the themes revealed by the data. The themes I will be introducing are: 1) advocate games for learning; 2) impact of learning on students' learning; 3) guiding principles; 4) supportive environment; 5) challenges; and 6) teacher-designed games for learning.

Case Contexts

All four cases involved K-12 schools in southern Alberta. Participants from three cases were referred to me by colleagues and the other participant was my former classmate. Three out of five teachers (see *Table 8.1*) claimed themselves as lifelong gamers. They were passionate about digital games and wanted to present the value of gaming to both students and other teachers. It was found that teachers who were gamers were keener on exploring and finding online, commercial, or educational games for students compared with teachers who were non-gamers or casual gamers. Because of their experiences with different games, gamer teachers also designed their own games that were fun yet met the curriculum outcomes. Four out of five teachers also gamified their classes by applying various gaming approaches (i.e., using commercial gamification platforms or by self-designed games).

The participating teachers' teaching experience ranged from 5 to 21 years (see *Table 8.1*) and across various subjects for different grades, though four out of five teachers used games in their math classes. Among them, only Sawyer had a formal education in gaming; Sophia had former PD experience in gaming; the rest of the teachers were simply

interested in games. Because of his educational background in gaming, Sawyer had a very solid theoretical foundation regarding why and how to use games in class. He had a strong rationale for why he designed games for his students and why it was important to design the games.

Table 8. 1

An Overview of Five Participating Teachers Demographic Data

Name	Gender	Age	Grades	Teaching Experience	Courses using gaming/ gamification	Characteristics	Game design experience
Cynthia	F	35-44	6	11	Math, Social Science	Lifelong gamer	Yes
Sophia	F	25-34	4	5	Math	Non-gamer	Yes
Mme MCC	F	35-44	6	16	Math	Casual gamer	Yes
Kameron	M	25-34	9-12	7	Media	Lifelong gamer	Yes
Sawyer	M	35-44	8	21	Math, Design Thinking/Computer Science	Lifelong gamer	Yes

Advocate Games for Learning

All five teachers had different rationales of using and designing digital games in class. As stated earlier, three out of five teachers (Cynthia, Kameron, and Sawyer) were lifelong gamers. While looking at why they were keen on using games, it was found that games had a deep impact on teachers who are gamers. They experienced the value of

games, so they advocated this tool to be used in class. While the non-gamer (Sophia) and casual gamer (Mme MCC) teachers used digital games since they believed that games to be an effective way to engage students in class. Both teachers believed that what students could achieve via games was worth of the time and money spent. Because of their passion and willingness, Cynthia, Kameron, and Sawyer had a broad awareness and understanding of what games were available to use in class. All of the participating teachers agreed that games could be an effective teaching strategy to reach this generation and meet their learning needs because they were more visual learners. Other reasons why some teachers were interested in using games included engaging male students in class, having all students more involved in learning, and enhancing students' higher thinking skills,

Impact of Game on Students' Learning

Games affected students' learning from different perspectives. Some of the themes were revealed in all cases while some of them were not. The following section will compare their similarities as well as differences across four cases.

All four cases identified that engagement was automatically attached to digital games. All teachers and principals agreed it was obvious that digital games were fun and could be used as an effective educational tool with which students could enhance their knowledge building in class. In turn, teachers were further triggered when they experienced students' engagement and would like to explore more and use and design more games. All the participating teachers described the desire of finding appropriate games for students to create an engaging learning environment.

Another emerging theme appealing in all cases was that digital games motivated students to learn and explore more without being pushed. In each case, how students were motivated was described from various perspectives. Amongst these four cases, teachers from the first two cases (Cynthia, Sophia, and Mme MCC) used games mainly to motivate students to learn certain subjects. Kameron used games to encourage male students to focus more in class. Sawyer used a self-designed game to motivate students to follow school rules, which ultimately had a positive impact on their academic achievement.

Although only Sawyer stated that he mainly used digital games as a practice tool instead of an evaluation tool, it seemed that it was an unsaid theme across all cases. Most teachers used digital games—either online, educational, or self-designed—for students to practice and reinforce what they had learned, especially in math class. Kameron also used games to enhance students' media skills and knowledge. The other teachers used games as an evaluation tool to assess students' various competencies; for example, Sophia and Mme MCC used *Mathletics* to assess students' math competencies and Sawyer used *Student Quest* to evaluate their school behaviours.

Three out of four cases identified that students were able to learn through digital games without knowing that they were learning. Those four teachers considered incidental learning as one of the benefits of using digital games. Interestingly, incidental learning all happened in their math classes. It was assumed that math could be one of the more difficult subjects. If students enjoyed playing games while learning math skills

without even realizing that they were studying math, digital games helped students with their understanding of certain abstract math concepts and grasping math skills.

Another prominent theme in the majority of the cases was that gaming allowed students to make mistakes without feeling frustrated. Teachers considered this as another benefit of using games. This trait allowed students to enjoy learning without worrying about the consequences. Learning is a process that includes countless failures. Gaming allows students to be not afraid of failing and willing to try over and over again.

Three out of four cases identified that games could personalize each student's learning experience. Digital games normally contain multiple levels and each level may include multiple puzzles. In addition, the storyline is not normally linear. Therefore, learners had the opportunity to explore the game based on their own pace and it often fits the learner's ability. Cynthia and Sawyer designed their own quest-based games because they believed that would be the best way to ensure the game targeted the curriculum objectives and was customized enough to meet their students' learning needs. Sophia and Mme MCC from case two customized their games or platforms to incorporate their curriculum outcomes.

Two cases identified that games provided instant feedback to players, which proved crucial in enhancing a student's learning. In case two, both Sophia and Mme MCC stated that games sometimes worked as a formative assessment tool, and the feature of instant feedback built into the game did not disrupt a student's learning flow while offering comments right away; students received hints of what the correct solution could be and kept working towards it. In case four, the learning lead, Jonathan echoed their

thoughts: timely feedback assisted students to refine or redirect their original plan to successfully solve the puzzle next time.

Half of all cases also argued that digital games encouraged collaborative learning among students. In case two, students noted that games provided opportunities to work together and they enjoyed working with their peers. One of the teachers also said that games allowed students to share ideas and construct knowledge when working in a group. Case four mirrored what students and the teacher shared in case two; students mentioned that they found it fun interacting with their peers. By playing the game *Lure of the Labyrinth*, students were assigned into groups which motivated them to share ideas to solve puzzles.

Guiding Principles

Each case shared different guiding principles while using and designing games in class. Overall, there were three key similarities across all or majority of cases. Case four shared number of principles that were not described in other cases.

All teachers and school administrators across the four cases emphasized that they had to ensure the games used in class were curriculum oriented. Sometimes it was easy to only focus on engaging students but neglected meeting curriculum outcomes. With this guiding principle in mind, teachers selected games purposefully that were not just for fun but also ones that supported student learning. Without curriculum outcomes embedded, it would be meaningless to use any kind of game in the classroom.

Another distinguished theme under guiding principles was related to a game's content. In the four cases, some schools were private, and some were public. However, all

schools were on the same page regarding what gaming content would be appropriate to students. Almost all of the school administrators had zero tolerance for inappropriate content, whether it be violence or anti-Catholic. All teachers and school administrators believed any inappropriate content would have a negative impact on younger learners and would not be accepted by parents either. Teachers were cautious while selecting games. For example, Kameron gave up the idea of using a commercial game to teach the French Revolution due to the violence within the game.

Three out of four cases identified that gaming is one of the learning strategies and teachers should consider using it among other teaching approaches. School principals emphasized that teachers should use various approaches to meet different learning needs. According to the school principal in case four, the current generation has lots of opportunities to be exposed to screens, so students should have other chances to interact with more traditional learning activities. Juliana was also convinced that teachers should still fulfill their instructing responsibilities instead of having students working only on games. In case two, both school administrators did not think it was wise to overuse games, meaning they did not recommend using only games in class. Noelle and Mary Lou encouraged teachers to try different teaching tools. In case three, both the teacher and principal considered using multiple teaching approaches to support student learning. In all three cases, all school administrators encouraged the balancing of gaming with other teaching approaches since teachers who solely use games in class may not be as effective as originally planned.

Supportive Environment

There were five similarities across cases in terms of what factors supported teachers using or designing digital games in class. Teachers' success and growth cannot happen without a supportive environment. Each case involved teachers, students, and school leaders; everyone worked as a team to ensure students had a positive and motivating learning experience. Teachers were willing to innovate their teaching approaches according to what they were passionate about.

In all four cases, none of the school leaders had a gaming background. They provided guidance and direction to teachers but ultimately relied on teachers' judgment and expertise in class. Although the school administrators were not able to provide any gaming related support, their openness to the idea encouraged teachers to be risk takers and explore this innovative teaching tool. The trust and faith to class teachers motivated them to use their expertise to enhance student learning. These relationships built foundations of positive communication between teachers and school leaders.

In two cases, the teachers identified that they had received different levels of financial support from school, although they rarely asked much either. In case one, there were not a lot of resources available for gaming, but the school principal had been supportive as long as there was need in class. In case two, the pilot project of using *Mathletics* required the school to purchase a group license for students. School leaders had been favourable to using the game to teach math skills since it was an age-appropriate, curriculum-oriented game.

Two cases identified more PD opportunities would be helpful for them to use or design games for students. In case one, Cynthia wanted to attend a gaming conference in America which happened during the provincial achievement tests. The school principal supported her going. In case two, although the school leaders believed that they had provided chances for teachers to work with either teachers or schools that had expertise in what they were interested, the teachers seemed to not receive what they had expected. The teachers were interested in and passionate about using games but they did not have much gaming background. If PD opportunities could provide more resources and specific guidance, teachers would be more confident with planning and using games more effectively and purposefully in the classroom.

Two class teachers took the initiative to ask for feedback from their school principal, colleagues, and students regarding the use of games within their teaching. In case one, Cynthia invited the principal to observe her class a few times to seek constructive feedback from her. She also asked for feedback from her students to ensure that gaming was an effective way to enhance their learning. In case three, Kameron asked for feedback from his students as he believed that it was important to listen to his students' voices. He wanted to know how to use the right game to support their learning and ensure their learning experience with the gaming approach was meaningful to them. Teachers believed that it was important to receive feedback from different stakeholders to ensure it was the "right" teaching approach to meet most students' learning needs. Feedback from non-gamers was helpful as it provided unbiased comments about gaming.

Considering all the participating teachers were the minority of using games, they did not have much professional support in school. It was identified that both Cynthia and Sawyer consulted their Twitter community about gaming related matters. They did not rely on internal support from their schools or school districts, as it was lacking. Additionally, Cynthia and Sawyer depended on the professional network built through attending conferences. PD resources in gaming were limited in current school districts. In case three, both teachers desired more PD opportunities to support their use of games for teaching.

Challenges

It was evident from the analysis there were four key challenges that impacted the use of game use for student learning. First, designing and using games is time-consuming. Three teachers articulated that designing and using games for students was a time-consuming task. For example, in case one, Cynthia commented that she did not mind spending the time to explore appropriate games although she did spend lots of her spare time on testing and designing games. In the meantime, her principal was concerned about her balance of life and work. In case three, it was not described as an emerging theme, but Kameron noted that it was time-consuming to find a curriculum oriented and content appropriate game. As with Cynthia, Kameron was willing to contribute his time to explore and design, but it was an important factor that may have impacted how well he could use or design a game for his students. In case four, Juliana was concerned about the time investment from the teacher and wondered if it was equal to what students could

have achieved without a game. Sawyer spent his whole summer designing *Student Quest* but believed it was worth it.

Second, in two cases, staff also raised the concern of addiction. In case two, school leaders were concerned that students spent too much time gaming although the intention was to practice their math skills. The curriculum lead said that personal interaction was more meaningful than playing a digital game. In case three, both Kameron and Peyton supposed there was a risk of game addiction if students were given opportunities to be exposed to games in class. Kameron was cautious about giving gaming related assignments and asked for details about what had been done to monitor the amount of time his students spent on those assignments.

Third, the use of funding this form of learning can be problematic. Two teachers said that their schools and students had provided financial support in encouraging them to use and design games. However, the other two considered it a challenge. In case three, the students purchased copies of games themselves as they would like to play the games they were interested in. In order to ensure privacy, Kameron also brought his own consoles to keep everything local. Peyton was concerned about limiting students' opportunities if there was a fee involved since they may not be able to afford purchasing the license for all students. He was therefore cautious about investing in gaming. Peyton also expected donations from the community to support gaming projects. In case four, Sawyer also spent his own money to purchase devices and related products. Since there was a tight budget, Sawyer used mainly free online games instead of educational or commercial games which required a group license.

Fourth, the first two cases did not indicate a negative impression about games from other stakeholders. However, the other two cases articulated strong challenges from this perspective. In case three, Kameron's personal experience told him that people still viewed games as a waste of time. This point of view had been changed a lot in the last 15 years, but the negative impression about games did not change much. In case four, Jonathan shared that some teachers in his school were uncomfortable with the idea of using digital games to teach, as they were not able to connect gaming with learning. They only saw the negative sides of digital games. Jonathan believed it was difficult for some teachers to understand the real value of games.

Teacher-Designed Games for Learning

All four cases involved participating teachers designing digital games for their students. Because of their various gaming and designing background and experiences, the strategies, rationales, platform/programs, and what skills they wanted students to achieve were all different. In cases one and four, Cynthia and Sawyer designed a quest-based game because current online, commercial, or educational games could not meet their students' learning needs or include the learning outcomes from the curriculum. Those two games were tailored to their students. Both teachers incorporated their planned learning activities and assessment practices into the game. In case one, the game was connected to Classcraft where students get points, while in case four, students were awarded badges and points which culminated in a certificate at the end of the school year. In these games, students chose different route based on their own pace and levels. In case two, Sophia designed a *Jeopardy!* game by using a Notebook template. Students

chose the problems that they managed to solve. All three cases found that customization was the key why they designed games for their students. In case three, Kameron designed the game to support students to learn about media. This game was not used as a practice or assessment tool unlike the other three cases.

Conclusion

Cross-case analysis highlighted both similarities and uniqueness across the cases. Overall, each case reported why teachers were interested in using or designing digital games through their personal gaming, educational, and teaching experience; the impact of games on student learning; the guiding principles from school administrators; and the support and the challenges present when teachers used or designed games. These findings are further discussed in Chapter nine in relation to the existing literature and in response to the research questions.

CHAPTER NINE: DISCUSSION OF THE FINDINGS

Introduction

The purpose of this study was to yield a better and deeper understanding of internal and external factors and supports that built teachers' capacity of game use and game design and what inspired them to move from being game users to game designers. This chapter discusses the findings of the study in relation to the research questions: 1) factors influencing teachers in using digital games; 2) factors influencing teachers in designing digital games; 3) conditions developing teachers' capacity to be game designers; and 4) factors that influence the transition from game users to game designers.

Factors Influencing Teachers in Using Digital Games

My first research question focused on identifying the key factors that influenced teachers in using digital game-based learning environments. Based on findings presented in Chapters Four to Eight, the following three factors were identified: lifelong gamer, digital generation, and impact of games on student learning.

Lifelong gamer. Three out of five participating teachers identified themselves as lifelong gamers. It was found that their personal gaming experience, their passion towards digital games, more importantly, using digital games to support students learning became an important factor to encourage teachers to explore various games as well as use them in their classes. Two participants answered the question of "Are you a video gamer?" in the online survey "Lifelong" and "all my life." One participant claimed that he "started playing arcade games and games on the TRS-80 in the early 80's." The teacher from case three identified that he received his first Nintendo when he was four

years old. He consistently reinforced the fact that he had been a lifelong gamer: “I am a huge gamer and I always have been.” Most participating teachers had a long history with gaming and strong passion toward games, believing in the value that games could bring to their lives.

The evidence can be found in various literature as well. Based on Heyse and Ohrnberger’s (2013) research, gamer pre-service teachers tended to experiment with and be the first to use new technologies compared with non-gamers. According to Gibson et al. (2007), gamer teachers noted that games could be an important or very important learning tool. Research also indicated that pre-service teachers’ previous gaming experience was positively correlated with their attitude towards using digital games in class (Hsu & Chiou, 2011). Teachers’ gaming experience and background affect their mindset towards games. The data in the cases and research literature argue that gamer teachers have a stronger passion on gaming and using digital games to support student learning than their non-gamer counterparts. They saw the value of digital games because they experienced by playing various games and understood the benefits of using games in class. Because of gamer teachers’ beliefs towards gaming, they were more confident and competent in using digital games and exploring various games to get to know and eventually select appropriate ones for students. In case one, during her interview, I asked Cynthia, “The reason you play those games is because you want to explore whether they would be appropriate for your students or you just want to try them out, or you just want to try them out for fun?” Cynthia replied, “I wanted to, I like puzzles, I like mysteries so

when I first heard of that game I was like, this sounds cool. And I played it myself for several years before I ever brought it into the classroom” She further explained:

Minecraft I specifically started playing because I was curious to see what the kids were so into. Then once I started playing it I enjoyed it on a personal level and kept playing it and then wanted to find ways I could bring it into the classroom.

My study found that gamer teachers opted for using digital games as their personal gaming experience had a positive impact on applying this teaching strategy in class. Participants who claimed themselves as gamers brought gaming into classroom and were willing to take their own time to explore and find games to support teaching and learning. My study found that a long history of gaming not only affected participating teachers’ comfortable level in using games but was also a factor to build their competency of designing games.

Digital Generation. All five participating teachers identified that one of the main factors influenced them to use digital games was because they believed they were speaking their students’ language by using games. Based on their understanding, they defined their students’ as a digital generation who tended to be visual learners. In case one, Cynthia commented, “[Students] are just very visual learners...They like videos. So I think that video is a really effective way of reaching them.” She further clarified that games were included within that category. Both teachers in case two said that this generation were visual learners and preferred instant feedback, so digital games could be a way to meet their learning needs and styles. This argument parallels with what researchers (Gilewicz, 2011; Prensky, 2005) have discussed.

According to Jukes et al. (2010), the current generation of students “prefer processing pictures, sounds, colour, and video before text” (p. 12). They use visual aids accompanied by text for clarification. Additionally, it has been widely discussed that the digital generation “has an impeccable attention span when engaged” (Gilewicz, 2011). For example, they could spend hours on playing digital games (Prensky, 2005). From the research cited, it evidenced some of the learning demands of this generation.

All five participating teachers confirmed that they took the current generation’s learning needs and styles into consideration when teaching. Because they believed their students were more visual learners, the teachers incorporated multimedia elements into their teaching and introduced digital games.

Impact of Games on Student Learning. The third factor that influenced teachers to use digital games was how games impact student learning. All participating teachers, school administrators and students indicated that digital games had an impact on students learning from different perspectives. During the interviews, all five participating teachers expressed their understanding on how digital games impact student learning in terms of 1) engagement, 2) motivation, 3) incidental learning, 4) allowing to make mistakes, 5) personalized learning, 6) instant feedback, and 7) collaborative learning.

First, all teachers identified that students became more engaged with digital games involved in learning. Students, especially male students, did not get distracted while gaming was involved in class. Students were also more interested in exploring topics introduced in class even after school if there was a gaming element embedded. Students

commented on how engaged they were when using digital games in class: “It’s kind of more fun and more engaging, I guess than other classes.” “In social [studies class], we engage. We do quests.” School administrators also found engagement was heightened when digital games were introduced in class. The school principal from case four stated: “It (a video game) is also engaging. It’s engaging for kids.” Teachers also reinforced the increase of engagement multiple times during their interviews.

Research has shown that engagement plays an important role within a DGBL environment (Inchamnan, 2016; Prensky, 2002). Levine and Vaala (2013) identified that formal education may not be able to engage many American youth who are “high media consumers” (p. 78), so maybe educators should consider offering “better designed, game-infused curricula” for students (p. 78).

The data from my research aligned with the research findings above. All three stakeholders (teachers, school administrators, and students) confirmed that engagement was an important factor to encourage teachers to use and design games and motivate students to learn in class.

Second, all five participating teachers indicated that a DGBL environment had the potential to motivate students to have a more positive learning experience. School principals from two cases echoed this belief as well. Because of the fun and engaging elements in games, students felt more motivated to look for solutions to problems. They did not consider the “playing” as “learning,” so they were more willing to take time to figure out the answers. One student from case one noted, “It’s just really motivating. I always check my ClassCraft when I’m home.” The school principal from case two stated,

“I think that [gaming] is definitely something that motivates students.” Sawyer from case four reinforced the importance of student motivation in class: “I think the benefits are the kids are generally motivated. They’re excited to be interacting in a game. The word game tricks them.”

Much of the research around gaming argued that digital games have the potential to create motivating experiences for learners (Deterding, 2011; Yee, 2006; Zhang, 2008). Game-based instruction could also induce students’ learning motivation because games transfer the learning process into an interesting learning environment (Chen, 2017; Liu et al., 2010). Researcher (Sancar-Tokmak, 2015) confirmed that digital games were a teaching technology, as the challenges embedded in the game enhanced students’ creativity, problem-solving skills, and achievement motivation.

The participating teachers, school administrators, and students had a high degree of consensus about how games motivated students in class. Their comments demonstrated why teachers used digital games. They were intrigued by students’ learning motivation when using games in teaching.

Third, four participating teachers in three cases noted that they found a game-based learning environment triggered incidental learning. This factor was strongly demonstrated in case one. The class teacher was amazed by how immersed students were in learning while playing games. She said, “I think that when the learning is accidental like that it sinks in deeper.” Cynthia believed that incidental learning simultaneously motivates deeper learning.

As noted in the literature, playing video games may facilitate incidental language acquisition (Mohsen, 2016). Mohsen's research (2016) found that the post-test scores of game playing students were significantly higher than those of game viewers. Kastoudi (2011) also noted that a quest-based digital game encouraged incidental vocabulary learning.

In my study, three cases were involved with math classes. Because math was considered a difficult subject due to the abstract concepts involved, participating teachers were interested in applying the gaming idea to their math classes. It was found that this gaming approach did not only engage and motivate students to learn math, but students were able to acquire knowledge despite not being aware that were learning. Teachers considered it as a bonus of using games in class.

Fourth, Cynthia and Sawyer from cases one and four respectively and students from case two reported that they found games allowed students to make mistakes without making them feel frustrated. One student from Sophia's class commented, "I think that with games you are not as stressed as when it's like a test and you're worried that you'll have questions wrong." Cynthia was also amazed by student enthusiasm while playing games. She found that students were willing to explore solutions despite repeatedly failing in the game. She noted,

[That] is every teacher's dream right? To have a student who's just willing to keep trying until they get it right, and how do we apply that with school...They already have that in game, so bring the game into the classroom and they'll be more willing to apply the same effort.

In case two, some students identified that games provided a less stressful environment for them to freely make mistakes. For example, one student mentioned, “I think that with games you are not as stressed as when it’s like a test and you’re worried that you’ll have questions wrong and that you’re not going to be able to do it again.” In a gaming environment, failing one level does not mean that you failed all. Players are given multiple chances to try differently next time.

Majgaard’s research (2014) found that a group of engineering students were motivated to test creative ideas as it was a “safe haven” (p. 276) to make mistakes without being judged. Also, Pope et al.’s book (2009) found that sport games have the potential to “teach and motivate players while allowing them to make mistakes and experiment” (p. 170); the game was referred as a “sandbox,” which again provided a safe environment, meaning that players still have the “sense of authenticity and accomplishment” (p. 170) when experiencing various risks and challenges.

The literature and the data from my study show that digital games provide a place for players to make mistakes without feeling they “failed.” Traditionally, students are not given multiple chances to make mistakes in a test or an assignment. When they failed one question once or twice, they tended to give up and think that they were not able to fix it. However, in a gaming environment, players are given chances to fail again and again without feeling judged nor stressed. Their mindset changed from “I can’t fix it” to “I can fix it” after trying different solutions (Maats & O’Brien, 2013). Also, the growth mindset (Dweck, 2006) advocated that mistakes are essential to learning and failure is an opportunity to learn, encouraging students to embrace their mistakes instead of avoiding

them. It was assumed that students were inclined to focus on what they did right rather than what they did wrong. In a digital game, students could view their mistakes as part of the journey towards success.

Fifth, in three cases, the theme of personalized learning emerged. In case one, it was observed that students were able to select tasks to meet their learning pace and interests while working on the same topic because the class teacher, Cynthia, designed the game with different routes. All students started with the same task and were then able to choose different options, leading them to different tasks. In case two, all stakeholders also commented on personalized learning. Two participating teachers reported that they could customize the learning tasks to be tailored to the curriculum. School leaders commented on the potential of games to meet students' individual learning needs. For example, the school principal, Noelle, said "It's a tool for teachers to be able to plan accordingly for each individual student. Not everybody in *Mathletics* is on the same program." In case four, both Jonathan and Sawyer emphasized the importance of personalized learning. They commented that all students should be able to interact with the learning activity and feel a certain level of success. Another perspective of personalized learning was that students were able to work at their own pace while playing games. Each class was unique in terms of the constitution of students, meaning there were different levels of abilities and disabilities. Students were able to learn at their own pace and meet their individual learning needs. Some researchers argued that learners should be given enough freedom to explore the game at their own pace (Federoff, 2002),

while others focused mainly on having students work at their own pace based on their individual readiness and learning needs (Wills, 1996).

Shifter (2013) described the first principle of incorporating games into personalized learning was “to connect the curriculum and the games to be used” (p. 158). Redding (2014) suggested introducing different role-play or online social games into class to enable different levels of personalized learning. Also, Scarlatos and Scarlatos (2008) found that active and personalized learning could be achieved through digital games. It was evident that gaming worked as a teaching tool to allow personalized learning in class.

My research found alignment with prior research on personalized learning in games. It was assumed that some of them were more visual learners, and some of them tended to learn by doing. Some students may have a different level of learning disabilities. First of all, incorporating curriculum outcomes into games allowed students to practice tailored learning activities in a gaming environment. The participating teachers used *Mathematics* and *Spellodrome* (See Appendix F) to foster students’ learning by embedding the curriculum outcomes in the game. Secondly, participating teachers either used self-designed games or educational games to ensure all students were able to enjoy and feel accomplished in the game. The design they selected was not linear but more complex; students had options to choose different routes and engage with different learning activities in the game.

Sixth, my research also found that digital games could provide instant feedback to students. Participating teachers and school administrators found this feature enhanced students’ learning. In case two, both Sophia and Mme MCC commented on how valuable

instant feedback was to students when playing games. For example, Sophia noted, “It’s instant feedback. That’s what I like it (*Mathletics*) too.” In case four, the curriculum lead was also impressed with this feature: “I think video games are or digital games work very well for learners because it gives them instant feedback and it also is able to adjust to the level of the child right away.” He believed it was an effective way to engage students and foster their learning.

The findings from my research coincide with the assertions from various literature on how digital games provide instant feedback to students. Instant feedback was crucial to students in “enabling them to learn continually until reaching a certain level of achievement” (p. 218), especially for more complex learning tasks (Wu et al., 2012). In Wu et al.’s research (2012), students were able to reflect upon the prompt feedback and make modifications accordingly instead of waiting for the evaluation results from the teacher. Researchers (Mendez & Gonzalez, 2011; Robertson & Howells, 2008) discussed that instant feedback (immediate rewards) was closely associated with motivating and engaging students with learning.

The data analysis and the research literature argued that instant feedback in digital games has a positive impact on student learning. Although instant feedback can be provided by other class activities, students tend to feel less stressed and be more willing to explore and try alternative solutions in a gaming environment. Because of instant feedback and immediate rewards, students are more motivated to make immediate modifications to achieve the goal or solve the puzzle. A test or an assignment normally

required an evaluation from teachers. During the time of waiting, students may lose the desire to seek a resolution and become disengaged.

Seventh, my research found that digital games could promote collaborative learning among students. Two out of four cases stated that students tended to collaborate with each other while playing games. In case two, both teachers and students discussed how games encouraged collaborative learning. Students found it fun to share with a partner compared with performing other learning activities alone. One participating teacher noted that she wanted students to “exchange ideas” in terms of how to solve problems, which helped “open a new way to do the activity.” In case four, students echoed the words from students in case two. They found the interaction with peers made the learning/playing more fun, a quality lacking in some of the other learning activities. Sawyer also encouraged students to work together or ask for help from each other when they were stuck in the game.

A few prior studies support the idea of digital games encouraging collaboration. Paraskeva et al.’s (2009) research stated that multiplayer educational games worked as a promising educational tool because they promoted collaboration among students. Other researchers (Boughzala et al., 2013) also found that games had the potential to be a valuable teaching tool because some games included a collaborative dimension which could motivate effective collaboration in a team.

Although not all the cases identified the collaboration inherent in using games, it was still considered significant as both students and teachers discussed this factor in cases two and four. It was obvious that students were impressive when engaging and

interacting with their peers. They enjoyed working with others and came up with different solutions. The process motivated knowledge building in a constructive and meaningful way.

In summary, there were three factors that influenced teachers in using games in class; these factors aligned with research in terms of gamer teachers tending to be passionate about gaming and being confident and competent with using this strategy in teaching, how teachers work on their teaching approaches to meet the digital generation's learning needs, and how games impact students' learning.

Factors Influencing Teachers in Designing Digital Games

The second research question focused on identifying key factors that influenced teachers in designing digital game-based learning environments. Based on findings, there are five factors that influence teachers' in the work of designing games for learning: not meeting curriculum objectives, customization, passion, programming skills, and gamification.

Not meeting curriculum objectives. Based on data analysis, all five participating teachers and school administrators emphasized the importance of alignment between curriculum objectives and games used or designed in class. They highlighted that meeting the curriculum objectives was key to applying any innovative teaching approaches. All participating teachers kept this guiding principle in mind while selecting games for students. They also found 1) it was very time-consuming to find appropriate games that align with curriculum outcomes especially for non-gamer teachers, and 2) the online or

educational games that could be used to teach curriculum-oriented objectives may not meet their students' learning needs.

In case one, the teacher, Cynthia stated that she designed a text-based adventure game for her students because she “would walk them through the same information in the social studies textbook but in a more interesting way.” It was assumed that she was not able to find other educational or online games that could cover the same learning outcomes for her social studies class. She also designed a quest-based game on 3D Game Lab for her social studies class which was associated to the class management gamification platform Classcraft. All the quests (learning tasks) were designed based on curriculum objectives. In case four, both Jonathan and Sawyer commented on why teacher-designed games were important in using gaming for students. Jonathan noted teachers had the pedagogy skills as well as the content knowledge to design games purposefully for their students considering some educational games were “chocolate covered broccoli” cases. Sawyer designed a card game to “help with the study of Sparta and Athens in the ancient Greece unit for grade six in order to “link students with the curriculum a creative way.” No other related games were associated to curriculum outcomes which became the incentive for Sawyer to design a game for his students.

The literature reviewed supported the theme that it was crucial to connect games used in class with curriculum learning outcomes. Popescu et al.'s research (2013) emphasized the importance and the trend of serious games curriculum integration. They used the Learning Management System (LMS) to integrate those two pieces together. It was noted “this connection would allow the integration of game outcomes with the other

curricular activities' outcomes and assignments" (p. 8). Other research may not specifically identify curriculum-oriented games used in class but in a broader way, for instant, some research referred curriculum-based technology (Harris et al., 2014; Jackson et al., 2009). For example, it was argued that the greatest weakness of some technology integration efforts was that they "have typically given short shrift to two key domains: content and pedagogy" (p. 395).

School administrators and curriculum leads argued that it would be meaningless if the curriculum outcomes were not integrated to the games used or designed in class. Educational games, online games, and commercial games may not be able to meet students' learning needs or teachers' teaching objectives, so teachers and school leaders suggested the possibility of teacher-designed games. Because it is assumed that teachers are naturally equipped with two primary knowledge forms, pedagogy and content (Koehler, 2012), the games designed by teachers could best meet students' learning needs and incorporate the curriculum outcomes at the same time if the teacher is also equipped with knowledge of technology. Both Cynthia and Sawyer had some programming background and rich knowledge in gaming and gamification platforms. They possessed all the knowledge forms: pedagogy, content, and knowledge (Koehler, 2012) to be the best game designers for their students.

Customization. It was discussed that although current commercial, educational, and online games are complex, multi-layered, and visually stimulating, they are not easily customized to support differentiated student learning. It is assumed that those games have been designed to meet a much broader audience than, for example, elementary

students or children under 12. Therefore, one of the primary motivations for teachers is how they can take the richness of GBL but design their own games that support the students in their classrooms at their levels of learning.

Customization was an important feature that teachers were looking for when using games in class. Not all the selected games allowed customization to meet students' learning needs. In case four, Sawyer looked for more digital badges to be embedded within the game but could not find anything that worked. The only option left was for him to design a game himself. With his passion, dedication, and solid technological knowledge, he designed the game - *Student Quest*. Sawyer spent the whole summer and purchased the add-on on WORDPRESS to design and develop the game. The result was positive and his students' academic achievement was improved and on the higher rank in the system due to the fact that they followed the school rules according to the *Student Quest* game.

Jenkins et al. (2003) argued that games used in classrooms needed to “develop customized modifications, curricular materials, instructional activities, and teacher-training programs to assist deployment in the schoolhouse” (p. 3). Niehaus and Riedl's (2009) research also discussed that customization was used to target learners' Zone of Proximal Development (ZPD) (Vygotsky, 1978) and allowed them to “practice underdeveloped skills and avoid the redundancy in areas” (p. 91) they have shown proficiency.

Passion. Passion of the teacher for digital games was evident in cases one, three, and four. Cynthia, Kameron, and Sawyer were all life-long gamers having played digital

games for more than 20 years. They also claimed that they were good at games and played various genres of games. These teachers themselves knew games and were able to select the games that aligned with the curriculum. When the teachers were not able to find curriculum aligned games for their students, they chose to design games by using less complicated programming platforms and were willing to take their time to work on the game's design. Cynthia designed a quest based and a text-based adventure game for her social studies class; Kameron designed his own digital games for his students to try in order to learn media; Sawyer designed *Student Quest* and a card game to teach the ancient Greek unit to his grade six students.

Because of their strong passion for games, each teacher had his/her own understanding of what accounted as a good game design. In case four, Sawyer designed the card game to teach ancient Greece unit because he wanted “to show them (students) how simple elements could make a complex game that used both chance and skills in an interesting way.” Sawyer believed a “good” game should have a balance of chance and skill. Finding this balance point on this continuum was the key of a successful game. He transferred his passion and theory into his teaching.

In Fullerton's book *Game Design Workshop* (2014), the author emphasized that passion was the most important trait to becoming a game designer. One game designer in his book stated,

I started by working on paper games design from an early age (I did my first paper game design when I was about 12 and actually had published work at the age of 14)...This was driven from a strong passion for games and a deep desire to

understand what made them tick. Through this passion, I eventually stumbled my way into the game industry.

Another testimonial from a game designer in the book said, “Passion is key! ...Those with the passion will go far” (Fullerton, 2014, Conclusion, para. 20). Overall, passion is one of the key factors that not only impacts but motivates or inspires teachers to design games for students.

Programming skills. Participating teachers from cases one, three, and four found that it had been challenging yet helpful to be equipped with basic programming skills. In case one, Cynthia stated she “would love to do more of digital game design but it’s very complicated if you don’t have a programming background.” She had been using free online platforms which did not require programming skills to design digital games for her students. She also commented that having more programming training opportunities (i.e., PD sessions) would be helpful for her to design games. In case three, Kameron took programming courses in college that allowed him to use these skills to design digital games for students. Lastly, Sawyer was the one with the strongest programming background; he started learning programming when he was eight years old due to his interest and passion in games.

In order to meet the game design market for students, teachers, and parents, more easy-to-use programming tools and platforms have been introduced and advertised to schools (Hayes & Games, 2008). For example, StarLogo TNG developed by the MIT Teacher Education Program (TEP) allows both students and teachers to build simulation games (Klopfer & Yoon, 2005). Scratch, also developed by MIT, has been used from

elementary schools to colleges to teach various subject areas including language arts, science, social studies, math, computer science, etc. (Scratch, 2017).

Although some of the games were designed for the elementary level in terms of complexity and aesthetics, they still required a certain level of programming skills to create. Because more user-friendly programs have been developed, teachers without strong programming skills are capable of designing games on their own. Even an introductory knowledge of programming could provoke teachers to take this further step compared with teachers who did not have programming skills at all.

Gamification. Four participating teachers in all cases established the idea of gamification to create an engaging and interactive learning environment. All of the teachers involved with gamifying their classes discussed the rationale of gamification was to make the text book material “more fun” and to “motivate” their students to learn. Cynthia in case one created “a text adventure game that would walk them through the same information in the social studies textbook but in a more interesting way.” Cynthia associated the game with Classcraft, a gamification platform, to gamify her class. The teacher from case two also used Classcraft for his class. Based on in-class observation, students received more points by completing various class activities. In case three, Mme MCC used Kahoot! to teach math and other subjects. She created a competitive learning environment that motivated students to solve various puzzles. In case four, Sawyer designed *Student Quest*, a digital badging platform, to gamify his class. All the school rules were quests in the game. By completing them, a digital badge was granted. Based on student interviews, students enjoyed these gamification ideas and were motivated to

achieve more points or badges by accomplishing quests in the games, such as learning activities in class, or school rules.

Gamification has been used in early childhood education, K-12 schooling, and higher education (Sanchez-Carmona et al., 2017; Ukala & Agabi, 2017; Sanchez et al., 2017), although it is considered as newly adopted in class. Some literature (Bicen & Kocakoyun, 2017; Sanchez et al., 2017) identified that Classcraft had been used as a gamification tool in class. Because Classcraft was not designed for a specific subject, it attracted teachers from different files and levels. Since Classcraft was launched, more than 575,000 accounts have been created. Additionally, “more than 1.1 million game events (using powers, losing HP, gaining XP, etc.) occur each month” (Sanchez et al., 2016, p. 502). Based on the feedback from participating teachers and students, this game provided an opportunity for students to be competitive with each other which motivated them to complete as many learning tasks as they could in order to get more points or badges.

This concept allowed students to experience learning as a fun, competitive, and interactive game. Although there were still points, badges, rewards embedded, students still enjoyed the learning journey as they did not consider it as learning. Students’ positive feedback and reaction to those ideas motivated teachers to gamify their classes. Because there are more user-friendly platforms for educators, participating teachers were able to design their own games. Since the programming skills which are needed to design a digital game independently are onerous, the gamification platforms or applications

provide an alternative for teachers to design the games that meet their teaching needs and students' learning requirements.

In summary, there were five factors influencing teachers in designing games. Those factors had a high degree of consensus within current literature on how to motivate teachers to design games themselves.

Conditions Developing Teachers Capacity to be Game Designers

My third research question focused on identifying the conditions that needed to develop teachers' capacity to be designers of digital games. From the data, three conditions were identified: participation of GBL conference, development of the network, and professional development to support their capacity development.

Participation in GBL conferences. In three cases, the participating teachers claimed that participating in GBL conferences would support them to use or design games. In case one, Cynthia attended the International Society for Technology in Education conference because "she thought it would be helpful for her teaching." During the conference, Cynthia connected with professionals who used or designed games on a higher level. In case two, Mary Lou took the initiative to provide information about conferences related to teacher's interests and encouraged teachers to attend. In case three, Kameron identified that he wanted to go to conferences to "learn to use digital games for education in a more meaningful way." He stated that he would like to take PD opportunities to keep up with gaming related resources. In case four, Sawyer not only attended but presented his research findings couple of times at GBL related conferences (i.e., Scratch Conference). One presentation was about using pre-made construction kits

to help kids create scientific simulations in Scratch. He also pointed out one scholar who is famous in gaming field provided “cool ideas” for him regarding using games in class. Overall, GBL related conference have been beneficial to support and guide teachers using or designing games.

According to Long’s research (2011), teachers tended to find what they had learned from professional conferences changed their implementation of the required curriculum and their teaching. Based on Long’s research (2011), most teachers participated in the conference because they wanted to learn more about the topics that they were passionate about and wanted to learn new methods for teaching students. It was also identified in other literature that high-quality teachers tended to take part in professional conferences (Stronge, 2007). A positive relationship existed between student achievement and how recently and often teachers attended these kind of development opportunities (Stronge, 2007).

Additionally, the connection between professionals and building networks with people who have a common passion encourages teachers to go one step further and feel more confident when using or designing games for students. Teachers needed support like that from school administrators to help with developing their capacity to be game designers, as the internal resources from either the school or district is limited.

Development of network. Participating teachers also looked to develop a professional network to support their gaming teaching approach. As previously mentioned, in case one, Cynthia had been connecting with her Twitter community, as did Sawyer from case four. Both commented that there were limited resources in school. The

only professional support for them was the gaming community on Twitter. Cynthia shared:

I have a pretty strong professional learning community on Twitter. Game-based learning is fairly new, there aren't a ton of people doing it, but I have like a pretty strong support network online of people who are also doing this stuff.

Sawyer discussed his outside support including both the Twitter and Scratch educator group: "I'd say my PLN my personal learning network through Twitter is probably the biggest place that I go for outside supports or ideas." When he wondered how to plan a lesson around a game or came up with a gaming idea he shared it with the group. For example, Sawyer said, "Suggestions of games. Suggestions of strategies. Looking at and talking about games and how they are being used in the class comparing them with mine." He also expressed his wish to this research as he "hopes this part of research gets right and distributed widely that it finds more teacher gamers."

Noble et al. (2016) wrote, "Twitter proved to be a transformative experience of professional growth that generated meaningful changes to teachers' instructional practice as well as how they thought about teaching and learning more broadly" (p. 187). Based on Carpenter and Krutka's research (2014), educators mainly used Twitter to share, collaborate, and network. Twitter has been used as a platform to connect and collaborate as opposed to a simply social media tool. On Twitter, teachers seek support that they may not be able to access in their own schools or school districts.

Studies show it is a relatively new approach for teachers to foster professional connection in social media (Carpenter & Krutka, 2014; Lord & Lomicka, 2014). However,

because of the reach of social media, teachers sharing the common passion of gaming as a teaching strategy can now connect with each other. Compared with participating in conferences and other forms of PD, Twitter provides more flexibility and feasibility for teachers to collaborate, share ideas, look for support, and ask for help. This networking could be another factor that motivates teachers who are already passionate about gaming to not only use but design games for their students.

Professional Development to Support Capacity Development. The last factor to answer the third research question is regarding the notion of ongoing and sustainable PD support to teachers. Three out of four cases identified the need and desire of having a PD support from their school administrators and district. Cynthia from case one stated that she would love to have PD on coding or programming; both teachers from case two, Mme MMC and Sophia, emphasized that they “needed more PD” on technology and gaming since they needed more resources or guidance on using games in class. In case three, the school principal, Peyton, discussed the potential benefit of having teachers using and designing digital games. He stated that teachers who were into innovative technology-supported teaching approaches, like gaming, could be a resource person in school because when teachers saw “kids are having fun and they’re learning,” they would want to have the same engagement within their class. Peyton also shared that he would expect the games that the teacher either used or designed were not for just one class or one semester. He hoped this teaching strategy could be used on an ongoing and sustainable basis which required ongoing and sustainable PDs to support teachers.

The ongoing and sustainable PD opportunities establish a culture of ongoing learning and a community of best practices for teachers (McLester, 2012). It was also identified that sustainable PD helped form healthy and constructive relationships among teachers since they could work together and learn from each other (Fox, 2007). PDs also encourage colleagues to build a learning community and open classroom helped cultivate ongoing PD among teachers (Breyfogle & Spotts, 2011). Therefore, PD experiences enable teachers who are experts in certain areas to provide mentorship to others who have a common interest but with limited related experience (Guskey, 2000). My research found that teachers who are passionate about designing digital games desired to have ongoing PD support from school to stay updated with gaming programs and gaming related resources and connect with peers.

In summary, there were three conditions that developed teachers' capacity to be game designers which agreed with prior research on supporting teacher through conference and PD opportunities as well as professional network building.

Factors Influencing the Transition from Game Users to Game Designers

My last research question focused on identifying the key factors that influenced the transition of teachers from being game users to game designers. The following three factors emerged from the findings: technological knowledge, pedagogical knowledge, and assessment knowledge. In my research, I used the TPACK framework not only as the theoretical foundation but also to analyze the data and answer my fourth research question.

Technological knowledge (TK). Participating teachers demonstrated a deep understanding of TK by either using or designing games in class. TK is knowledge about “certain ways of thinking about and working with technology can apply to all technology tools and resources” (Koehler & Mishra, 2009, p. 64). In cases one, three, and four, the teachers considered themselves as life-long gamers which meant they were well aware of the genres, level of engagement and interactivity, degree of difficulty, and connection with curriculum outcomes of the games they had used in class.

In Meletiou-Mavrotheris and Prodromou’s research (2016), their findings illustrated the use of TPACK as a framework to facilitate pre-service teachers’ professional growth by using games in class. The study identified the intervention based on the TPACK framework to help pre-service teachers familiarize themselves with a gaming environment, different kinds of educational games, encouraged “critical reflection” (p. 390) on use of games; it also motivated teachers to think of games beyond a drill-and-practice tool but more like an “exploratory tool for acquiring new knowledge and skills” (Meletiou-Mavrotheris & Prodromou, 2016, p. 390). More research is focused on implementing the TPACK framework, especially TK, to train pre-service teachers in using games in class (Franklin & Annetta, 2011; Hsu et al., 2017; Sardone & Devlin-Scherer, 2010; Shah & Foster, 2015). In Shah and Foster’s research (2015), the authors indicated that technological competencies played a crucial role for pre-service teachers to integrate games into classroom. The training enhanced their ability to facilitate complex games and recognize that the pedagogical facets of games strengthened their TK.

In my research study, all three gamer teachers (Cynthia, Kameron, and Sawyer) had solid TK: they were all passionate about gaming, mindful of gaming resources, and well familiar with different games. They spent their time exploring what games would fit into their class and students as well as closely connecting with curriculum objectives. Compared with the non-gamer teachers in case two, teachers who were equipped with stronger TK were more motivated or positively affected to become game designers. Their technological competencies (knowledge of games and gaming resources) helped with this transition.

Pedagogical knowledge (PK). Another factor that influenced teachers to become game designers is their PK which refers to “teachers’ deep knowledge about the processes and practices or methods of teaching and learning...This generic form of knowledge applies to understanding how students learn, general classroom management skills, lesson planning, and student assessment” (Koehler & Mishra, 2009, p. 63). By using or designing digital games in class, teachers needed to design learning activities around the game which was purposefully selected based on their students’ needs. This process required teachers understand not only what students need to learn but how they learn. Sawyer, the teacher from case four, stated, “[I]t’s a game that somebody else has made you have to plan around the game and around the content.” He used pedagogical skills to develop activities and assessments accordingly after he selected an appropriate game for students. When he designed *Student Quest*, he developed the quests to manage his classroom, which in turn encouraged the students to follow the school’s rules and improve their academic achievement. Students were assessed by rewarding the digital

badges and points. Sawyer used his PK to design and develop teaching and learning activities, assessment practices, and the game itself.

Research has shown that teachers played an important role in implementing game-based learning in class. Teachers needed support or training to help them effectively use this tool to foster students' learning (Gresalfi et al., 2011). In Shah and Foster's research (2015), a pedagogical framework, Game Network Analysis (GaNA) was used to assist teachers to introduce digital games in class. In the study, participants were required to play and analyze various games to strengthen their pedagogy capacity. By practicing this activity, participating teachers learned how to adopt a game into teaching by discussing their thoughts with other teachers.

Based on the above literature, in order to incorporate games into class, teachers are required to have robust PK to plan activities and assessments around the games they select. In a more advanced level, teachers not only plan the lesson around the games but also develop the games themselves to ensure the alignment of game design, learning and teaching activities, and assessment. Without strong PK, it would be challenging for teachers to integrate games in class, further hindering their transition into becoming game designers.

Assessment knowledge. The third factor that influenced the transition from game users to game designers was a teacher's ability and confidence to assess games in class. In all cases, it was found that teachers had strict guiding principles either developed by themselves or provided by school leaders to select appropriate games for students. However, the guiding principles were not always sufficient for teachers to select

appropriate games. Teachers needed all three components combined to be able to assess games. For instance, teachers from cases one, three, and four played various games themselves and decided what games would be used in class. They used their technological knowledge, pedagogical knowledge, and content knowledge (CK) to evaluate the in-class value of each game. They played the role as a gatekeeper to ensure the quality of each game used and designed in class.

When the existing games were not able to deliver the designated content, teachers chose to design their own games to fill the gap. In case two, the two participating teachers were non-gamers, and they found it challenging to find games that could be used in class since they depended on a school leader's guidance and school resources. The technological pedagogical content knowledge-games (TPACK-G) framework indicates that those teachers' game knowledge (GK) was fairly weak compared with gamer teachers who had strong GK to enable them to decide what existing games could be used and what to do if none of the existing games would work.

In Kenny and McDaniel's research (2011), they argued that teachers would not be able to make proper assessments regarding what games could be effectively used in class if they did not play games on a regular basis, meaning that they had fairly weak GK. GK affected teacher's confidence in using and eventually the capacity of designing games. In the same research, it was indicated that although GK played an important role for teachers to integrate games in class, it was not the only factor to motivate teachers. Teachers needed to discover the relevance of specific games to the content area as well as

learn how to plan the lesson around the game (Kenny & McDaniel, 2011). The TPACK-G is crucial for teachers to make the transition from a game user to a game designer.

In summary, there were three key factors that influenced teachers' transition from game users to game designers. These factors are parallel to what the literature spoke of how the TPACK frame assists with building a teacher's capacity to use and design games in class.

Summary

This chapter presented the findings of my research in relation to existing literature. Much of what was found in my study aligns with previous research. Research studies have discussed the relationship between gaming or game-based learning with the emerging themes instead of specifically teacher designed games. In my study, passion plays an important role in motivating teachers to not only use games but design games. Additionally, due to the wide use of social media, Twitter becomes an important means for teachers to grow professionally and make connections with others who have common interests. Lastly, it was indicated that TPACK has been used as a framework to train pre-service teachers in introducing digital games in class.

The final chapter provides an overview of this research, what worked well and what were some challenges in conducting the research, implications and recommendations for future research.

CHAPTER TEN: CONCLUSION AND RECOMMENDATIONS

This chapter consists of three sections. To begin, I describe my contribution to the research. I also address what worked well and what were some of the challenges of the study. In the second section, I identify three key areas in terms of implications for practice related to teachers as game designers. In the third section, I provide recommendations for future research. The chapter ends with concluding remarks.

This instrumental multi-case study investigated internal and external factors and supports that build teachers' capacity of game use and game design and inspire them to move from being game users to game designers.

The five participants (teachers) involved with this study provided their perspectives and insights regarding how and why they used and/or designed digital games in class and what factors and influences shifted them from game users to game designers. Findings from the study revealed how the internal and external factors motivated teachers from using to designing games for students.

Contributions to the Research

There is extensive research literature in terms of student-designed games and how DGBL impacts a student's learning in class. However, there are few studies focusing on teacher's perspective. The uniqueness of my research is to investigate teachers' use of games in their teaching as well as the shift into designing games for their classrooms. What are the factors and conditions that build teacher's capacities as game users and designers? The internal factors were a passion towards gaming and their faith and belief in the values of games. External factors included the deficit of current online, educational,

and commercial games as well as the attributes of our digital generation and the positive impact on student learning.

Second, what is involved in the shift for teachers to become game designers? For teachers to move from game users to game designers, they need to be in educational environments that support their innovativeness and to be risk takers in designing games. They also need to have both technological and pedagogical knowledge and confidence to be able to design a game-based learning environment that fosters students' learning. Additionally, they need to have knowledge skills and ability to assess the quality of their gaming environment that indeed has an impact on and supports student learning as well as meets the learning outcomes.

Success and Challenges of the Study

In this section, the successes and challenges of the study will be discussed. In terms of successes, participating teachers' passion towards gaming enabled the research to occur. I took almost six months to find all the participants. However, once they were contacted, most of them strongly supported the study and were willing to participate. One teacher said, "I am absolutely in support of anyone wanting to put more research into this type of thing (gaming) and would be happy to help in any way." They met with me and shared their experiences on using games in class. Another teacher offered me to observe two classes, so I could compare the differences while using the same game to teach math.

Another success was that I decided to collect data from different stakeholders. I am an advocate for using games to enhance students' learning, but I needed to hear the

voices of students and school administrators to support this assumption. By collecting data from teachers, students, school administrators, and curriculum leads, I was able to get a holistic picture regarding how and how well the games worked. Student feedback and reflection provided evidence from other perspectives, so I would not be biased.

There were also challenges while conducting the research. First, it was challenging and time-consuming to find participants. The original plan was to recruit participants from students who took a graduate level course, Digital Game-Based Learning. As a result, only a couple of students showed interest and not all of them used games for teaching. Ultimately, only one student was able to be part of the study. The other potential reason was that some students do not use their university email after graduating, and there was no other way to track them. I approached colleagues who were either teachers or administrators in K-12 school or school boards to find more participants. The additional four participating teachers were found through this strategy.

My second challenge was the inability to control the sequence of interviews with stakeholders. In case three, I managed to have an interview with both the teacher and school principal. Usually, the interviews were conducted with the teacher, principal, or the curriculum lead individually. It would be helpful with the validity of data if a focus group interview with both teachers and school principals/curriculum lead clarified some statements because it was found teachers and school administrators may have had conflicting opinions regarding some matters.

Implications for Practice

From the four case studies used in this research, the implications for practice in relation to motivating and encouraging teachers to use or design games can be addressed at three levels: 1) implications for teachers, 2) school administrators, 3) professional developers, and 4) game designers.

Implications for teachers. Not all the teachers appreciate the value of DGBL due to lack of time and resources, reluctance of trying innovative ideas, or not being able to find curriculum aligned games. In order to design and facilitate DGBL in classrooms, teachers need to be willing to develop both technical and pedagogical knowledge and skills. The prerequisite of this teaching initiative is that teachers need to see the value of DGBL and this research provided a potential solution to the above challenges and revealed the values of DGBL. Additionally, this research showcased some exemplars for future pre-service and in-service teachers regarding the possibilities and opportunities of designing a game in class. Although teacher-designed games may seem low tech or not complex enough compared with commercial games, the features of aligning with curriculum and meeting students' particular learning needs while providing engagement and interactivity in class are cutting-edge strategies that can be adopted by various educational scenarios.

Implications for school administrators. Openness to DGBL is needed for teachers to use and design games in class. Providing support and opportunities is needed to allow teachers to be risk-takers to trail, innovative, and explore in pedagogically sound ways. School administrators could use these findings to explore what resources (i.e., staff,

PD, and funding) are needed to support teachers' innovativeness and to see the values of what digital games could do within the classroom. For instance, school administrators could provide resources and support, such as partnerships between teachers who have expertise in certain areas, PD opportunities, and funding to go to professional conferences, based on what teachers need to build their teaching capacity regarding gaming or other innovative teaching adoptions.

Implications for professional developers (in-service or pre-service). Both in-service and pre-service professional developers could use these findings to provide ongoing and sustainable PD support for school teachers regarding community practices, mentorships, and networking. These opportunities could engage teachers to discuss their needs and requirements to develop their teaching capacity. For pre-service teachers, professional developers could develop a series of courses regarding DGBL considering some of the teachers may have been gamers themselves. Those courses would prepare those teachers to use games in a pedagogically sound way.

One of the assumptions regarding game design was that teachers might need strong programming skills to become creators of games for student learning. According to my research, for example, in case one and two, the three participating teachers did not have programming skills, but they still managed to not only use but also design games for their students by using gamification platforms and programs. To help with this item, in teacher education programs, there may be an opportunity in a few courses containing components of game design by introducing user-friendly game design platforms or programs to develop their programming skills. For in-service teachers who are interested

in using or designing games, on-going and sustainable PD support would be helpful. PD sessions facilitated by experienced teachers who use or design games for students on a regular basis not only in one school but also in school district would provide an opportunity for other teachers to learn from each other, to share experiences and questions, and to ask for resources and support.

Another perspective regarding PD opportunities is to support teachers' game design capacity. Depending on in-service or pre-service teachers' various gaming background and experiences, the professional learning could be designed with different phases. First, teachers could be given opportunities to play various games. The more they play, the more teachers would know what themes or genres of games could attract students. Second, after teachers experience games through gameplay, the next step would be to guide them analyze games and generate principles of good game design. More importantly, this phase could give them opportunity to understand what game characteristics could create effective learning and why. Last, by introducing gamification and game design platforms and programs, participating teachers are encouraged to design the games for their students. In addition, it would be helpful in professional learning sessions to provide spaces for teachers to share and discuss gaming ideas so they can learn with each other.

Implication for game designers. One of the rationales of initiating my research was the gap identified from the literature regarding current digital educational games may not be able to address educational demands when used in class. My research provided insights for in-service teachers in terms of what should be included in a game

design and what is as important as fun and engagement in an educational game. My research could bridge the gap between educators and game designers by offering what is needed to make educational games meaningful and authentic for students and other targeted groups.

Recommendations for Future Research

The findings from this research identified both internal and external factors that motivate teachers to use and/or design digital games in class as well as making the transition for teachers from using digital games to designing them. These findings have also uncovered more areas worthy of investigation. Further research is recommended to explore the following areas:

The nature and extension of professional development for teachers who want to be designers of DGBL classrooms. Professional development is an important factor that supports teachers to learn new teaching strategies, gain and expand their knowledge, and develop more advanced teaching skills. I am recommending that design-based qualitative research is conducted with teachers who are interested in becoming game designers to develop digital games by attending a series of ongoing PD sessions facilitated by gaming experts and teachers who have experiences in digital game design. All iterations of PD sessions will be analyzed to guide the modification of session design. Potential research questions could include:

- 1) How do the game design professional development sessions build teachers capacity as well as confidence as game designers?

- 2) To what extent do the professional development sessions influence teacher's game design in class?
- 3) What are the most influential changes made to teacher's DGBL environment application in class?

Data sources could include pre- and post-interviews and surveys with participating teachers, observation, and artifacts. The pre- and post-interviews and surveys can be analyzed to compare how teachers' confidence level has changed after attending the game design PD sessions and what changes participants will make in applying DGBL to their classroom. These observations can be used to look at what questions they may have in terms of game use and design and why they have had those questions. Lastly, the artifacts they developed at the end of the session can be assessed to see what gaming related capacity they have built during the PD sessions.

Impact on students' academic achievement. My research was focused on teachers' perspectives on using or designing digital games to support student learning. The games that were used or designed in class aimed at creating an engaging and interactive learning environment and foster student learning. Therefore, a recommended study is to conduct mixed method case-study research to examine the impact on student learning through games created by teachers. The potential research questions could include:

- 1) To what extent do the games designed by teachers' impact student knowledge skills and attitudes aligned with the curriculum?
- 2) How does the gaming experience influence student academic achievements?

- 3) How does the gaming experience influence student attitude on learning?
- 4) How does the gaming experience influence student learning efficiency?

Data could be collected through in-class observations, student focus group interviews, students' tests results, and game artifacts. The data resources would provide a holistic picture from different perspectives to answer the research questions. In-class observations are used to witness students' reactions and attitudes towards games used in class. They can also be used to assess a student's learning efficiency. Focus group interviews are conducted to find out, from students' perspective, how games influence student learning. Students' final test results can be used to see whether gaming experience had a positive correlation with academic achievements by comparing grades with last year's students. Lastly, the gaming artifacts can be used to examine what curriculum objectives were covered and what learning skills were targeted.

Conclusion

Digital games have been widely used in more educational settings. Given the fact of growing digital generation population in current and future teaching candidates and students, digital games seem to become one of the necessary teaching tools and strategies in class. My research contributed to the literature on both DGBL as well as teacher education in K-2 context by identifying how to build a teacher's capacity in terms of using and designing games that foster student learning.

The challenges and opportunities described in the findings outlined the support that teachers needed to encourage and motivate them to be risk-takers who were not afraid of making mistakes and failing by trying innovative and unique teaching strategies.

Teachers who were passionate about gaming and understood the value of games were willing to spend the time and energy to look for games or design games themselves to meet their students' learning needs and the curriculum learning outcomes. Because existing educational and online games may not be able to meet the above criteria, teachers who know their students' learning needs, understand what the curriculum requires, and have the skills and capacity to design games can fill the gap. This group of teachers has the potential to provide a solution for classes who need engaging elements that enhance student learning.

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LIST OF APPENDICES

Appendix A: Interview Questions with Teachers

1. What was your experience on gaming before you use and/or design digital games in class?
2. When you were a student, had any of your teachers used or designed games in class? If so, can you give me an example?
3. What made you want to use and/or design games in class?
4. Is it possible for you to summary what are the key factors that influence you in using and/or design digital game-based learning environments? Why are these important to help you use digital games in class?
5. What are the outside supports you get when you use digital game-based learning environments? Do you thinking they are important? If so, why?
6. What kind of games do you use in class? For example, online games, commercial-off-the-shell games, or educational games.
7. What are the particular benefits/challenges when you use and/or digital games in class?
8. What is the budget you have to use or purchase digital games in class?
9. Do you still plan to use and/or design digital games for your students in the future? Why or why not. Is there anything you want to work on or you need to make the game use and/or game design process easier? If so, could you explain in details?

Follow up questions re class observation:

1. What is the purpose of using ...
2. What are they skills you expect your students to achieve through those games?

Appendix B: Interview Questions with School Administrators/Curriculum Leads

1. What do you think of teachers using and/or designing digital games in class? Please explain your thoughts in details. They are using mathletics, what do you think about it?
2. What kind of guideline you and your teachers apply in term of using game/designing games in class?
3. As a school administrator, how do you support the use/design of games in learning?
4. What do you see a role of designing digital games in students' learning?
5. What if you have 2-3 teachers who are interested in digital game-based learning, what kind of guidance you would provide?
6. Can you give me an example of a decision making process among school administrators if the game had certain degree of, for example, violence, or some inappropriate content, but it is really related to curriculum outcomes.
7. Has (teacher's name) asked for your help in terms of game use and/or game design in class? If so, in what way have you helped him or her? Can you give me an example of how you and the class teacher work together to use or design digital games for his/her students?
8. What are the particular benefits/challenges when you work with the class teacher in terms of game use and/or game design?

Appendix C: Interview Questions with Students

1. What were the digital games your teacher use in class?
2. What are the differences between game-using classes and non game-using class?
3. Do you play any digital games after class to help you learn any in-class knowledge points? If so, what were they? How did they help you with learning?
4. Have you provided any feedback in terms of game-using and/or game-designing to your teachers? Can you give me one example?
5. What are the particular benefits/challenges when you use digital-games to complete your in-class or after-class assignments or activities?

Some follow up questions in terms of in-class observation.

1. How did you decide to play xxx and go with project xxx?
2. What kind of feedback have your given to your teacher? If not, what would you provide?
3. Do you think playing xxx would help you achieve the learning outcome? How?

Appendix D: Observation Field Notes

Observational Field notes

Setting:

Drawing of the classroom setting:

Observer:

Time:

Length of observation:

Description of Object	Reflective Notes
	What kinds of games do teachers use and/or design in class and what is the rationale for using these in teaching and learning? The rationale of having the first question is to ensure obtaining holistic data on teacher-used or teacher-designed digital games (e.g., type, genre, platform, purpose, etc.).
	How do participating teachers use games to facilitate student learning? This question will help the researcher to understand how teachers align the embedded activities in games to curriculum content and learning objectives?

	How do students engage with the games (e.g., nature of the discussion, level of integration, and level of participation)? Based on students' reaction to either teacher-used games or teacher-designed games, the researcher could investigate and compare, to what extent, students get engaged with the games.
	How do teachers achieve instructional objectives through game play?
	What types of knowledge and/or skills do students gain from the game experience?

Appendix E: Online Survey

Draft Survey: Understanding the Transition of Teachers from Game Users to Game Designers

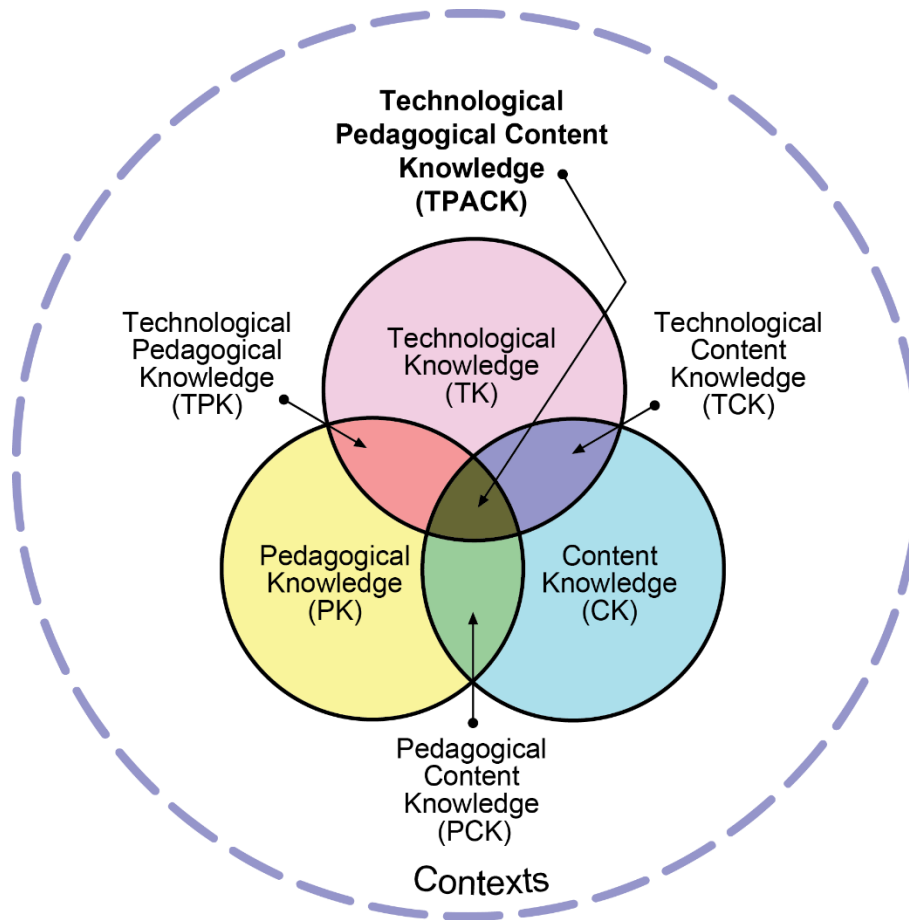
1. Age:
2. Gender:
3. Years of teaching:
4. Currently which grade are you teaching:
5. Currently which subject are you teaching:
6. Years of playing digital games:
7. Please name a few digital games you played:
8. Have you taken any digital game-based learning courses or workshops:
9. If yes, please list the duration of the courses/workshops and when did you take it:
10. Have you used digital games for teaching: Yes _____ No _____
11. If yes, please name a few:
12. Have you designed games for teaching: Yes _____ No _____
- _____
13. If yes, please briefly introduce one (e.g. which subject/topic, target audience, why designed the game)
14. If you would like to continue participating my research, please leave your contact information:
Email:
Phone number:

Thank you so much for your participation!

Appendix F: Game/Platform Description

Game/Platform	Description
3D GameLab (Rezzly)	3D GameLab (currently it is called Rezzly) is a gamification platform where educators can design quests and digital badges to create customized learning experience for students.
Algebra Memory	A paper-based game that Cynthia developed herself
ClassCraft	Classcraft is a role-play gamification platform designed for class to increase motivation, engagement as well as encourage positive behavior (Classcraft, 2018).
Kahoot!	It is a free platform that converts quizzes into game-like activities.
Mangahigh	It is a gamify platform particularly aiming at primary and secondary math subjects. Teachers can review assignment results in real-time and track student's progress (Mangahigh, 2018).
Mathletics	It is an online math learning space embedded with curriculum outcomes from provinces across Canada.
Minecraft	It is a sandbox game about placing blocks and going through different adventures. Educators have been using the games to teach various subjects, including history, math, science, music, geography, etc. as well as address different skills, for example, reading, writing, problem-solving, and coding.
Prodigy	Prodigy is a platform that provides over 900 curriculum aligned math games (online games) for students from grade one to grade eight.
Professor Layton and the Curious village	It is a puzzle adventure video game on Nintendo DS. This game includes both math and English Language Arts focused activities.
Rush Hour	It is a card game that teaches both math and logic.
Spellodrome	It is an online game providing individual learning pathway to students to enhance their literacy skills.

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