

TEACHERS' EXPERIENCE, ATTITUDES, SELF-EFFICACY AND PERCEIVED
BARRIERS TO THE USE OF DIGITAL GAME-BASED LEARNING:
A SURVEY STUDY THROUGH THE LENS OF A TYPOLOGY OF EDUCATIONAL
DIGITAL GAMES

By

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ABSTRACT

TEACHERS' EXPERIENCE, ATTITUDES, SELF-EFFICACY AND PERCEIVED BARRIERS TO THE USE OF DIGITAL GAME-BASED LEARNING: A SURVEY STUDY THROUGH THE LENS OF A TYPOLOGY OF EDUCATIONAL DIGITAL GAMES

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In this study 116 pre-service, internship year, and in-service teachers in a large Midwestern university in the USA responded to a survey asking about their current experience, attitudes, self-efficacy, and perceived challenges and barriers to the implementation of digital game-based learning (DGBL) in the classroom. The 33-item survey instrument distinguished four genres of educational digital games: Edutainment games and educational applications, serious games, simulation and multiplayer online games, and educational game design tools. And the design of these four genres of games was associated with four contemporary learning theories/teaching philosophies, behaviorism, cognitive constructivism, social constructivism, and constructionism. Findings show that a majority of teachers were light game players whose gaming activities were mobile-centric. These teachers were overall affirmative about the likelihood of integrating games for instruction and they favored the use of Edutainment games and educational applications based on pre-existing familiarity, comfortableness and ease of use. Findings also showed that there is a mismatch between teachers' teaching philosophy and their preferred game genre for instruction. Confirmatory factor analysis was conducted to extrapolate a set of five barriers that impede with teachers' use of games. The five barriers were mismatch between DGBL and standardized curriculum, administrative and parental negative perceptions, lack of technology support and preparation in teacher preparation and professional support, short class periods, and low quality of educational digital games.

A typology is proposed as an analytic framework for studying teachers' fundamental understanding of educational digital games and for guiding teachers to utilize informed pedagogical practices incorporating DGBL in the classroom. Future research on using games for education needs to investigate how teachers' philosophy of teaching could potentially impact their choices of games and affect effective implementation of DGBL.

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CHAPTER 1

INTRODUCTION

“Almost all creativity involves purposeful play.”

~ Abraham Maslow

The purpose of using technology in education should focus on meeting students where they are in their development; therefore digital games might be a place to start. The Pew Internet and American Life Project (2008) interviewed 1,102 parent-teen pairs and found that 97% of these children from 12 to 17 years old reported playing digital games every week and that about half of them played digital games every day. The Horizon Report reported that “gaming culture has been growing to include a substantial sector of the world’s population with the average age of gamers lowering each passing year” (Johnson, Adams, Cummins, Estrada, Freeman, & Ludgate, 2013, p. 20). The Entertainment Software Association found that the age demographic of gamers in the United States to be people aged before 18 and 18 - 35 representing more than 60% of all gamers (Entertainment Software Association, 2012). The average gamer is 35 years old and the average age of a video game purchaser is 38 (Entertainment Consumers Association, 2015).

Results of national surveys indicated that children in America play video games over seven hours per week and are inclined to multi-task more than any prior generations (Rideout, Foehr, & Roberts, 2010). In research, scholars contended that contemporary digital games and multi-media are changing how students approach the task of learning in that the influx of multi-modal information affluent on the Internet and rich opportunity for communication and collaboration in social media platforms are revamping the width and depth of resources students

can literally access with ease. A mismatch between how students are attuned to learn and how teachers tend to teach in the classroom nowadays hence engenders. Most teachers usually do not have a working knowledge base of games and do not understand the pedagogical possibilities of educational digital games (Futurelab, 2005). Without pre-existing background in games, understandably teachers are inclined to feel uncertain about what using digital games for teaching in the classroom entails.

These studies show that a growing body of adolescent and young adult students entering K-12 and higher education systems are likely have had prior experience or current engagement in digital gaming. Given the recent advancements in technology and the increasingly ubiquitous nature of digital mobile devices (e.g., smartphones and tablet computers), these gaming students might be concurrently fluent technology-users who anticipate teaching styles and content delivery that meet their learning preferences at school. In other words, it is not only the students who are playing digital games. Considering age range and the ESA statistics mentioned earlier, similar habits of gaming can be found in beginning or pre-service teachers. It is safe to assume that a substantial proportion of our teacher population could already have personally had experience playing digital games, have experience seeing digital games being used in formal or informal settings to facilitate teaching, or have thought about the possibility of using digital games themselves to further educational goals in a classroom.

The Horizon Report stated that the time-to-adoption horizon for digital games is estimated to be two to three years from now. According to Johnson et al. (2013), “game play has traversed the realm of recreation and has infiltrated the worlds of commerce, productivity, and education, proving to be a useful training and motivation tool” (p. 21). Coupling the enormous growth of the gaming industry, research initiatives (e.g., Serious Games Initiative, Games for

Change), research conventions (e.g., Game Developers Conference, Serious Games Summit, Meaningful Play, Games Learning and Society), and game-based learning schools such as Quest to Learn have added a strong and continued push to integrate new media technologies including digital games to facilitate learning at different educational levels. That said, Johnson et al.'s (2013) time-to-adoption proposition would likely hold true based on observations of the developing trend in the rising sector of digital game-based learning (DGBL) and game research.

This trend poses questions for practicing teachers and teacher educators. First, in two to three years will our teachers be ready to teach while incorporating digital games, and second are teacher educators taking note of the educational potential of digital games and preparing our future teachers to teach using digital games?

Rationale of Study

One goal for teacher education is to prepare pre-service teachers to integrate or repurpose existing or new media and technologies into tools for delivering educational contents (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, O. & Sendurur P., 2012; Gronseth, Brush, Ottenbreit-Leftwich, Strycker, Abaci, Easterling & van Leusen, 2010; Ottenbreit-Leftwich, Glazewski & Newby, 2010a; Ottenbreit-Leftwich, Glazewski & Newby, 2010b; Tondeur, van Braak, Sang, Voogt, Fisser & Ottenbreit-Leftwich, 2012; Williams, Foulger & Wetzal, 2009). The International Society for Technology in Education (ISTE)'s standards require teachers to be able to design and develop digital age learning experience and assessments. In congruence with ISTE standards, Michigan Educational Technology Standards also require teachers to teach in a way to help students develop proficiency and productivity in using technology. To achieve these goals, technology training in teacher education programs may include exposure to educational tools or platforms such as *Smartboard*, course management

systems, digital portfolios, classroom website design and social media such as Twitter and Facebook (Hayes & Ohnberger, 2013).

A relatively less explored area lies in training pre-service teachers to use digital games for teaching and learning. DGBL is a teaching strategy/approach that involves applications of digital games that entail defined learning outcomes, and is a developing trend in e-learning (Prensky, 2001). There are two rationales supporting the use of DGBL. First, the thinking patterns of learners today have changed considering that they are native speakers and users of the languages of digital multi-media. Second, young people are experiencing innovative forms of computer and video game play and the continuing experience and exposure to these new forms of entertainment has an impact on their perceptions, cognitive abilities, and preference for learning (Prensky, 2001; Susi, Johannesson, & Backlund, 2007). Ultimately, DGBL is about leveraging the mechanisms and effects of digital games to engage users for learning.

Accompanying the aforementioned rising trend in using digital games for educational purposes, we have observed a surge of interest in the field of game research from stakeholders representing a variety of disciplines. Digital games present a venue through which students can feel engaged in processes of interactive and immersive learning (Barab, Gresalfi & Arici, 2009; Franklin & Annetta, 2011; Gee, 2007; Prensky, 2006; Squire, 2011).

Nevertheless, to date research investigating pre-service and in-service teacher attitudes towards using digital games in the classroom (Hayes & Ohnberger, 2013; Hsu & Chiou, 2011, Millstone, 2012) showed that despite teachers' interest, teacher preparation has not done much to prepare teachers in using digital games in formal learning contexts. A recent national survey reported by the Joan Ganz Cooney Center showed that a little more than half of 505 K-12 teachers sampled nationwide reported using digital games in the classroom (Millstone, 2012).

Responding to sources for ongoing learning related to digital games, 66% reported learning from other teachers within their school district, 50% indicated that they were self-taught, while 42% reported learning from seminars, conferences, and conventions. Among other findings, Millstone found that 18% of digital game using teachers use digital games every day, with K-5 teachers reported higher usage (57%) than middle school teachers (38%), partially due to the fact that middle school teachers have a more stringent standard curriculum to adhere to in order to prepare students for standardized testing. The majority of these in-service teachers reported first learning about DGBL from professional development (46%) followed by self-directed study (35%). Only 12% of these teachers indicated prior learning about DGBL in their respective teacher preparation. Overall the findings pinpointed to a lack of preparation on using digital games during teacher education and induction.

Purpose of Study

This study seeks to build upon findings from previous research in teachers' attitudes toward using digital games and extend the scope by examining potential relationships among factors such as teachers' gaming experiences, attitudes, self-efficacy, and perceived challenges and barriers which might facilitate or impede with teachers' adoption of DGBL. This study also attempts to articulate a conceptual framework that outlines considerations generated from both internal and external contextual factors related to the adoption and integration of digital games in schools. Taking into account the historical development in the design of educational digital games and the accompanying paradigm shift of learning theories over the last few decades, a typology of educational digital games is created to help teachers understand the importance of matching choice of game genre with appropriate pedagogical practices.

The significance of this study is three-fold. First, this study replicates findings regarding pre-service teachers' attitudes toward using digital games for teaching while examining generalizability of prior research findings across population by simultaneously investigating intern and in-service teachers. Second, this study fills the paucity in the literature in studying the use and inculcation of DGBL in teacher education programs (Franklin & Annetta, 2011). Third, this study seeks to validate and refine the researcher-developed survey instrument to predict factors potentially impacting teachers' inclination and choice of game genre when implementing DGBL.

In chapter 2, a brief overview of the historical development of educational digital games and concurrent trend in game research will be presented first. Second, a case would be made to illuminate the connections between the evolving design of educational digital games and the paradigm shift of contemporary learning theories. Consequently, a typology of educational digital games would be introduced to help teachers understand the importance of matching instructional strategies with chosen games. Third, extant research on pre-service and in-service teachers' gaming practices and attitudes toward using new technologies (including digital games) for teaching will be discussed to undergird the need for understanding and leveraging their pre-existing experiences of using technologies and games to meet varying personal and educational goals. The fourth section will be devoted to the development of a conceptual framework that encompasses the theoretical and pedagogical underpinnings of the TPACK framework (Koehler & Mishra, 2005; Mishra & Koehler, 2006) and the heart of serious game design (Winn & Heeter, 2007). My aim is to articulate a comprehensive framework for teachers to reference when approaching the implementation of DGBL in classroom teaching.

Chapter 3 will discuss instrumentation of the attitudinal survey which includes probes into teachers' current gaming experience and orientations, attitudes, self-efficacy, and perceived challenges and barriers to the integration of DGBL. In chapter 4, the research design (Creswell, Clark & Hanson, 2003; Campbell, Gregory, Pattern & Bybee, 2012; Teddlie & Tashakkori, 2011) used in this mixed method study will be discussed. Results and findings will be presented in chapter 5 and chapter 6 will lay out responses to research questions and shed light on directions for future research.

CHAPTER 2

REVIEW OF LITERATURE

Historical Development of Educational Digital Games

It is important to operationalize a definition of *educational digital games* and this definition would be used consistently throughout this study. In brief, educational digital games are referred to as electronic games (as opposed to traditional analog, card games, board games, and physical games) designed not only to provide entertainment but also with the primary purpose to promote learning and education using interactive and multimodal technologies.

In addition, participation in digital game play implies one or more players can engage in play simultaneously while being exposed to essential game elements such as game goal, rules, assets, game space, play mechanics, and scoring system.

Games and Squire (2011) aptly depicted the historical development of educational digital games in a review that documented the developing trends in the early days of edutainment games, instances of successful repurposing of commercial games for learning, and more recently the rise of serious games. Through reviewing research that discussed the development of digital games for education (Egenfeldt-Nielsen, 2005; Flynn, Bacon, & Dastbaz, 2010; Games & Squire, 2011), I summarized four main strands of educational game genres with which teachers can consider integrating into instruction.

1. *Edutainment Games and Educational Applications for Mobile Devices*: Edutainment games are computer or video games created to achieve the purpose of education through entertainment. The primary target group for edutainment games are mainly preschool and young children, with emphasis on areas of mathematics, reading, and science.

Edutainment games were popular during the 1990s along with the growing market in multi-media personal computers (Michael & Chen, 2006). Nonetheless, the wave of edutainment software and games was not successful in formal learning settings and in business because a majority of these games were created with incomparable quality to commercially produced counterparts and the surge of interest in the Internet (Michael & Chen, 2006; Squire & Jenkin, 2003; Zyda, 2005). Consequently, edutainment games became associated with games that were boring and offered not much more than repetitious “skill-and-drill” practices (van Eck, 2006). Examples of edutainment computer games are *Math Blaster*, *Reader Rabbits*, *Oregon Trail*, and *Where in the World is Carmen Sandiego*.

With the recent technological advancements in mobile technology in the late 2000s, a new wave of short-form and edutainment-like games have found a new home among smartphone and tablet computer users. These games are educational applications designed to run on mobile technologies often with low hurdles in game play knowledge or skills to attract light game players or young children with limited experience in playing complex digital games. By the same token, educational applications for mobile devices tend to be small in scope and follow the theory of learning edutainment games endorsed, providing players an abundance of repetitious practice to help players learn how to play while accessing the embedded contents via rote learning. *Brain Coach*, *Dinosource*, *Spell Pop*, *Monster Physics*, and *Motion Math Zoom* (see Figure 1) are instances of recent popular educational applications running on mobile devices.

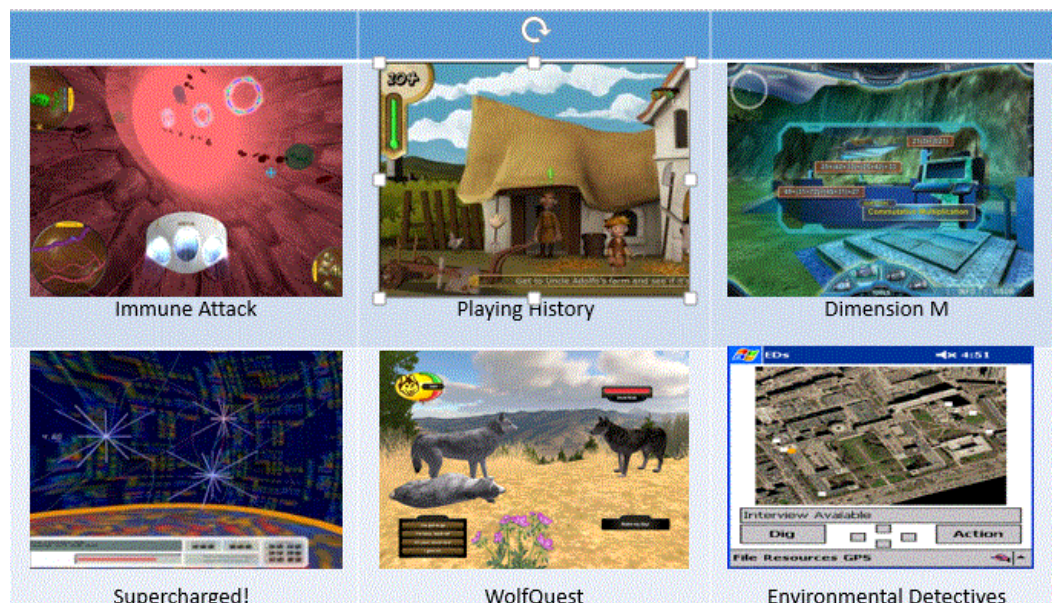
Figure 1. Screenshots of Edutainment Games and Educational Applications (Google Images, n.d.)



2. *Serious Games*: With the U.S. Army's release of the video game *America's Army* in 2002, the serious game movement was launched (Susi et al., 2007). The widely used term *serious games* became popular after the Woodrow Wilson Center for International Scholar founded the *Serious Games Initiative*. A generic definition of serious games means digital games created for purposes other than entertainment. Michael and Chen (2006) referred to serious games as “games that do not have entertainment, enjoyment, or fun as their primary purpose” (p. 21). This is not to say that serious games are not entertaining or enjoyable but to say that the main purpose of serious games is to facilitate learning, training, or education. Serious games refer to digital games created based on real-life models, systems or workable simulations and used on personal computers or video game consoles for purposes of healthcare, public policy, training, science, corporate management, advertising, education, or simulation. Michael and Chen (2006)

stated that serious games encompass the same goals as edutainment games but expand beyond teaching memorization and facts to include teaching, training, and informing at all ages to help game players acquire new knowledge or skills. Corti (2006) stated that the motivational power of serious games is what first made game-based learning appealing to training and developing professionals. However, game-based learning entails more than using fun as a means to entice learners. Compared to commercial video games, Zyda (2005) argued that serious games embodied more than just story, art, and software to include the element of *pedagogy* which attempts to educate and impart knowledge or skills, whereby making games serious. Examples of serious games are three-dimensional aviation or navigation simulators, military campaign simulation *America's Army*, environmental preservation game *Wolf Quest*, and healthcare awareness games *Remission* and *Quest for the Code* (see Figure 2).

Figure 2. Screenshots of Serious Games (Google Images, n.d.)

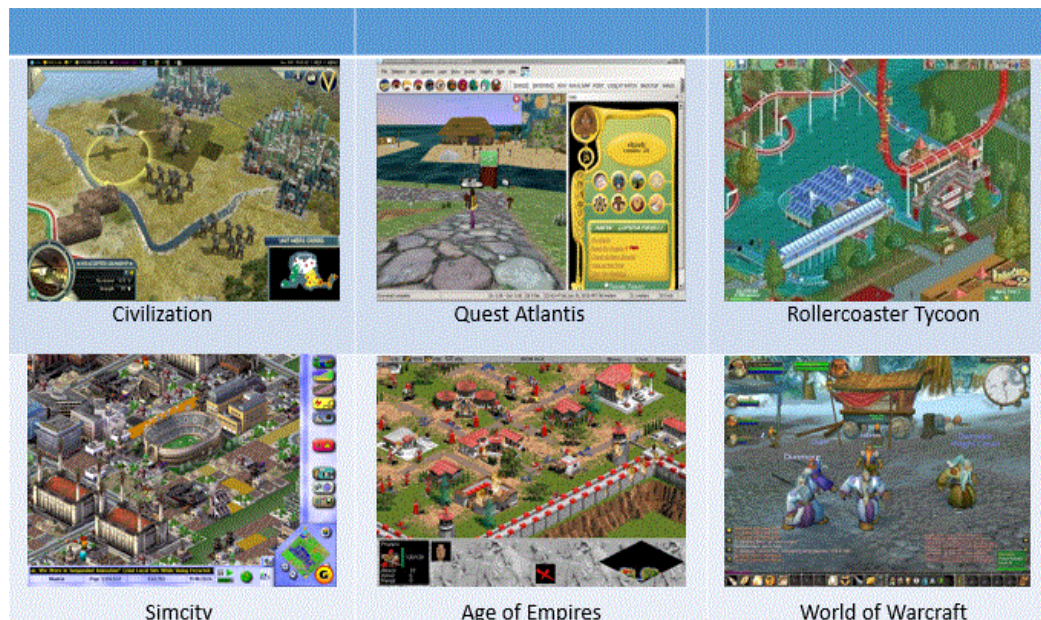


Serious games reduce the amount of play in the gaming experience, which potentially detracts from the enjoyment of the experience. Nevertheless, serious games are potentially effective tools for learning and education.

3. *Commercial Off-The-Shelf (COTS) Strategy/Simulation Games and Massive Multiplayer Online Role-Playing Games (MMORPGs)*: Increasing efforts had been exerted by researchers to examine the educational rendering of digital games in the classroom by using games originally produced for entertainment and commercial purposes (Charsky & Barbour, 2010; Foster & Mishra, 2009; Kirriemuir & McFarlane, 2003; Squire, 2004, 2005). Corti (2006) stated that “simulations and role playing are two key genres of entertainment-oriented games that many people deem to be particularly appropriate for adoption as training tools” (p. 2). Simulated environments or systems or realistically recreated role play scenario allow players/learners to experience things otherwise too risky, expensive, or physically impossible to achieve in the real world context (Corti, 2006). Squire and Steinkuebler (2005) discussed that playing multiplayer online games is an act of knowledge co-construction, which fosters information literacy and information-seeking skills. Foster, Katz-Buonincontro, and Shah (2011) used four video games, including a simulation game *Rollercoaster Tycoon*, and documented the integration process of DGBL in an urban high school setting to develop students’ math and science skills. These studies were tenable and provided practical instances documenting teachers’ use of game-based learning activities and teaching strategies to link game play to broader course learning objectives while acknowledging difficulties in such implementations. Examples of commercial off-the-shelf games are simulation and strategy-based games or MMORPGs such as *Age of Empires*, *SimCity*, *RollerCoaster*

Tycoon, Civilization, World of Warcraft, and Zoo Tycoon (see Figure 3). These games are marked by turn-taking, strategizing moves to counteract moves possibly made by enemies, quest-based guild system, and multi-player communication and in-game collaboration. When effective, the repurposing of these commercial games, usually called “commercial off the shelf”, can be leveraged for learning in formal curricular contexts given several advantages including potential familiarity to students, well-designed game features, presentation and effects, and the resources readily available in online communities or affinity spaces (Charsky & Mims, 2008; Gee, 2007; Sandford et al., 2006; Squire, 2011).

Figure 3. Screenshots of Strategy/Simulation Games and MMORPGs (Google Images, n.d.)



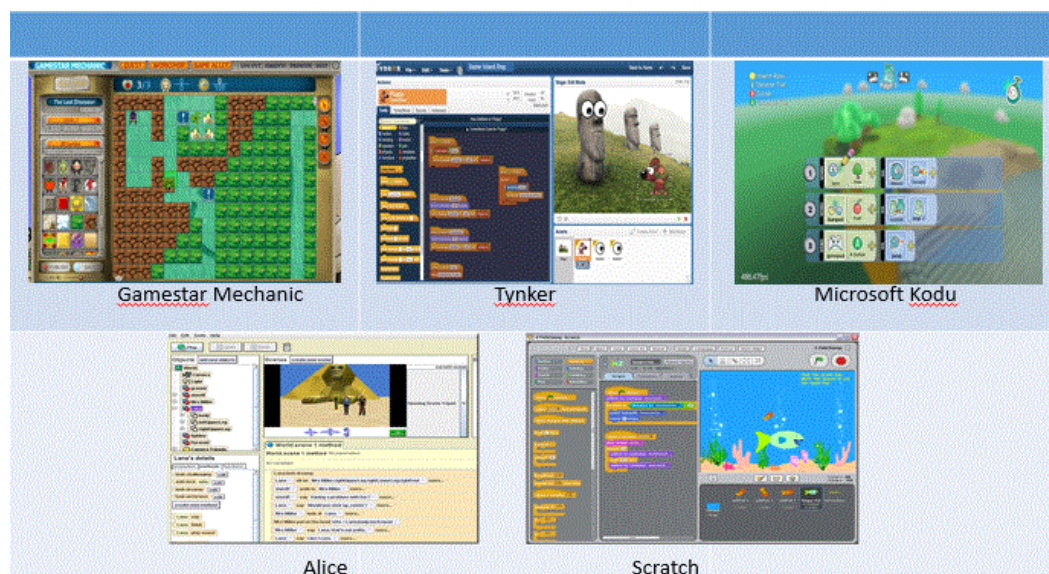
Collectively, research involving the use of COTS games in formal learning settings emphasized the need for “more detailed examples of classroom use, pointing out that the

majority of games used in schools are used by teachers that develop an affinity for the games and the associated necessary expertise in their own time” (Sandford et al., 2006, p. 1). Charsky and Mims (2008) emphasized the importance of teachers’ mastering of games and the knowledge development as being “invaluable in helping students overcome frustration and troubleshooting any issues that may arise (during game-based learning activities)” (p. 38). For teachers with less familiarity with digital games, guidance in the form of game-based lesson plans would be necessary. To effectively render COTS games for classroom teaching, the bottom line is that teachers would have to familiarize themselves with the game mechanics and dynamics of the chosen game, and identify in-game features potentially relevant to be used to promote learning of educational content. Consequently the use of COTS represents higher hurdles since these commercial games were not by default designed with the emphasis to explicitly educate as in most educational games.

4. *Educational Game Design*: The process through which players go through in learning these entry level game design tools align with the underpinnings of current learning theory where knowledge is socially-constructed and situated in interactive contexts (Gee, 2003; Prensky, 2001). The learning outcomes induced through design-related activities are usually in the form of virtually constructed worlds, playable digital artifacts of functional game environments where core elements such as rules, goals, scoring system, and assets are embedded to create a win state, the end game within a digital game. Research done in the area of educational game design have found that the process of iterative design, play-testing, and game refinement based on peer feedback can lead to learner/players’ emergent development of creativity, system thinking, problem-solving,

computational thinking, and spatial reasoning skills (Denner, Werner & Ortiz, 2012; Games & Squire, 2009; Salen, 2007; Wu & Richards, 2011). Even though these skills are not directly tied to formal academic subject area knowledge examined in standardized testing, researchers have contended that the skills are critical 21st century skills necessary for students to successfully navigate in today's borderless world of computing, information, and technology (Gee, 2007; Wing, 2006, 2008). The adoption of educational game design in classroom settings usually requires that the teacher is familiar with or preferably well-versed in essential game elements and the flow of game play because very often game design starts from a blank slate. This means students will need more design-related guidance and technical support from the teacher, leaving educational game design by comparison a higher hurdle for teachers inexperienced in using games to teach. Examples of entry-level programming tools for teaching about educational game design are *Microsoft Kodu*, *Gamestar Mechanic*, *Storytelling Alice*, and *Scratch* (see Figure 4).

Figure 4. Screenshots of Educational Game Design Tools (Google Images, n.d.)



Theories and practices notwithstanding, studies have found that digital games promote conceptual, strategic, and procedural learning rather than textual and rote learning required by school curricula and standardized test-taking. Does the mismatch of learning objectives promoted in game-based learning and standard-based learning lead to a fallout? Not necessarily. As Squire (2006) aptly put, “as video games mature as a medium, the question becomes not whether they will be used for learning but for whom and in what contexts” (p. 27). His statement captured the upswing momentum of game-based learning and called for the need for more research focusing on not why but on how games should be used to promote learning at different grade levels in schools (van Eck, 2006).

The following discussion provides a purview on potential connections between the design of educational digital games and the development of learning theories with the aim to link learning to gameplay, and to provide rationale for the integration of educational digital games in K-12 learning contexts.

Linkage between the Paradigm Shift of Learning Theories and the Historical Development of Educational Digital Games

Over the last few decades, the contemporary shift in learning theories in education has paralleled the development of increasingly complicated game design, mechanisms, and effects in digital games (Flynn et al., 2010). Based on the connections between the evolution of educational video games and accompanying paradigm shift in learning theories, Egenfeldt-Nielsen (2005) identified three contemporary generations of educational video games.

The first generation of educational games, created beginning during the time frame of 1980s, were “edutainment” games which were designed with the underlying principle that

learning is behavioristic. Specifically, controlled input such as repeated drill and practice were embedded in edutainment games to induce direct learning. Edutainment games such as *Math Blaster*, *Reader Rabbits*, *Oregon Trail*, *Where in the World is Carmen Sandiego* had been prevalently used in primary school settings to promote directly observable learning. However, most edutainment games were not successful because they were designed with low budgets, overly simplistic rules and effects, and learning objectives that did not support progressive understanding (Michael & Chen, 2006). Edutainment games lost their appeal easily when compared with commercially produced counterparts.

Beginning in late 1990s, the second generation of educational games were designed based on cognitive learning (Egenfeldt-Nielsen, 2005). Corresponding to the shift in learning theories, these educational games moved away from the focus on behavior to an overt focus on the learner. This generation of educational games were designed based on the premise that players/learners are not black boxes and they come to play the game with prior knowledge and schemata. The different knowledge bases learners bring in into game play would interact with the game content to produce differentiated effects on learning. These games were designed based on cognitive constructivism learning concepts such as scaffolding, chunking, perception, and facilitation and they attempted to present information and deliver content in a cognitively appropriate format to specific learners. *Revolution*, *Immune Attack*, *Life Preservers*, *Spore*, *Environmental Detectives* are instances of the second generation of educational games.

The third generation of educational games, mostly arising in early 2000s, stressed the importance of the processes of educational use of digital games. In other words, these games focus on the introduction of a social context that promotes meaningful, creative, socio-culturally interactive learning activities, collaboration, and problem-solving which were core learning

concepts from constructivism and situated learning theory (Lave & Wenger, 1991). When adopting these games, the teacher becomes the central facilitator adapting digital game experiences to classroom teaching (Gros, 2007) by engaging students in hands-on activities such as group work or field experience in further exploring game contents rather than relying solely on the game to impart knowledge. Example games in this generation were simulation games such as *Civilization*, *The Sim Series*, *Age of Empires*, *RollerCoaster Tycoon 3*. Egenfeldt-Nielsen (2005) noted that most popular educational games included features of adventure, strategy, and simulation. He concluded that there was a tendency in the market to produce games based on the second and third generation learning models, i.e., games designed based on learning principles of cognitive constructivism and social constructivism.

The fourth and most recent wave of educational digital games were designed around late 2000s and early 2010s following the constructionist learning approach (Papert & Harel, 1991). These games promote learning that involve the act of construction. In essence, design and creation of game space and artifacts are the main gameplay mechanics. Players engaging in the construction of a game rely on creativity and systematic thinking as they test hypotheses and learn from trial and error in designing a functional game. Over time these players would develop a designer language and mindset through dialoguing with the game being designed and game-testers who provide feedback (Denner et al., 2012; Games, 2008, 2010; Hayes & Games, 2008). Game players were encouraged to take on the role of makers, creators, and designers who can participate to varying degrees in the design process (Salen, 2007; Werner, Denner, Campe & Kawamoto., 2012). Examples of such educational games are entry-level game design tools such as *Gamestar Mechanic*, *Storytelling Alice* and *Scratch*.

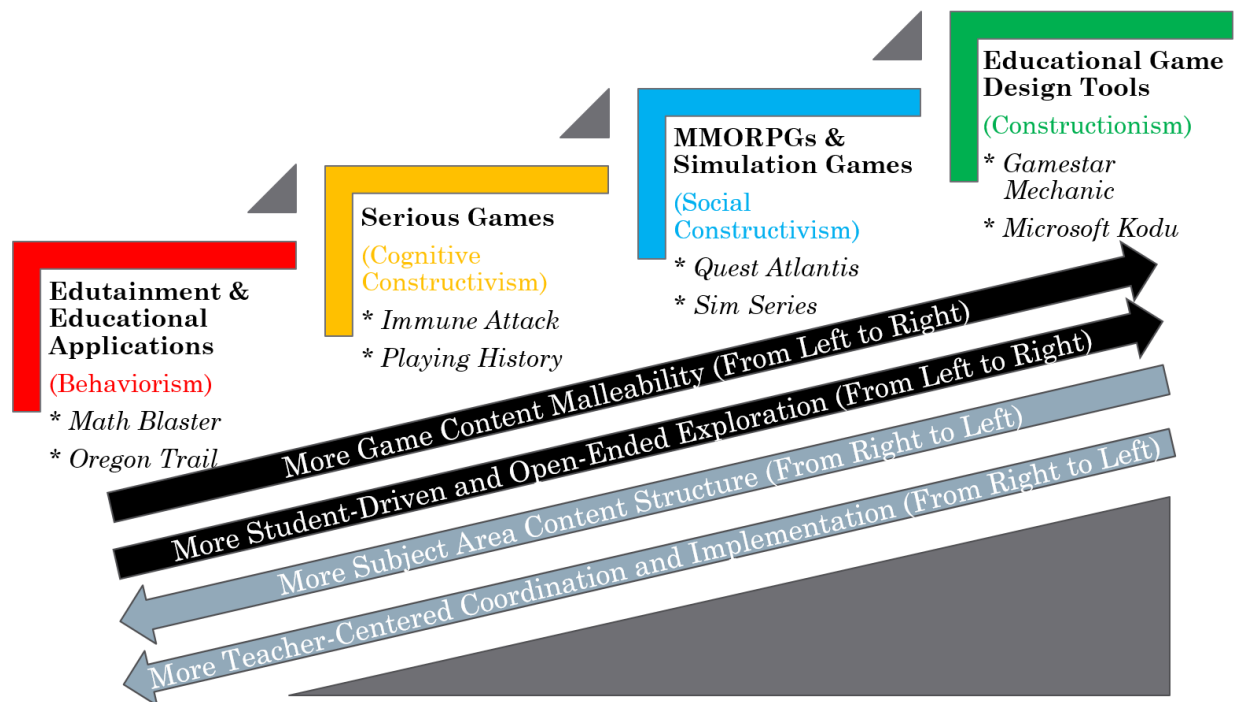
In summary, Egenfeldt-Nielsen (2005) and Flynn et al. (2010) described how the shifting main theories of learning had in turn impacted the trends in the design of and gameplay in educational digital games. Flynn et al. found that there is “a casual link between the design of video games throughout the past 25 or so years that mirrors the hierarchical nature of theories of learning” (p. 1550). Since the design principle and gameplay of educational digital games paralleled with the development of learning theories, there exists the need for the development of a classification scheme regarding how well certain games, when used for education, can satisfy certain learning objectives.

Building on their work, I have attempted for the purpose of this research to align the contemporary learning theories with examples of popular educational digital games used both in formal and informal learning contexts (see Figure 5). While some game titles may be categorized under a certain learning theory, it does not mean that they strictly adhere only to the learning principles imparted by that learning theory. Rather, it is acknowledged that all of these games may share commonalities in terms of game features and play mechanics that could be categorized under more than one learning theory. Below are four major learning theories that may be used to categorize educational digital games.

1. Behaviorist Theory: This theory focuses on Skinner, Pavlov and Thorndike’s observation that human are biologically wired to learn and learning can be achieved by reinforcing, substituting, or removing external conditions and stimuli (Phillips & Soltis, 2004). In sum, this theory poses that learning happens best with repeated practices following the pattern of stimulus and response and the evidence of learning are directly observable behaviors.

2. Cognitive Constructivist Theory: This theory concentrates on Chomsky and Dewey's proposition of understanding how the brain takes in information and how it processes and link that information to pre-existing knowledge to solve problems (Flynn et al., 2010, p. 1551). It poses that learning is about individuals constructing and conceptualizing knowledge, and integrating newly acquired information with existing schema.
3. Social Constructivist Theory: This theory focuses on Vygotsky's social aspect of learning, posing that knowledge is formed through individual creation but based and maintained by the social group, culture, or context (Flynn et al., 2010, p. 1551).
4. Constructionist Theory: This theory of learning is connected to experiential learning and poses that teaching is most effective when parts of the learning activity the learner experiences are about constructing a meaningful product (Papert & Harel, 1991). This theory places emphasis on learning to think systematically and design a functional game space while faring through tasks related to problem-solving and construction (Games & Squire, 2011; Salen, 2007).

Figure 5. Typology of Four Types of Educational Digital Games and Corresponding Learning Theory, Building on Previous Research of Many Others (See Literature Review)



The typology along with the pointing arrows suggest that these four types of educational digital games vary in terms of the degree on predetermined game content and structure, content malleability, and the types of learning opportunities afforded in accordance with its respective design principle based on different learning theories.

The ladder-like spectrum does not imply strict hierarchy of preference or usability but suggests a trajectory through which teachers may progress (from left to right) when they gain more experience and skills in using digital games for teaching. As such, it would be reasonably safe to assume that edutainment games or serious games tend to be more pre-structured in terms of game content and the subject area knowledge they are going to promote for learning when used in a classroom context. These games are usually more teacher-centered and potentially requires less effort on lesson planning or coordination on the part of the teachers because they

represent pre-packaged contents readily to be delivered with appropriate game-based instructional practices. On the other end of the spectrum, educational game design tools or MMO games are less restricted with regard to game structure and allow more flexibility for teachers to tailor teaching strategies to address desired learning objectives. These games are more student-driven because students are encouraged to wield creativity and use problem-solving skills to learn new contents through teacher-scaffolded activities or peer-supported explorations, thereby posing potentially more strenuous and challenging lesson planning, technology set-up, and classroom management for teachers.

For more concrete pedagogical instances, when a teacher wants to promote creativity, collaborative learning, and problem-solving (learning principles of constructionism) in subject areas such as science or computer engineering for young adolescents, educational digital games such as *Minecraft Edu* and *Tynker* would work best because they are open-ended and the gameplay encourages exploratory and discovery learning. Conversely, when a teacher intends to facilitate drill and memorization (learning principles of behaviorism) among young children, games such as *Math Blaster* or *Reader Rabbits* would lend themselves best because these games are more structured and involve repeated practices that foster fundamental sensorimotor skills.

Note that some games can share features that can be built on to promote learning objectives in line with multiple learning theories. A game such as *Immune Attack* or *Oregon Trail* can be adopted by the teacher to facilitate individual learning in accordance with principles in both cognitive constructivism and behaviorism when scaffolded with appropriate learning activities such as fact worksheets and personal reflections. Similarly, when teachers want to promote both social constructivist and constructionist learning, they can adopt *Gamestar Mechanic* and carry out game-based learning by putting students in collaborative groups,

allowing for play-testing, encouraging social interaction, entertaining peer feedback, and promoting student learning through building and testing hypotheses via trial and error.

Overall, a teacher's decision on choosing which type(s) of educational digital games for classroom adoption should depend on sound pedagogical considerations of in-game subject area content, content appropriateness, student age, target learning objectives, individual or group dynamics, available technology set-up and resources. Similar to any other lesson planning, it is imperative for teachers interested in using game-based lessons to familiarize themselves with the chosen game(s) before real-time classroom implementation. For a reference list of educational digital games designed based on the four contemporary learning theories, target learning opportunities and befitting age group, please see Table 1.

Table 1. List of Educational Digital Games, Target Learning Objectives and Corresponding Learning Theory in Design

	Behaviorism	Cognitive Constructivism	Social Constructivism	Constructionism
Target Learning Opportunities	*Memorization *Drill *Repetition *Individual work	*Individual information processing *Individual problem-solving	*Group work *Collaboration *Co-constructing and sharing knowledge	*Learning by building *Systemic thinking *Creativity *Collaborative problem-solving
Target Age Group	K-6	6-10	8-12	8-12
Game Titles	* <i>Math Blaster</i> * <i>Jeopardy</i> * <i>Reader Rabbits</i> * <i>Oregon Trail</i> * <i>Where in the World is Carmen Sandiego?</i> * <i>Dinosource</i> * <i>Words with Friends</i> * <i>Monster Physics</i> * <i>Motion Math</i> * <i>Zoom</i> * <i>Bridge Constructor</i>	* <i>Life Preservers</i> * <i>Immune Attack</i> * <i>Re-Mission</i> * <i>Playing History</i> * <i>Spore</i> * <i>Dimension M</i> * <i>Supercharged!</i> * <i>Environmental Detectives</i> * <i>WolfQuest</i> * <i>Quest for the Code</i>	* <i>Civilization</i> series * <i>Quest Atlantis</i> * <i>Roller Coaster Tycoon</i> series * <i>SimCity</i> * <i>Age of Empire</i> * <i>World of Warcraft</i> * <i>Everquest 2</i>	* <i>Gamestar Mechanic</i> * <i>Tynker</i> * <i>Minecraft Edu</i> * <i>Microsoft Kodu</i> * <i>Storytelling Alice</i> * <i>Scratch</i> * <i>Code School</i> * <i>Codea</i>

Just like any other educational technologies, it is important to bear in mind that DGBL should not be considered a panacea. Plugging a digital game into classroom instruction does not guarantee that students will enjoy the process or that the game will produce satisfying learning outcomes. Depending on desired learning objectives, student age, learning preferences, and technology availability, the context for using DGBL can vary greatly from case to case.

Sandford et al. (2006) called for the differentiation between the types of learning opportunities afforded to teachers by different types of games, and stated that the differentiation would aid the process of coming to a fuller understanding of the potential of using digital games in education (p. 3). I hope this typology of educational digital games can help teachers understand that the four different genres of educational digital games were designed to potentially promote different kinds of learning opportunities for students. Therefore teachers should approach the adoption of each genre of digital games accordingly with a different set of instructional goals, practices and desirable learning outcomes.

In the next section, research done in the area of teacher attitudes and beliefs in using technologies including digital games in the classroom would be discussed.

Teacher Attitudes toward the Use of Digital Games for Classroom Teaching

Attitude matters in terms of how deeply or widely technology is infused by teachers (Angers & Machtmes, 2005; Ertmer, 2005; Hutchison & Reinking, 2011; Lucas & McKee, 2007). Across the Atlantic Ocean, Sandford, Ulicsak, Facer, and Rudd's (2006) work in the United Kingdom reported teachers' viewpoints toward game-based learning by stating that "91% [of teachers] felt that players developed their motor-cognitive skills, while over 60% thought that users would develop their higher order thinking skills and could also acquire topic-specific knowledge". This indicated a general acknowledgement among teachers in the UK that they had overall positive attitudes toward using digital games in teaching. Some researchers argued that teachers need to familiarize themselves with video game contents so that they can leverage video game content and use video games to deliver or supplement instruction (Evans & Barbour, 2007a; 2007b; Hsu & Chiou, 2011).

Research conducted in the USA showed that pre-service teachers' prior knowledge of and experience with digital media and technologies can effectively mediate the use and impact of pre-service teacher preparation (Ertmer et al., 2012; Lambert, Gong, & Cuper, 2008; Tondeur et al., 2012). This finding points to the importance of taking prior knowledge and experience in using technology into account when teacher educators attempt to help teachers develop a knowledge base and skillset in using technology for teaching. One of the main purposes of this current study is to survey teachers' experience in gaming, attitudes toward and self-efficacy of using DGBL. The rationale was that teachers, at the forefront of the daily activity of teaching, are *gatekeepers* of technology in the classroom and the possibility and potential of using DGBL is hinged on their prior experience, attitudes towards and self-efficacy on using digital games for teaching. By assessing teachers' experience, attitudes and beliefs about DGBL at different phases of their career, this study aims to inform game research initiatives, improve pedagogical practices using DGBL, and describe potential upsides and pitfalls of using DGBL to different stakeholders in education.

In a recent study that examined pre-service teachers' gaming practices and attitudes, Hayes and Ohrnberger (2013) compared gaming teachers with non-gaming teachers and found that these teachers' beliefs about how technology affects learning and about the role of technology in future careers can weigh in on their interest in using specific technology for learning. According to van Eck, advocates of game-based learning had got through the message that digital games would be beneficial for education, but continuing to preach the effectiveness of digital games in education may run the risk of disseminating the message that "all games are good for all learning outcomes, which is categorically not the case" (2006, p.18). It is important to note that not all digital games are created equal and not all digital games can facilitate learning

as defined in formal learning contexts. Consequently, research done in the effects of digital games in education need to focus on exploring why digital games are motivational, engaging, and effective by providing practical guidance or best practices that exemplify how DGBL promotes learning objectives. In DGBL proponents' perspective, there is no reason for not utilizing age and content-appropriate digital games in education. That said, it is also imperative for teachers to take students' experience in gaming into consideration when planning the use of educational games for teaching and learning in the classroom.

Worth noting also is the issue of student perceptions toward the use of educational digital games in the classroom, Bourgonjon, Valcke, Soetaert, and Schellens (2010) found that young students' preference for using video games for learning can vary based on their prior background in leisure gaming. Contrary to most game research where the focus lies in investigating gamers or people who play games habitually, Wu, Richards, and Saw's (2014) research studied light and non-gamers' motivations to play a massive multiplayer online role-playing game (MMORPG) to learn a target language. They found that these novice players were driven by the motivation component *relatedness* as they played to practice using English for communicative purposes. These light players were drawn specifically to the built-in game features of socialization and teamwork as they fared through the initially steep learning curve.

Players with varying levels of prior background and experience in leisure gaming could either relish or detest the use of video games in the classroom because familiarity with gaming may come into play and the use of a single game may not suffice to cater to students' different learning styles and preferences. Despite the high likelihood that almost all children nowadays play digital games at some point in their life, Lenhart et al. (2008) found great variation among the types of digital games they play, the social aspects surrounding their game play (e.g., who

they play with and which gaming affinity group they choose to associate with), and how frequently they engage in game play.

Another pivotal stakeholder in the issue of using DGBL in the classroom would be parents. Brand (2007) in a Australian study reported that 73% of parents deemed that games helped their children learn about technology, 68% expressed that games helped children learn math and 64% said games helped children learn about planning. Parents nowadays are acknowledging that digital games can serve more than as entertainment and beginning to understand the potential of their children learning from the mechanisms and effects of educational digital games when adopted for instructional use.

Articulation of a Conceptual Framework for the Adoption of DGBL

TPACK is a framework used to describe the three areas of knowledge needed for effective technology integration (see Figure 6, Koehler & Mishra, 2005; Mishra & Koehler, 2006). Placing the framework in the context of educational game design, it helps to pinpoint crucial aspects in the design of games (Foster & Mishra, 2009) and also illuminate the importance of a combined expertise when it comes to tackling the nuanced issue of integrating technology into teaching – content knowledge from content experts, pedagogy from practitioners, and technology skills from game designers or technology users. In the following, I delineate the structuring of a conceptual framework that merges the TPACK framework and the Heart of Serious Game Design (see Figure 7, Winn & Heeter, 2007) in an effort to help teachers gain a better understanding of the aspects and knowledge involved in the use of DGBL in classroom settings.

Figure 6. TPACK Framework (Mishra & Koehler, 2006)

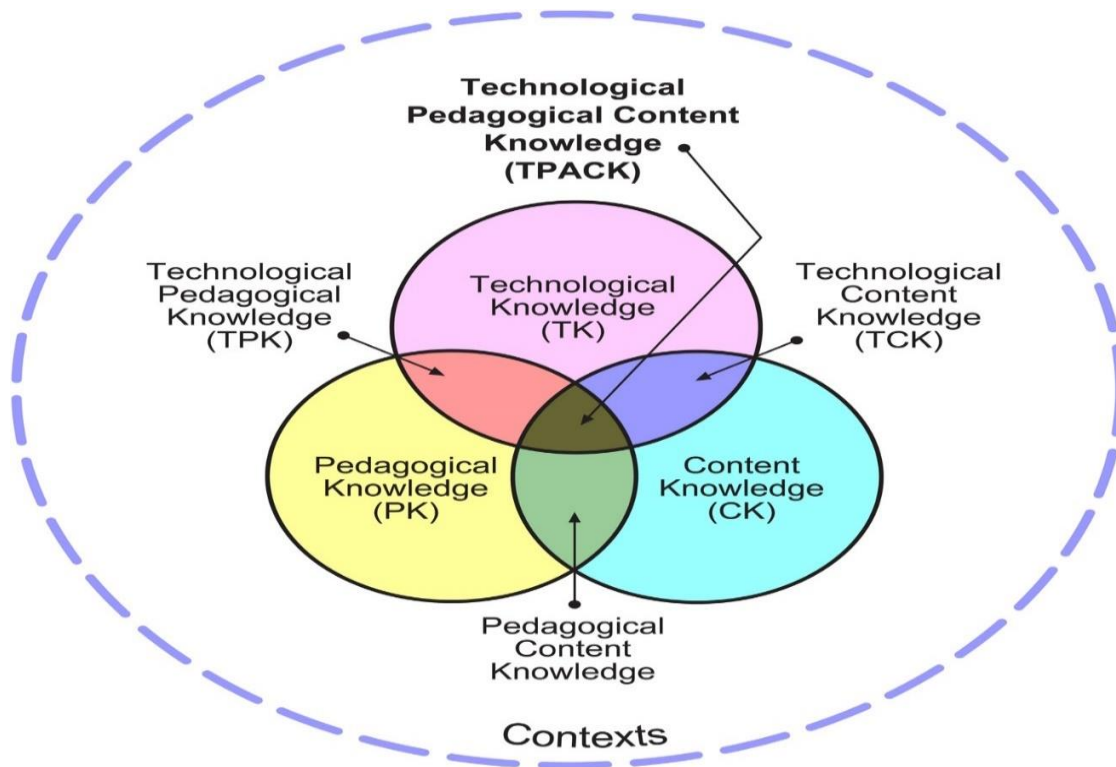
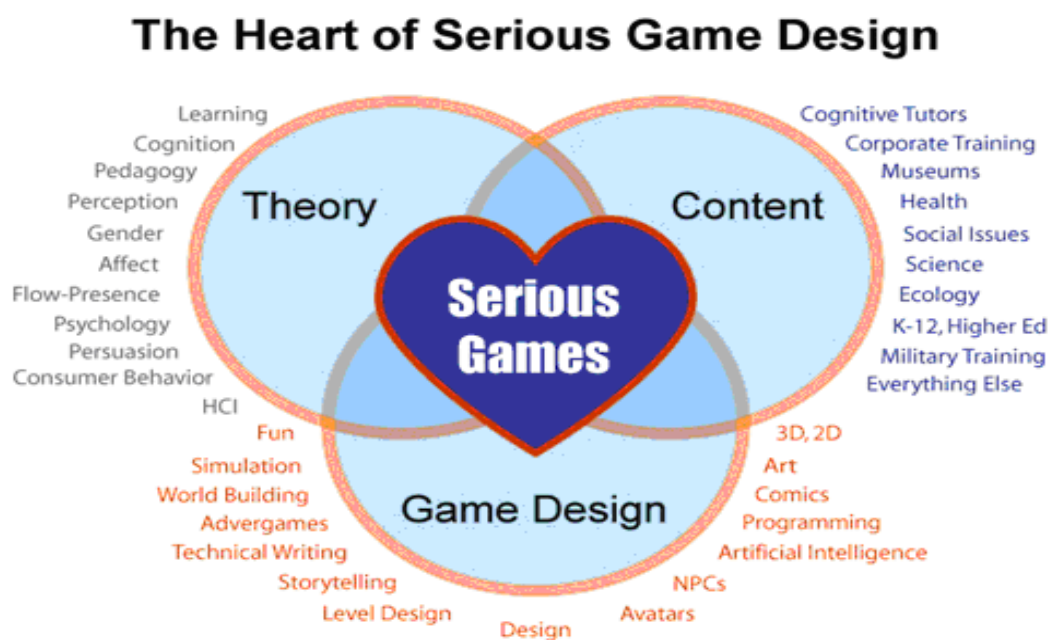


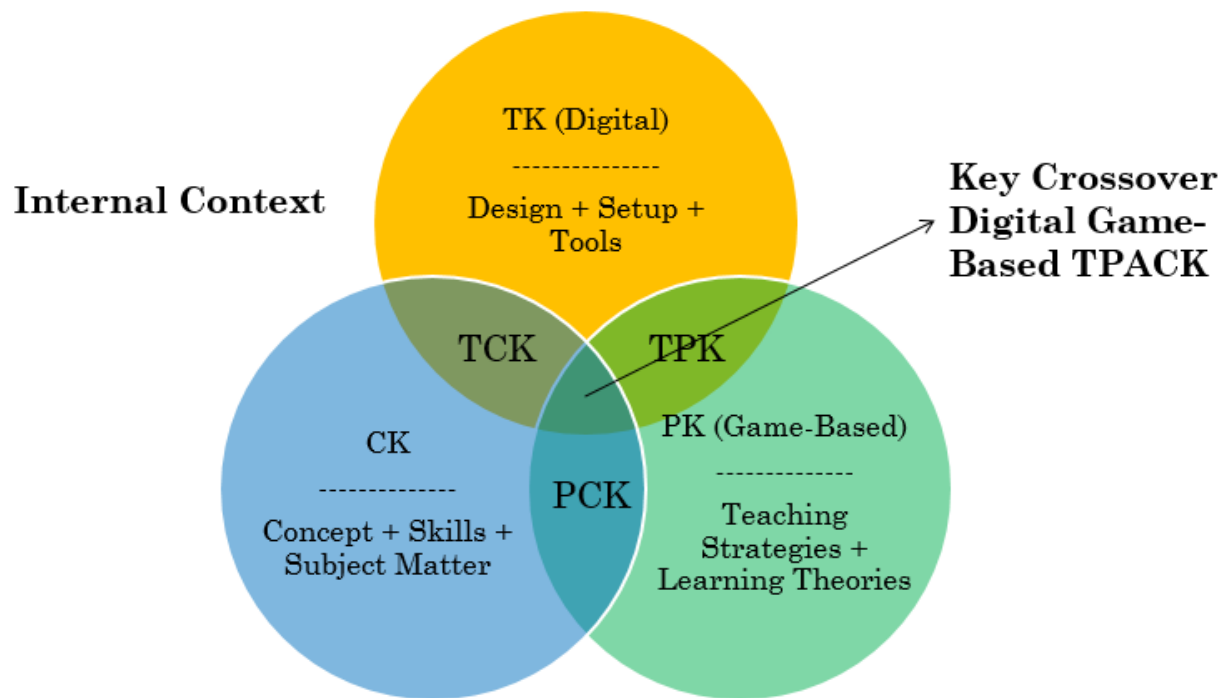
Figure 7. The Heart of Serious Game Design (Winn & Heeter, 2007)



The attempt to articulate a framework that combines two frameworks is arduous and at the same time risky, meaning that the underpinnings of the framework might be at stakes with the original intentions of each of the framework. My intent in proposing the framework stemmed from the need to bridge pedagogical practice and technical design by foreshadowing educational digital games as one of many viable technology-enhanced options to help teachers at different levels approach the adoption of DGBL. As Kereluik and Mishra (2012) pointed out, “frameworks are valuable in that they offer not only the identification of a problem, but also potential solutions” (p. 2885). It is such a framework can help outline ways through which a problem can be conceptually investigated. The conceptual framework posed in this study is not the first attempt to identify the complicated interaction of different areas of knowledge involved in using game-based learning, but it is the first attempt to combine two sets of framework, one based on the knowledge base of educational technology integration, and one centering around sound educational game design, with the aim to provide a common ground on which conversations and solutions surrounding the adoption of game-based learning can be systematically approached and examined.

Consequently, one important goal is to cast light on how these two frameworks share important commonalities in highlighting the central overlapping component of three different expertise – Pedagogical Knowledge (game-using practitioners), Content Knowledge (content or curriculum experts), and Technological Knowledge (digital tool users) – resulting in the culminating core knowledge of DGBL TPACK, i.e., educational digital games used by content area teachers in tandem with appropriate pedagogical practices and technology set-up to deliver effective instruction and meet educational goals. Figure 8 outlines the components involved in the internal context (internal to the teacher) of using DGBL in classroom settings.

Figure 8. Conceptual Framework for Implementation of DGBL (Internal Context)



In the conceptual framework, there are three overlapping areas of knowledge (apart from the central overlapping DGBL TPACK) in between each pair of the knowledge base—TCK, TPK, and PCK. To elaborate, TCK asks about how the subject matter is better illuminated by the integration of digital tools used in the classroom teaching context. With PCK, teachers need to ask themselves the question, “How do the chosen game-based teaching strategies achieve content objectives?” An example of PCK would be teachers’ understanding and willingness to recognize and take advantage of students’ prior expertise and “game literacy” during the development of game-based lesson plans, assignments, methods of assessment, and resources. PCK is important because it addresses the pragmatics in preparing game-based lessons and also gives “some students the chance to actively contribute to lessons in a far deeper way than might be usual” (Sandford et al., 2006, p. 3). When it comes to TPK, teachers need to find answers to the question, “Is the digital tool used the most effective to match the teaching strategies to

promote game-based learning?” Accordingly, teachers need to understand that the implementation of DGBL demands “a higher tolerance for letting go of the learning process than other new media genres” (Alvarado, 2008, p. 5).

With TCK, PCK and TPK in place, the convergence among those three areas of knowledge brings forth DGBL TPACK which represents a teacher’s developing core knowledge, mindset, and skillset to effectively leverage educational digital games for learning. Game-using teachers would have to cope with technological set-up and implement DGBL pedagogical practices appropriate for teaching content-specific knowledge. Adapting the results from prior research investigating teachers’ different knowledge bases needed for effective technology integration (Angeli & Valanides, 2009; Kereluik, Casperson, & Akcaoglu, 2010; Schimdt, Baran, Thompson, Mishra, & Shin, 2009), Table 2 lists description of the seven knowledge components teachers need to acquire for effective implementation of DGBL in a classroom.

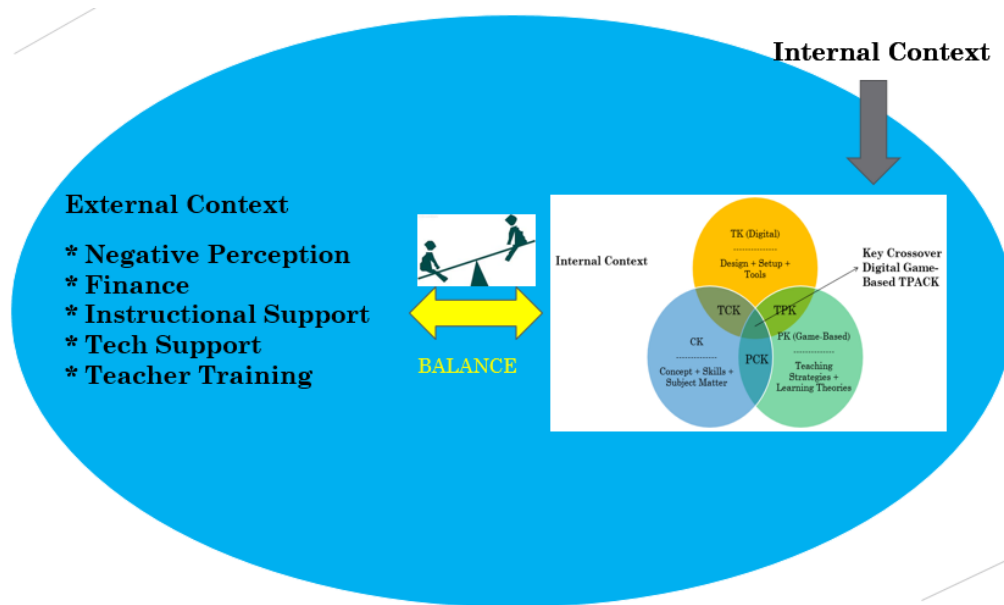
Table 2. Description of Different Knowledge Bases in the DGBL TPACK Framework

	Description
CK	Knowledge of subject area contents
PK	Knowledge of teaching strategies, assessment, organization, and classroom management in implementing game-based learning
TK	Knowledge of the technological set-up and use of digital tools
PCK	Knowledge and skills to use game-based learning strategies to approach teaching of specific content
TCK	Knowledge and skills to identify contents suitable to be taught with appropriate digital tools
TPK	Knowledge and skills to implement game-based learning while making justified choices of digital tools
DGBL TPACK	Knowledge, mindset, and skills to integrate game-based learning while achieving synergy between technology, pedagogy, and content

Since DGBL represents a pedagogical approach, it is to be noted that PK, TPK, and PCK are the prerequisites of DGBL TPACK considering that the presence of pedagogical knowledge and teaching strategies in implementing game-based learning (PK) lays foundation for the subsequent development of knowledge and skills in using game-based learning to deliver subject area content (PCK) and assist the process of technology integration in game-based learning environments (TPK). In other words, the challenges for teachers to successfully incorporate DGBL lies mainly in having first and foremost a sound base of knowledge in game-based learning PK, and building on PK to develop a base of PCK and TPK so that content area knowledge and digital game technology can be blended to work effectively with digital game-based learning pedagogy (DGBL TPACK).

In addition to the consideration of the knowledge components in the internal context, it is equally important to take external factors into account when attempting to integrate DGBL in the classroom (see Figure 9). An analogy can be made here with a seesaw where factors from both internal and external context must be accounted for to reach a balanced state so that effective implementation of DGBL can take place in a classroom setting. Put another way, both internal and external factors play important roles in determining whether DGBL can be successfully implemented in the school. External barriers that may impede with the use of DGBL include factors such as the lack of technology or instructional support, insufficient teacher training, financing of games, and negative perceptions toward games as a play thing incompatible with formal learning.

Figure 9. Conceptual Framework for the Implementation of DGBL (Internal and External Context Combined)



CHAPTER 3

SURVEY INSTRUMENTATION

In the effort to create a comprehensive instrument for measuring teachers' gaming experience, attitudes, and self-efficacy toward using digital games for teaching, a review of research was conducted but an existing valid instrument seems lacking (Hsu & Chiou, 2011; Jones et al., 2007). The following section delineates the process and considerations over which a construct both quantifiably and qualitatively measuring teachers' gaming background, attitudes, self-efficacy, and perceived challenges and barriers to the integration of DGBL was developed. Components of the attitudinal survey on DGBL adoption consists of adapted elements from prior research and pilot-tested survey items.

There were four main dimensions in the overall structure of the attitudinal survey and each of these four dimensions had been previously studied and provided empirical evidence in its impact on predicting teachers' attitudes toward new media and technology use, including the use of digital games in educational settings. The four dimensions are current gaming experience (Hayes & Ohrnberger, 2013; Itō, 2010; Jones et al., 2007), attitudes toward using digital games in a classroom (Gibson, 2007; Hsu & Chiou, 2011, Lambert et al., 2008; Millstone, 2012), perceived self-efficacy on the adoption of digital games for teaching (Chatham, 2007; Egenfeldt-Nielsen, 2005; Flynn et al., 2010), and perceived challenges and barriers to the integration of DGBL in the classroom (Baek, 2008; Becker, 2007; Kerbitchi, Kappers, & Henry, 2009; Rice, 2007). The following discussion foregrounds considerations as to why each of the four dimensions was chosen for this study.

Current Gaming Experience

A number of scholarly work shared consensus in that when students who grew up playing digital games become teachers, they tend to be more receptive towards using digital games in the classroom (Aguilera & Mendiz, 2003; Rice, 2007). Therefore it is reasonable to conjecture that teachers' gaming experience would factor into their attitudes toward digital games and potential adoption of digital games for teaching. Jones et al.'s (2007) findings based on surveying USA pre-service teachers (N=42) showed that 81% played their first digital game in junior high or high school. Only 4.8% reported not having played any digital game. One could assume that prior gaming experience would affect these pre-service teachers' attitudes toward digital games but intriguingly Jones et al. found that "prior experience with games did not necessarily predict positive attitudes towards games. A better predictor was how frequently they currently play computer games" (p. 1).

In consequence, five items were created to gauge teachers' current experience in gaming. They dealt with teachers' current amount of hours spent per week on gaming, enjoyment of gaming, choice of gaming platform, frequency in gaming-related practices, and gaming orientations (Itō, 2010).

Attitudes toward Using Digital Games in the Classroom

While a substantial number of studies investigated teachers' attitudes toward using technologies in general to support classroom learning, a relatively less explored area lied in examining teachers' attitudes toward integrating educational digital games into classroom teaching (Hsu & Chiou, 2011, p. 2135). Jones et al. (2007) studied pre-service teachers' attitudes toward digital games by using researcher-developed computer gaming inventory. They

used exploratory factor analysis to analyze the acquired data and found six latent constructs: gaming interference, gaming enjoyment, friendship related to gaming, features in games, gaming as diversion, and attitudes towards digital games. They found that active gamer pre-service teachers “tended to have better attitudes towards digital gaming in general” (p. 5). In an exploratory study investigating pre-service teachers’ (N=125) awareness of digital game-supported learning in Taiwan, Hsu and Chiou (2011) administered a four-dimension survey and found that a majority of pre-service teachers played digital games and they believed digital games were potential learning tools for students. The four dimensions under examination were digital gaming experience, attitudes toward digital gaming, self-efficacy, and awareness of digital game-supported learning.

For the purpose of this study, six items were created to probe into teachers’ attitudes toward using digital games for teaching. The six items examine teachers’ comfortableness with the idea of using digital games for teaching, perception of digital games, perception of educational digital games, belief in themselves using digital games in current or future teaching, perceived usefulness of using digital games for teaching, and whether they would consider using student-suggested game titles for game-based learning (Sandford et al., 2006; Pressey, 2013).

Self-Efficacy on Adoption of DGBL

Based off of teachers’ favorable attitudes, another component in the development of this attitudinal scale lies in teachers’ perceived self-efficacy on the potential adoptions of DGBL in the classroom. What is at stake here is whether attitude breeds action. The concept of self-efficacy had been extensively studied in organizational research. Briefly defined, self-efficacy is the conception or “belief in one’s capabilities to mobilize the motivation, cognitive resources,

and courses of action needed to meet given situational demands” (Wood & Bandura, 1989, p. 408).

Research had been done to investigate the impact of self-efficacy on the process of learning and learning outcomes. Hung (2008) studied the influence of self-efficacy and self-regulation on potential experience of flow during digital game play. Lin (2009) devised an online game self-efficacy and creative self-efficacy scale to examine the impact of the two sorts of self-efficacy on creative performances. Extant literature has not fully explored teachers’ self-efficacy as it relates to potential adoptions of DGBL in the classroom.

In this study, nine survey items have been created to address and operationalize the definition of self-efficacy as related to the mobilization of three elements—motivation, cognitive resources, and courses of action (Wood & Bandura, 1989). An item related to motivation would be, “I believe I am capable of using digital game-based learning to deliver educational content in my teaching.” Items related to cognitive resources tapped into teachers’ level of interest in adopting the four types of educational games for classroom teaching—Edutainment games and educational applications for mobile devices, serious games, simulation or multi-player online games, and educational game design tools. Note that the typology of educational games developed and used in this study was based on a review of literature that illuminated the connections between the paradigm shift of contemporary learning theories and the design/development of education digital games (Egenfeldt-Nielsen, 2005; Flynn et al., 2010; Games & Squire, 2011). The researcher-developed typology does not imply that these four types of educational games are mutually exclusive. In fact, these four types of educational games may share commonality in game features, representations, play mechanics and flow of game play. Lastly for example, an item that investigates courses of action would be an open-ended inquiry,

“If you are to design a DGBL lesson plan using this type of game you choose...what considerations would go into your lesson planning?”

Challenges and Barriers to the Integration of DGBL

An array of influential factors in the implementation of DGBL includes resources, teacher training, and administrative buy-in (Sandford et al., 2006). Research has been conducted to examine the adverse effects of gaming and the findings represent potential challenges or barriers that may deter teachers and other stakeholders from endorsing or utilizing digital games for teaching (Baek, 2008; Becker, 2007; Hayes & Ohnberger, 2013; Kerbitchi, Hirumi, Kappers & Henry, 2009; Kirrienmuir & McFarlane, 2003; Rice, 2007).

Research investigating the use of games for learning and examining outcomes of game-based learning has accumulated. In a review of more than 250 claims made by game-based learning studies, Foster and Mishra (2009) reported a categorization scheme coded in two broad themes: psychological effects and physiological effects, both positive and negative. For example, psychological effects engendered from game-based learning included development of cognitive skills and sustained motivation. Physiological effects included aggressiveness, antisocial behavior, coordination, and motor skills. The contribution of their work was to point out game genres to help school teachers identify a range of games appropriate for classroom use and supportive of learning objectives (p. 45). However, game-based learning has also been identified to be incompatible with regular school hours, leading adolescents to violence or social isolation. Mitchell and Savill-Smith (2004) documented negative impacts of binge game play on gamers: health issues (e.g., fatigue, moodiness, strain injuries), psycho-social issues (e.g., social isolation, substitute for social relationships, depression), and effects of violent digital games (e.g., aggression, development of negative personality trait). Positive impacts of gaming

included development of spatial reasoning skills, visual selective attention, analytical skills, psychomotor skills, hand-eye coordination, problem recognition and problem-solving, increased social skills, and improved self-monitoring (Foster & Mishra, 2009; Mitchell & Savill-Smith, 2004; Squire & Barab, 2004).

Negative influences induced by gaming such as addiction, deteriorating psychological well-being, aggressiveness, and violence have been studied particularly through excessive immersion in MMORPG environments (Rice, 2007). While the body of research focuses on the adverse outcomes of gaming and gaming-related activities (i.e., contents and representations in certain game genres that may lead to negative outcomes of gaming), there exists also internal and external-to-teacher factors that would prevent DGBL from coming into play in school settings. For instance, impeding factors could include lack of working knowledge in digital games, lack of skills in implementing game-based learning, licensing fees, cost for implementation, lack of foundation on technology infrastructure, and anti-gaming political climate in education (Kirriemuir & McFarlane, 2003; Squire, 2006).

In the present study, challenges to the integration of DGBL in the classroom are defined as internal factors generated from within the use and implementation of digital games to deliver educational contents. That is, challenges are the factors that lie intrinsic to the teachers themselves and these factors can usually be overcome through self-directed or guided study, repeated practice, accumulation of experience, or exertion. Examples of challenges, i.e., internal factors, are the lack of knowledge in teaching strategies, organization, assessment, and classroom management in implementing DGBL (PK); Lack of skills in using game-based learning strategies to approach teaching of specific subject area content (PCK); Lack of skills in using game-based learning while making justified choices of digital tools (TPK). In the survey

currently used for this study, three items were included mainly to reflect teachers' internal challenges in developing sufficient knowledge base or skills in PK, PCK, and TPK to carry out DGBL, all of which are essential building blocks for the core component of DGBL TPACK.

Kerbitchi et al. (2009) used a survey to examine K-12 teachers who used digital games in teaching. They also reviewed instructional game websites and summarized literature documenting the use of educational software, including digital games. Their finding indicated that teachers had to cope with the challenge of integrating digital games into school curriculum, suggesting that teachers need to be provided with game-based curriculum resources. In addition, teachers cannot be anticipated to embrace digital games as a pedagogical tool for teaching and learning unless they have a sound understanding of the affordances and constraints of DGBL, and are confident in their emergent ability to leverage digital games effectively to enhance learning and deliver educational objectives. That said, the lack of teacher professional development was also cited as one barrier to the integration of digital games in school curriculum (Becker, 2007; Kerbitchi et al., 2009).

Barriers to the integration of DGBL in the classroom are defined as external factors imposed upon teachers' practicing of DGBL. These barriers are usually factors impeding with the practice of DGBL and essentially lie outside of teachers' control. Rice (2007) qualitatively reviewed a number of scholarly work to investigate barriers to the integration of digital games in the classroom. His analysis resulted in six main barriers: negative perceptions towards digital games as educational components, difficulty of providing state of the art graphics in educational games, lack of adequate hardware in the classroom to run advanced digital games, school day divided by short class periods which hindered long-term engagement in complex games, lack of real world affordances, and lack of alignment to state standards. Other research-based examples

of barriers are insufficient amount of hardware in the classroom, technical and logistical requirements, licensing costs, and misalignment with school information technology policy (Kerbitchi et al., 2009).

Baek (2008) administered a survey (N=444) on South Korean elementary and secondary teachers regarding their attitudes toward the use of digital games in the classroom. Six inhibiting factors were found in top-down ranking order of inflexibility of the curriculum, negative effects of gaming, students' lack of readiness, lack of supporting materials, fixed class schedules, and limited budgets. Note here the six factors Baek identified are external barriers teachers most likely do not have control over when considering the use of digital games in classroom settings.

Based on UK teachers' opinions on the limits and potential of using video games in primary and secondary school teaching, McFarlane, Sparrowhawk, and Heald (2002) found that the majority of teachers held a positive view of adventure and simulation games. These teachers acknowledged that digital games contributed to the development of personal strategies such as problem-solving, deductive reasoning, memorizing, and sequence learning. On the group level, these teachers thought that task-based learning and cooperation can be incorporated into the setting of a digital game. Despite their favorable attitudes, these teachers expressed that it would be difficult to use these simulation games in secondary school teaching because of time constraint in a class period and the need to adhere to coverage of standard curriculum. Another main disadvantage of using digital games in the classroom was the amount of preparation time for both students and the teacher had to spend guiding themselves within the game world. Just as with any kind of new introduction of technology into teaching and learning, the users (both teachers and students) need sufficient time to learn and obtain a feel of the game environment and interface, and master the play mechanics.

In reviewing survey results, Kirriemui and McFarlane (2003) examined a survey commissioned in 2002 by the British Education and Technology Agency (BECTA) which investigated how and where digital games were used in schools. Another survey under examination of similar scale was the 2002 Teachers Evaluating Educational Multimedia (TEEM) project that also surveyed the use of digital games in UK schools. In terms of obstacles in implementing game-based learning in the classroom, both surveys results overlapped in reporting the most frequently mentioned obstacles:

1. The “limited timespan of individual classes” (p. 7) meaning that game-based learning needs to establish students’ immediate learning
2. Verification that the digital game is suitable for class learning purposes
3. Need for support material for teachers, e.g., game-based lesson plan and student performance evaluation.
4. School information technology licensing agreements might “make it difficult to introduce specific new software onto school networks” (p. 7).
5. Contemporary digital games may be costly and require new or expensive classroom hardware upgrades that could be unjustifiable.

In result, based on prior research findings a total of 18 potential factors were included in a survey item to capture the scope of potential external barriers that may deter or prevent teachers from using digital games in the classroom.

In Kirriemuir and McFarlane’s (2003) report, they observed a trend of increasing and creative use of digital games in a variety of classroom settings, but concluded with ambivalence by stating that it was “frustrating...schools provide games for recreation or as rewards for good behavior but fail to use them for learning-oriented purposes even where this potential is

recognized” (p. 10). As noted by Egenfeldt-Nielsen (2005), we need more cases and experiences in using digital games in educational settings accompanied by sound pedagogical considerations and practices. Teachers with sparse background in gaming are understandably reluctant to use games in teaching because they would feel unprepared and concerned about the amount of time and resources for preparation, a process usually unaided by school staff. Considering this lack of prior experience, it is strongly recommended that the school technology staff assist during the intervention of DGBL in the classroom (Gros, 2007).

Attitudes and Self-Efficacy toward Digital Game-Based Learning Survey

Based on the review of prior studies, a new 33-item survey was developed for the present study. This instrument included four dimensions of attitudinal scale and is purposefully created to investigate the specific impact of teachers’ current gaming experience, attitudes toward using digital games, self-efficacy on the implementation of DGBL, and perceived challenges and barriers to the adoption of DGBL in classroom settings. Taken altogether, the four dimensions could be potential predictors to teachers’ adoption of DGBL in the classroom.

The survey also includes questions related to demographics and probes into teachers’ teaching philosophy. By investigating what type of educational digital games teachers are most inclined to adopt for classroom instruction and compare whether their chosen game type matches with their teaching philosophy, findings of this study would reveal teachers’ preferred game type and their implicit endorsement or beliefs about what teaching and learning entail. Open-ended items were also included to assess teachers’ lesson plan pedagogical considerations when it comes to integrating digital games in classroom instruction. As a result, the complete 33-item survey consists of an array of 5-point Likert scale (1 indicating strongly disagree to 5 indicating strongly agree) multiple choice items and open-ended prompts delving into survey participants’

demographics, gaming experience, attitudes toward using games for teaching, self-efficacy on using DGBL, perceived challenges and barriers, and teaching philosophy (see Figure 10 in Appendix).

APPENDIX

Figure 10. Attitudinal Scale on the Adoption of DGBL

Purpose of Survey and Consent Information
Consent Form Title of Research Project: Teachers' Attitudes and Self-Efficacy towards the Adoption of Digital Game-Based Learning Dear All: We would like to ask you to spend about 20 minutes to complete a 33-item survey, to hear from you about your attitudes towards using digital games for educational purposes in your pre-service teacher preparation, internship year or in-service teaching. Your feedback via this survey will be helpful to us in our efforts to understand the affordances and constraints of using digital game-based learning (DGBL) in the classroom setting. Your participation in this project is completely voluntary. At any time during the survey you may refuse to provide information or discontinue your participation without giving a reason and with no negative consequences. You may complete the survey anonymously. At the end of the survey you have the option of providing your email address if you are interested in learning more about digital game-based learning and are willing to be contacted for follow-up information, but this is completely optional. Survey takers who provided email will be entered into a raffle for a chance to receive an \$100 electronic gift card as token of appreciation. If you do provide your email address, this email address will be kept confidential and will not be shared with anyone else. Your name will not be identified in any written records or reports. Thank you for considering this request. Your input would be greatly appreciated. If you have concerns or questions about this study, such as scientific issues, how to do any part of it, please contact the researchers: Dr. Patrick Dickson (pdickson@msu.edu) 509E Erickson Hall Michigan State University East Lansing, MI 48824 517-355-4737 Min Lun Wu (wumin3@msu.edu) 517-775-8897 By clicking "Next" you are voluntarily agreeing to participate in this research study.

Figure 10. (cont'd)

Current Gaming Experience

Important Definition of "Digital Games":
Throughout this survey, the term "digital games" refers to "video games played digitally on a technological device including home gaming console, handheld gaming device, tablet computer, cell phone or smart phone, and home computer."

***1. How many hours do you CURRENTLY play digital games (including on a gaming console, tablet, cell phone, or on the Internet) per WEEK on average?**

☐ Never

☐ Less than one hour

☐ One to three hours

☐ Three to five hours

☐ Five to seven hours

☐ Seven to ten hours

☐ More than ten hours

If never, please briefly explain why:

***2. I enjoy playing digital games.**

Strongly Disagree Disagree Neutral Agree Strongly Agree

☐ ☐ ☐ ☐ ☐

***3. Which of the following platforms have you MOST frequently used for playing digital games in this past year?**

☐ Gaming console (Playstation 3, Xbox 360, Wii, etc.)

☐ Computer (Web-based games and other games played online)

☐ Tablet computer (iPad or Android-driven tablets)

☐ Handheld gaming device (Playstation Portable, Playstation Vita, iPod Touch, Nintendo 3DS, etc.)

☐ Cell phone or Smart Phone (Android smart phone, iPhone, Blackberry, Windows smart phone, etc.)

☐ Game Arcade Center

Other (please specify)

Figure 10. (cont'd)

***4. How frequently do you engage in the following game-related practices?**

	Never	Once or Twice Per Year	Monthly	Weekly	Daily
Visit game websites, read reviews and/or discussion boards	☐	☐	☐	☐	☐
Use cheat codes, walkthroughs or game hacks	☐	☐	☐	☐	☐
Help or guide others when playing	☐	☐	☐	☐	☐
Write or contribute to game websites, reviews and/or discussion boards	☐	☐	☐	☐	☐
Use mods or other player-generated game code that changes something in the game	☐	☐	☐	☐	☐
Modify or create game code	☐	☐	☐	☐	☐
Create mini-game(s) using game creation software (GameMaker, Microsoft Kodu, Gamestar Mechanic, Game Quest, Unity, Flash, Action Script, etc.)	☐	☐	☐	☐	☐

Other game-related practices. Please specify.

***5. Choose the description below that BEST describes why you play digital games.**

☐ I play video games to pass the time when I am bored, have some free time, or I am waiting for something else to happen.

☐ I play video games when I get together with my friends, or online with many other players. Playing video games is another social activity for me.

☐ I play video games because I enjoy playing them as a leisure pursuit; if I get together with people to play, we focus on the game and are persistent in mastering the game.

☐ I devote a lot of time to playing video games. I engage in one or more of the following activities: playing games competitively, modifying game content or code, and/or creating walkthroughs and guides for other players. I am recognized by others as knowledgeable about games and as a skilled player.

Other reasons about why you play games. Please specify.

Figure 10. (cont'd)

Attitudes towards Using Digital Games in the Classroom

6. What do you think of first when you think about “digital games”? Please name a few digital games and briefly describe your impressions.



Figure 10. (cont'd)

7. What do you think of first when you think about “educational digital games”? Please name a few educational digital games and briefly describe your impressions.



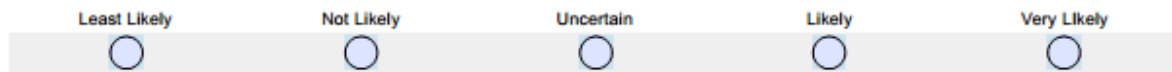
***8. I am comfortable with the idea of using digital games as tools for teaching educational content.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

Figure 10. (cont'd)

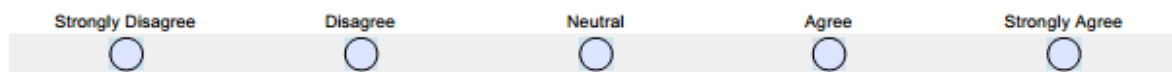
***9. What do you believe is the likelihood of you incorporating digital game-based learning in your current or future teaching?**

Least Likely Not Likely Uncertain Likely Very Likely



***10. I believe I would consider student-suggested digital games that may be appropriate to be used for classroom teaching and learning.**

Strongly Disagree Disagree Neutral Agree Strongly Agree



Why or Why Not? Please briefly explain.

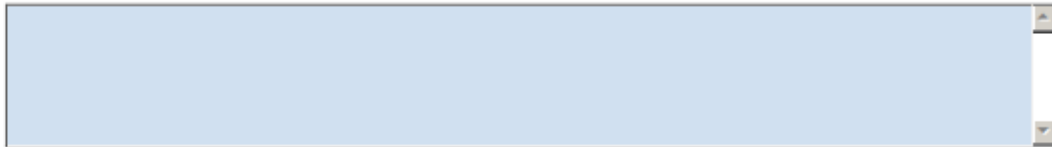


Figure 10. (cont'd)

***11. I believe digital games can be useful tools to teach educational content for the following reasons.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
They tend to be fun, hands-on, motivating and engaging for students.	☐	☐	☐	☐	☐
I myself played games and I learned through gaming.	☐	☐	☐	☐	☐
I enjoy incorporating new digital technologies into teaching.	☐	☐	☐	☐	☐
Nowadays students are more attuned to learning with digital media or new technologies.	☐	☐	☐	☐	☐
They give me a step up among classroom teachers who are interested in using digital technologies for teaching.	☐	☐	☐	☐	☐
Digital games are easy to set up to facilitate classroom teaching and learning.	☐	☐	☐	☐	☐
Digital games provide me with another platform to engage my students in learning.	☐	☐	☐	☐	☐
They promote personalized learning.	☐	☐	☐	☐	☐
They can promote learning in STEM (science, technology, engineering, mathematics).	☐	☐	☐	☐	☐
Using digital games help me relate to my students.	☐	☐	☐	☐	☐
They promote cognitive and collaborative learning.	☐	☐	☐	☐	☐
They can be used as reward when students do well in class.	☐	☐	☐	☐	☐
They can be used to promote learning objectives that meet common core standards.	☐	☐	☐	☐	☐
They can be used as supplemental learning materials.	☐	☐	☐	☐	☐

Figure 10. (cont'd)

Digital games bridge the gap between what students do at home and at school.	☐	☐	☐	☐	☐
Honestly I don't think digital games can be used as effective learning tools. Here is why (comment in below comment box).	☐	☐	☐	☐	☐
Other reasons (please specify)					

Figure 10. (cont'd)

Self-Efficacy on Adoption of Digital Game-Based Learning

Great job! You have finished more than 1/3 of the survey. Go go go ~



 Math Blaster	 Reader Rabbit	 Oregon Trail
 Where in the World is Carmen Sandiego	 Monster Physics	 Motion Math Zoom

Figure 10. (cont'd)

***12. Please read the following descriptions of the four types of educational digital games and respond accordingly.**

TYPE ONE

Edutainment Games and Educational Applications for Mobile Devices -- Games or software created to both entertain and teach educational content mainly through drill and practice.

For example:

Math Blaster--- Help students refine essential math skills through a unique combination of algebra lessons and arcade-style game play.

Reader Rabbits--- Featuring a variety of simple games designed to teach school children basic reading and spelling skills.

Oregon Trail--- Teach about the realities of 19th century pioneer life on the Oregon Trail. The player assumes the role of a wagon leader guiding his party of settlers from Independence, Missouri, to Oregon's Willamette Valley over the Oregon Trail via a covered wagon in 1848.

Where in the World is Carmen Sandiego--- Teach geography and reference skills. The player takes on the role of police and explores the globe tracking down crafty criminals.

Monster Physics--- Building app that lets you play with physics. Build and operate your own car, crane, rocket ship, plane, helicopter, tank and more.

Motion Math Zoom--- The intuitive pinch gesture allows kids to navigate among concrete objects (animals) that represent abstract numbers: from dinosaurs in the thousands to amoebas in the thousandths.

I would most likely adopt "Edutainment Games and Educational Applications" for classroom teaching.

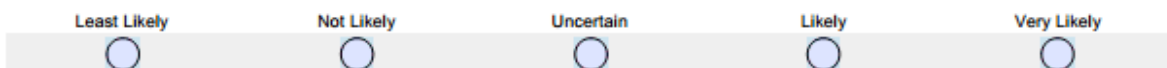


Figure 10. (cont'd)



Figure 10. (cont'd)

***13. TYPE TWO**

Serious Games -- Games designed to promote cognitively stimulating experience to aid individual learning and knowledge construction in math, science, literacy, history, or learning in healthcare, business, advertisement or training.

For example:

Immune-Attack --- Teaches science. Players navigate a nanobot through a 3D environment of blood vessels and connective tissue in an attempt to save an ailing patient by retraining their non-functional immune cells.

Playing History--- Teaches history by letting players be part of history in the making through engaging in personal stories in larger world history episodes such as the plague, the slave trade, and the Vikings.

Dimension M--- Sci-fi adventure game with math questions tied into the storyline. Players learn how basic algebra and arithmetic can be practical applications in the real world. This online math game has been used to supplement math curriculum in schools.

Supercharged!--- Places students in a 3D environment where they must navigate a spaceship by controlling the electric charge of the ship, placing charged particles around the space. Students must carefully plan their trajectory through each level by tracing the field lines that emanate from charged objects, and in the process of doing so, develop a more hands on understanding of how charged particles interact.

WolfQuest--- 3D wildlife simulation that helps players understand wolves and the roles they play in nature by being virtually incarnated as a gray wolf themselves.

Environmental Detectives--- An augmented reality game that teaches chemistry and environmental engineering to high school students. In this game students play the role of environmental engineers to locate the source of toxins and solve water pollution problems.

I would most likely adopt "Serious Games" for classroom teaching.



Figure 10. (cont'd)



Figure 10. (cont'd)

***14. TYPE THREE**

Simulation and Massive Multi-Player Online (MMO) Games – Turn-based strategy and multi-player role-playing games that simulate real-life experiences or systems embedded with opportunities for analytic learning through social interactions and collaborations.

For example:

Civilization series--- Commercial turn-based simulation game repurposed for teaching humanity and history. Players select a historical civilization to develop sustainably to be the dominant and surviving civilization. Suitable for teaching principles of history and knowledge of geography.

Quest Atlantis--- Educational multi-player online game that teaches socio-cultural and environmental inquiry. Players take on the role of empowered scientists, doctors, reporters, and mathematicians who have to understand disciplinary content to accomplish quests. The game has demonstrated learning gains in science, language arts, and social studies.

RollerCoaster Tycoon series--- Commercial game repurposed for teaching business planning, management, and marketing. Players are in charge of managing and construction of amusement parks; rides can be built or demolished, terrain and scenery can be adjusted, and prices can be controlled to keep visitors happy.

SimCity--- Commercial game repurposed for teaching political science and urban planning. Players build and design cities by zoning land, adding buildings, changing tax rates, and building power grids and transportation systems, enhancing their cities over time.

Age of Empires--- Commercial game repurposed for teaching history. Real-time strategy game focusing on historical events throughout time. Age of Empires covers the events between the Stone Age and the Classical period, in Europe and Asia.

World of Warcraft (WoW)--- Commercial MMO role-playing game where players join guilds, outfit, and improve their avatar by venturing through quests cooperatively and competitively with other online players from around the world.

I would most likely adopt "Simulation and Massive Multi-Player Online Games" for classroom teaching.

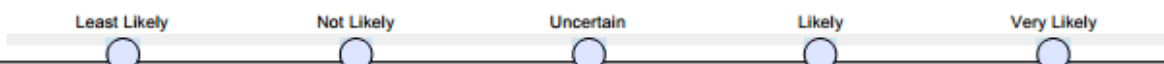


Figure 10. (cont'd)



Figure 10. (cont'd)

***15. TYPE FOUR**

Educational Game Design -- Game creation tools that teach about basic game design and programming where players learn to think systematically and design a functional game space while faring through tasks related to problem-solving and construction.

For example:

Gamestar Mechanic--- Online game community designed to teach the guiding principles of game design and systems thinking. The game is optimized for youngsters to learn the principles of game design by playing a narrative-based Quest where they play, repair and build games using the in-game design tools. As they advance in the Quest, players also earn "sprites" (characters, avatars, enemies, etc...) for use in their own games. At any time, players can switch to their Workshops and make an original game using the assets they have earned. Players can publish their games to an online community within the platform called Game Alley where other users can play and leave feedback on their games

Tynker --- Children-friendly browser-based computer programming tool for grade 4-8 students. This tool uses cartoon style graphics to teach young learners how to arrange blocks of code to create animated stories. As kids advance, they will be introduced to syntax-driven programming.

Microsoft Kodu--- A simplified visual programming model for even young children to approach and enjoy game design. The simplicity is achieved by situating the programming task in a largely complete simulation environment. The user programs the behaviors of characters in a 3D world, and programs are expressed in a sensory paradigm consisting of a rule-based system or language, based on conditions and actions.

Alice--- Freeware object-based programming tool and also educational programming language for beginning learners interested in computer programming. Alice uses a drag and drop environment to create computer animations using 3D models.

Scratch--- An educational programming language and multimedia authoring tool that can be used by pupils, teachers, and parents for a range of educational and entertainment projects for math and science. Projects include simulations and visualizations of experiments, recording lectures with animated presentations, and interactive art and music.

I would most likely adopt "Educational Game Design" for classroom teaching.

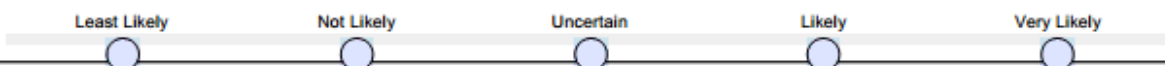


Figure 10. (cont'd)

***16. I believe I am capable of using digital games to deliver educational content in my teaching.**

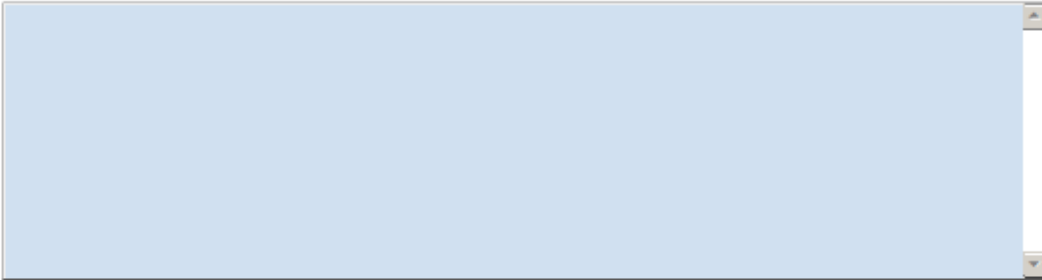
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

Figure 10. (cont'd)

***17. I have had experience using a digital game to deliver educational content or facilitate learning.**

- ☐ Yes
☐ No

If yes, please briefly describe the experience.



***18. In this past year, I have used digital games to facilitate teaching and learning in a classroom for this many time (s).**

- ☐ None
☐ One time
☐ Two times
☐ Three times
☐ Four times
☐ Five times or more

Figure 10. (cont'd)

19. If you are to design a digital game-based learning lesson plan by choosing and using ONE type of the four types of digital games listed in question 12 to 15:

- 1. Edutainment and Educational Apps**
- 2. Serious Games**
- 3. Massive Multiplayer Online Role-Playing and Simulation Games**
- 4. Educational Game Design**

Which type of digital game would you choose and why?



20. Using the TYPE of digital game you chose from the previous question to design a digital game-based learning lesson plan, what are the considerations that would go into your lesson planning?

For instance, what are your subject-specific learning objectives, instructional practices, technical implementation, student activities, outcome assessment, and alignment with standards? (If you have a specific game in mind, you can base your lesson planning off the game)

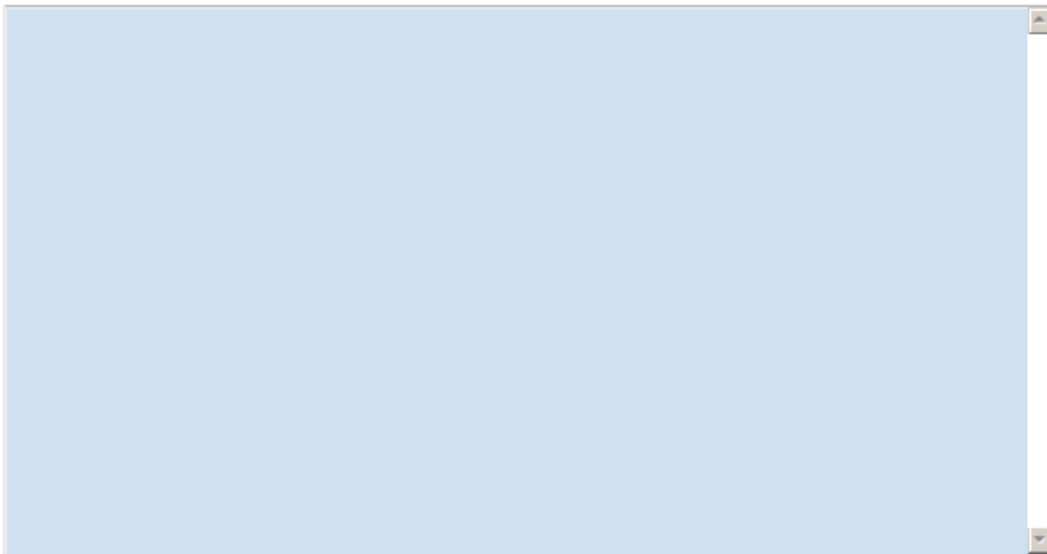


Figure 10. (cont'd)

Perceived Challenges & Barriers to the Integration of DGBL

Alright! You have progressed through more than 2/3 of this survey. Final stretch, keep it going!



***21. I believe the following are challenges to me in Integrating digital game-based learning in my classroom.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Lack of knowledge and skills in teaching strategies, organization, assessment, and classroom management in implementing game-based learning	☐	☐	☐	☐	☐
Lack of knowledge and skills to use game-based learning strategies to approach teaching of specific content	☐	☐	☐	☐	☐
Lack of knowledge and skills to implement game-based learning while making justified choices of digital tools	☐	☐	☐	☐	☐

Other challenges? Please specify.

Figure 10. (cont'd)

***22. I believe the following are barriers to my integrating digital game-based learning in my classroom.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Cost of purchasing games	☐	☐	☐	☐	☐
Most teachers seem skeptical about using video games for education	☐	☐	☐	☐	☐
Parents' negative perceptions of video games as educational	☐	☐	☐	☐	☐
Lack of administrative support to use video games for teaching	☐	☐	☐	☐	☐
Technology is distraction	☐	☐	☐	☐	☐
Low quality in graphics or audio effects in educational digital games	☐	☐	☐	☐	☐
Inadequate computer or technology support to run digital games in the classroom	☐	☐	☐	☐	☐
Playing video game may have negative influences on my students	☐	☐	☐	☐	☐
Low quality in the design and play mechanics of educational digital games	☐	☐	☐	☐	☐
Not enough time to use video games in short class periods	☐	☐	☐	☐	☐
Administrators' negative perceptions of video games as educational	☐	☐	☐	☐	☐
Digital game-based learning cannot meet desired learning objectives	☐	☐	☐	☐	☐
Lack of preparation to use digital game-based learning in teacher education	☐	☐	☐	☐	☐
Video games may pose classroom management issues	☐	☐	☐	☐	☐
Lack of professional development on using video games for teaching	☐	☐	☐	☐	☐
Short class period hinders long-term engagement in complex games	☐	☐	☐	☐	☐
Lack of alignment with	☐	☐	☐	☐	☐

Figure 10. (cont'd)

curriculum or state standards
Video games require additional lesson planning time
Other barriers? Please specify.

Figure 10. (cont'd)

Demographics

***23. What is your current status?**

☐ Pre-Service Teacher

☐ Internship Teaching

☐ In-Service Teacher

Other (please specify)

***24. What is your gender?**

☐ Female

☐ Male

***25. What is your age?**

☐ 18 to 22

☐ 23 to 26

☐ 27 to 32

☐ 32 or older

Figure 10. (cont'd)

***26. Area of Specialization (Check all that apply)**

☐ Arts

☐ Early Childhood Education Unified with Special Education

☐ English and Language Arts

☐ Foreign Language

☐ Health

☐ History

☐ Instructional Strategist: Mild/Moderate (K8) Endorsement

☐ Mathematics

☐ Music

☐ Science

☐ Social Studies

☐ Speech/Theater

☐ Engineering

☐ Secondary Language Education

Other (please specify)

***27. What grade range best reflects your current teaching or the ideal grade level that you would like to teach?**

☐ Preschool

☐ Lower Elementary

☐ Upper Elementary

☐ Middle School

☐ High School

☐ Higher Education

☐ I'm not now or planning on being a teacher

Other (please specify)

Figure 10. (cont'd)

Teachers' Teaching Philosophies					
Please read the following four statements of teaching philosophy and respond accordingly.					
*28. Teaching should focus on using DRILLS and PRACTICES to make sure students remember what they learned from class.					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am likely to adopt this teaching philosophy	☐	☐	☐	☐	☐
The above statement aligns with my teaching philosophy	☐	☐	☐	☐	☐
The above teaching philosophy is good for my students	☐	☐	☐	☐	☐
*29. Teaching should focus on understanding how individual student TAKES IN INFORMATION and helping them PROCESS and LINK that information to PRE-EXISTING knowledge to solve problems.					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am likely to adopt this teaching philosophy	☐	☐	☐	☐	☐
The above statement aligns with my teaching philosophy	☐	☐	☐	☐	☐
The above teaching philosophy is good for my students	☐	☐	☐	☐	☐
*30. Teaching should focus on facilitating SOCIAL INTERACTIONS among students so that knowledge is CO-CONSTRUCTED and shared.					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am likely to adopt this teaching philosophy	☐	☐	☐	☐	☐
The above statement aligns with my teaching philosophy	☐	☐	☐	☐	☐
The above teaching philosophy is good for my students	☐	☐	☐	☐	☐

Figure 10. (cont'd)

***31. Teaching is most effective when parts of a learning activity the learner experiences are about CONSTRUCTING a meaningful product.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am likely to adopt this teaching philosophy	☐	☐	☐	☐	☐
The above statement aligns with my teaching philosophy	☐	☐	☐	☐	☐
The above teaching philosophy is good for my students	☐	☐	☐	☐	☐

Figure 10. (cont'd)

32. If you would like to be entered into the raffle for a chance to receive a \$100 electronic gift card, please leave us your email below.

33. Do you wish to be contacted for a follow-up on learning about using educational digital games for teaching? Please respond below.

☐ Yes

☐ No

If yes, please leave your email below.

Figure 10. (cont'd)

Thank you for your time and thoughtful responses!



CHAPTER 4

RESEARCH METHOD

Research Design

This study is an exploratory case study that employs the quasi-experimental concurrent triangulation mixed method design (Campbell et al., 2012; Creswell et al., 2003). The mixed-method research design used both quantitative and qualitative methods for data collection and analyzed with the purpose of cross-validating multiple sources of findings within a single study. By adopting a mixed-method design, the triangulated findings would achieve more explanatory power.

Participants and Setting

Participants of this study are undergraduate and graduate students who enrolled in educational technology courses in a large Midwestern university. By the time of participation in this study, these students were either pre-service, internship year, or in-service teachers in mainly K-12 school contexts. Monetary incentive was provided in the form of electronic gift card to one participant selected via a raffle, out of a pool of participants who fully completed the online survey.

Research Questions

Four main questions with sub-questions were formulated to guide this current study. The term “digital games” as used in this study refers to “video games played digitally on a technological device such as home gaming console, handheld gaming device, tablet computer, cell phone or smart phone, and home computer.” This definition was presented verbatim to guide respondents to the online survey.

1. What are teachers' current gaming experiences as defined by hours spent on digital gaming per week, enjoyment, platform, frequency in game-related practices, and gaming orientations?
2. What are teachers' attitudes toward implementing DGBL in the classroom?
 - 2.1 Are teachers comfortable with the idea of using digital games for teaching?
 - 2.2 What are teachers' perceived usefulness of using digital games for teaching?
 - 2.3 What are teachers' perceptions of educational digital games?
 - 2.4 What do teachers believe is the likelihood of them using digital games in current or future teaching?
 - 2.5 How likely would teachers consider using student-suggested game titles for digital game-based learning?
3. What are teachers' perceived levels of self-efficacy on integrating DGBL?
 - 3.1 Which type of educational digital game would teachers prefer to use for DGBL?
 - 3.2 Do teachers' game genre choice align with their teaching philosophy?
 - 3.3 What do teachers believe is their capability of using DGBL in the classroom?
 - 3.4 Have teachers used DGBL in the classroom before? How frequent do they use DGBL?

- 3.5 What are teachers' considerations in drafting a DGBL lesson plan?
4. What are teachers' perceived challenges and barriers toward using DGBL in the classroom?

Procedure for Data Collection

An online survey, which contains 33 items, focusing on the investigation of teachers' current leisure gaming background, attitudes toward DGBL, self-efficacy on the adoption of digital games for teaching educational content, perceived challenges and barriers to the integration of DGBL, and teaching philosophies was administered via SurveyMonkey, an online survey hosting site.

By collecting quantitative and qualitative data, the concurrent triangulation design used in this mixed method study helps to examine and achieve validity and reliability of the researcher-constructed attitudinal scale through data triangulation and corroboration of findings.

Data Analyses

Survey results were entered into the Statistical Package for Social Sciences (SPSS), and analyzed using independent samples t-test, Pearson bivariate correlation analysis and principal component analysis. Construct validity (reliability) of the survey instrument was evaluated. Confirmatory factor analysis was performed to seek latent structures underlying the perceived barriers toward using DGBL. Correlation analysis was performed to evaluate how teachers' teaching philosophy line up against their chosen genre of educational digital games to be used for DGBL in the classroom. Content analysis (Krippendorff, 2004) was conducted to assess the qualitative data collected from the open-ended items on the survey.

CHAPTER 5

ANALYSES & FINDINGS

The survey was administered through an online survey website. Multiple survey requests were sent out periodically to encourage participation. An estimated number of 1,000 potential survey respondents was reached and a total of 160 people took the survey (response rate at 16%). Among the 160 survey takers, 116 respondents completed the survey in full (completion rate 73%). While the response rate of the survey was far from ideal, the completion rate showed encouraging signs considering the survey provided marginal incentive, a chance to win an electronic gift card, for voluntary participation.

Descriptive Quantitative Data Analysis

Delving into survey data, the below discussion succinctly outlines the responses as obtained from each of the 33 survey items. No missing values were recorded since survey respondents were required to complete each item successively to progress. However, respondents were allowed to skip item 6, 7, 19, and 20 which were designed to solicit open-ended responses. Below is a discussion of the findings sorted by themes.

In terms of demographics, to increase survey completion rate and prevent survey takers from potentially withdrawing over the concern of releasing personal information, items investigating demographic information were intentionally slotted toward the end of the survey (item 23 to 27). However for the purpose of discussion, demographic information will be presented first.

Responses to item 23, “What is your current (teaching) status?” are shown in Table 3. A sizable 44% of the respondents were pre-service teachers and only 19.8% were internship year

teachers. Considering the fact that a majority of the survey respondents were pre-service teachers who do not yet have their own classrooms and could be naïve or overly optimistic users of technology, there should be a more nuanced view of their self-reports here in this study.

Table 3. Percentage Response to “Current Teaching Status”

Teaching Status	Pre-Service	Internship Year	In-Service
	44	19.8	36.2

N = 116

Results of item 24 that inquired about gender indicated 86.2% of respondents being female and 13.8% being male (see Table 4). This result reflects the commonly observed phenomenon in the gender distribution of the teaching force in teacher education programs nationwide.

Table 4. Percentage Response to “Gender”

Gender	Male	Female
	13.8	86.2

N = 116

Responses to item 25 concern survey respondents’ age range and the results are shown in Table 5. A combined 81.9% of respondents are between the age range of 18 to 26 where they are either in teacher preparation, internship year or at the phase of induction into formal school teaching settings.

Table 5. Percentage Response to “Age Range”

Respondent Age	18-22	23-26	27-32	32 or older
	50.9	31.0	6.9	11.2

N = 116

Results from item 26 showed respondents’ area of specialization and they were allowed to choose more than one area. A lopsided 64.7% are in English and language arts; 13.8% are in mathematics. There is a three-way tie among early childhood education unified with special education, secondary language education, and social studies at 9.5%. For a complete rundown of the areas of specialization, please refer to Table 6. The fact that 64.7% of survey respondents specialized in English and language arts may have skewed the overall survey results but it also opens a window for the introduction/salience of game-based learning tools for that particular subject matter.

Table 6. Survey Result on Area of Specialization

Answer Choices	Responses	
▼ Arts	6.90%	8
▼ Early Childhood Education Unified with Special Education	9.48%	11
▼ English and Language Arts	64.66%	75
▼ Foreign Language	6.90%	8
▼ Health	1.72%	2
▼ History	3.45%	4
▼ Instructional Strategist: Mild/Moderate (K8) Endorsement	2.59%	3
▼ Mathematics	13.79%	16
▼ Music	1.72%	2
▼ Science	6.03%	7
▼ Social Studies	9.48%	11
▼ Speech/Theater	0.00%	0
▼ Engineering	0.00%	0
▼ Secondary Language Education	9.48%	11
Total Respondents: 116		

Responses to item 27, “What grade range best reflects your current teaching or the ideal grade level that you would like to teach?” are shown in Table 7.

Table 7. Percentage Response to “Current or Ideal Teaching Grade Level”

Grade Level	Preschool	Lower Elementary	Upper Elementary	Middle School	High School	Higher Education	Not Planning to be a Teacher
	0.86	44.8	25	10.3	9.5	4.3	5.2

N = 116

The most chosen by 44.8% of respondents was “lower elementary”, with “upper elementary” at second chosen by 25% of respondents. Hence 69.8% of survey respondents preferred or were already teaching in K-6 contexts.

Current Gaming Experience and Orientations. Turning now from demographics to respondents’ experience with games, item 1 and 2 focus on current gaming experience and item 3 through 5 focus on gaming practices and orientations. Responses to item 1, “How many hours do you currently play digital games (including on a gaming console, tablet, cell phone, or on the Internet) per week on average?” are shown in Table 8.

Table 8. Percentage Response to “Hours Spent on Gaming on Weekly Average”

Average Hours	Never	Less Than 1 Hr	1-3 Hrs	3-7 Hrs	More than 10 Hrs
	15.5	37.9	25.9	20.7	0

N = 116

The most frequent response was “less than one hour” chosen by 37.9% of the respondents. Overall, the result showed that a great majority of the survey respondents were at

best light gamers and some were non-gamers. Taking this important factor into consideration, a majority of the respondents do not personally play games and hence their attitudes toward DGGL could be naively optimistic. These respondents' attitude could be an important reality for any teacher education program aspiring to prepare teachers to integrate DGBL. There is a need for teachers to acquire foundational experience in gaming as a crucial first step to grapple with the idea of using DGBL in instruction. On the other hand, no survey respondent chose "more than ten hours", a response that might be expected from hardcore gamers.

On item 2, respondents were asked to rate their enjoyment of games in general on a 5-point scale from strongly agree to strongly disagree to the statement "I enjoy playing digital games." Responses are shown in Table 9. Overall the pattern shows a generally positive response, with 57.8% choosing either strongly agree or agree compared to only 13.8% choosing disagree or strongly disagree.

Table 9. Percentage Response to "Enjoyment of Digital-Gaming"

Enjoyment	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	6.0	7.8	28.4	46.6	11.2

N = 116

Responses to item 3, "Which of the following platforms have you most frequently used for playing digital games in this past year?" are shown in Table 10. The most frequent choice was cellular/smart phone at 63.8%. This foregrounds the commonly observable phenomenon, the popularity and ubiquity of smartphones among our survey takers (mostly in their twenties) that may have had in turn boosted activities of mobile device-based social gaming. Coming in second is "tablet computer" at 19.8%. Combining tablet computers with cell phones, an

overwhelming portion of 82.6% survey respondents cemented the stronghold of mobile device ownership among young technology users and the affinity between themselves and the high penetration rate, when it comes to the choice of platform for the activity for gaming.

Table 10. Percentage Response to “Most Frequently Used Platform for Gaming”

Platform	Gaming Console	Personal Computer	Tablet Computer	Handheld Gaming Device	Smartphone	Arcade Center
	6.0	8.6	19.8	0.9	63.8	0.9

N = 116

Responses to item 4, “How frequently do you engage in the following game-related practices?” are shown in Table 11. Choices include “visit game websites, read reviews and discussion boards”, “use cheat codes, walkthrough or game hacks”, “modify or create game code”, “create mini-games using game creation software”, etc. Choices are rated on a frequency scale from “never”, “once or twice per year”, “monthly”, “weekly”, to “daily”. Across the board, the rating average for all seven game-related practices are quite low, hovering around 1.07 to 1.54, with one being the minimum score and five the maximum. The more common game-related practices these survey respondents engaged in were visiting game websites, reading reviews, and helping or guiding others when playing. Considering that modding and creating mini-games using game creation software tend to be activities habitual or hardcore gamers would take on, the result of this survey item was not surprising given a great majority of our survey respondents are light gamers at best and quite a few are non-gamers.

Table 11. Frequency on Game-Related Activities

	Never	Once or Twice Per Year	Monthly	Weekly	Daily	Total	Weighted Average
Visit game websites, read reviews and/or discussion boards	70.69% 82	17.24% 20	5.17% 6	4.31% 5	2.59% 3	116	1.51
Use cheat codes, walkthroughs or game hacks	79.31% 92	15.52% 18	4.31% 5	0.86% 1	0.00% 0	116	1.27
Help or guide others when playing	60.34% 70	27.59% 32	9.48% 11	2.59% 3	0.00% 0	116	1.54
Write or contribute to game websites, reviews and/or discussion boards	93.97% 109	6.03% 7	0.00% 0	0.00% 0	0.00% 0	116	1.06
Use mods or other player-generated game code that changes something in the game	93.97% 109	5.17% 6	0.00% 0	0.86% 1	0.00% 0	116	1.08
Modify or create game code	99.14% 115	0.86% 1	0.00% 0	0.00% 0	0.00% 0	116	1.01
Create mini-game(s) using game creation software (GameMaker, Microsoft Kodu, Gamestar Mechanic, Game Quest, Unity, Flash, Action Script, etc.)	95.69% 111	2.59% 3	0.86% 1	0.86% 1	0.00% 0	116	1.07

Results of item 5, “Choose the description below that best describes why you play digital games” were compiled in Table 12. In summary, 89.7% opted for the choice that describes the activity of gaming as one to pass time when bored or while waiting for something else to happen. In other words, for these 104 survey respondents, the activity of gaming serves only to pass time or as something to do during transition to a following activity. The other three available choices which depict different gaming orientations that involve elements of competitive gaming, social gaming, and persistence in gaming received minimum to no advocacy. This indicates and reinforces the previously discussed finding that our survey respondents turned out to be in the most part non-gamers or light gamers.

Table 12. Description on Gaming Orientations

Answer Choices	Responses
▼ I play video games to pass the time when I am bored, have some free time, or I am waiting for something else to happen.	89.66% 104
▼ I play video games when I get together with my friends, or online with many other players. Playing video games is another social activity for me.	5.17% 6
▼ I play video games because I enjoy playing them as a leisure pursuit; if I get together with people to play, we focus on the game and are persistent in mastering the game.	5.17% 6
▼ I devote a lot of time to playing video games. I engage in one or more of the following activities: playing games competitively, modifying game content or code, and/or creating walkthroughs and guides for other players. I am recognized by others as knowledgeable about games and as a skilled player.	0.00% 0
Total	116

Attitudes toward Using Digital Games in the Classroom. Survey Item 8 through 11 were designed to study aspects demonstrating teachers’ attitudes toward using DGBL. Responses to item 8, whether they are “comfortable with the idea of using digital games as tools for teaching educational content” are shown in Table 13. 15.5% chose neutral and a combined 6.9% indicated uncomfortableness. On the contrary, 77.6% of survey takers expressed

comfortableness in using digital games to supplement classroom instruction. The results also showed that over 3/4s of the 116 participating teachers are comfortable with the idea of using digital games as tools for classroom teaching. Encouraging as it may seem, these teachers' favorable attitude toward digital games concurrently begs the question as to how prepared they are to incorporate DGBL in the classroom.

Table 13. Percentage Response to “Comfortableness of Digital-Gaming”

Comfortableness	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1.7	5.2	15.5	49.1	28.5

N = 116

Response to item 9, “What do you believe is the likelihood of you incorporating digital game-based learning in your current or future teaching?” are shown in Table 14. This question reinforces item 8 in the sense that it taps beyond attitudinal perception to gauge the behavioral possibility of practicing DGBL. Ideally, the result of this question should emulate that of item 8. Here 16.4% chose “neutral”, 6% chose “not likely”, and none chose “least likely”. On the affirmative end, 49.1% chose “likely” and 28.5% chose “very likely”.

Table 14. Percentage Response to “Likelihood of Incorporating DGBL”

Likelihood	Least Likely	Not Likely	Neutral	Likely	Very Likely
	0	6.0	16.4	49.1	28.5

N = 116

Consequently 87.5% of respondents confirmed the likelihood of their implementing DGBL in current or future teaching. This result appeared reassuring considering that much similar to item 8, almost exactly the same choosing pattern emerged out of the number of item 9 response counts for each of the five choices. In other words, for this particular group of 116 teachers, favorable attitudes toward DGBL are consistent with the likelihood of them incorporating DGBL in the classroom. From the viewpoint of survey instrumentation, the investigated concept of attitude in item 8 and likelihood in item 9 may be merged as one index with which to predict teachers' use of DGBL in classroom settings.

Item 10 probed into whether teachers "believe they would consider a student-suggested digital game that may be appropriate to be used for classroom teaching and learning" and the results are shown in Table 15. No one chose "strongly disagree", 3.4% chose "disagree" and 10.3% chose "neutral". 63.8% chose "agree" and 22.5% chose "strongly agree". This result again reinforced these 116 teachers' positive perceptions toward DGBL observed at the point of survey-taking.

Table 15. Percentage Response to "Consideration of Using Student-Suggested Games for Classroom Teaching"

Consideration	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	0	3.4	10.3	63.8	22.5

N = 116

Of the respondents, 86.3% either agreed or strongly agreed to the concept of using student-suggested digital games for classroom teaching and learning sends the message that these teachers are open-minded about and could entertain the idea of leveraging students' pre-existing

background and experience in gaming toward using carefully chosen games for DGBL in the classroom.

Responses to item 11, “I believe digital games can be useful tools to teach educational content for the following reasons” are shown in Table 16. A total of 16 statements is provided as potential rationale for using DGBL and they include “They tend to be fun, hands-on, motivating and engaging for students”, “I enjoy incorporating new digital technologies into teaching”, “Digital games provide me with another platform to engage my students in learning”, “They promote personalized learning”, “Using digital games helps me relate to my students”, “They can be used as reward when students do well in class”, “They can be used to promote learning objectives that meet common core standards”, and a comprehension check negative statement phrased as “Honestly I don’t think digital games can be used as effective learning tools” and etc.

Table 16. Percentage Response and Mean to “Reasons for Believing DGBL are Useful Tools for Teaching Educational Content”

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
They tend to be fun & engaging for students	0.9	0	4.2	50.9	44.0	4.37
Another platform to engage students in learning	0.9	0.9	6.9	50.9	40.4	4.29
Students attuned to learning with digital media	0.9	3.5	6.9	48.2	40.5	4.24
Enjoy incorporating digital technologies into teaching	0.9	1.8	12.9	42.2	42.2	4.23
They can be used as supplemental learning materials	0.9	1.7	6.9	56.9	33.6	4.21
They promote learning in STEM	0.9	0.9	17.2	48.2	32.8	4.11
They can be used to promote learning objectives that meet common core standards	1.7	0.9	16.4	54.3	26.7	4.03
They promote personalized learning	0.9	4.2	16.4	49.1	29.3	4.02
Used as reward when students do well in class	0.9	6.9	11.2	53.5	27.5	4.00
Digital games bridge the gap between what students do at home and at school	0.9	3.5	18.1	54.2	23.3	3.96
They promote cognitive and collaborative learning	1.7	5.2	19.0	50.9	23.3	3.89
They give me a step up among classroom teachers interested in using digital techs for teaching	1.7	6.9	29.3	39.7	22.4	3.74
Using digital games help relate to students	3.5	11.2	22.4	37.1	25.9	3.71
I myself played games and I learned through gaming	7.8	18.1	19.8	34.5	19.8	3.41

Table 16. (cont'd)

Digital games are easy to set up to facilitate teaching	3.5	18.1	30.2	34.5	13.8	3.37
Honestly I don't think digital games can be used as effective learning tools	59.5	25.9	6.9	6.0	1.7	1.65
N = 116						

In analyzing survey respondents' answers, it was observed that across the board all of the 15 affirmative statements received most prominently the choice of "agree", ranging from 34.5% to 56.9%. In 13 out of the 15 affirmative statements, the choice "strongly agree" came in second in term of being chosen percentage-wise, ranging from 19.8% to 42.2%. This finding indicated that our survey respondents held an overall positive attitude toward using digital games as tools for instruction.

On the lower end, 34.5% chose "agree" when it comes to "I myself played games and I learned through gaming" and "Digital games are easy to set up to facilitate classroom teaching and learning." 37.1% chose "agree" on "Using digital games helps me relate to my students." On the higher end, 54.3% chose "They can be used to promote learning objectives that meet common core standards" and "Digital games bridge the gap between what students do at home and at school." 56.9% chose "They can be used as supplemental learning materials."

The mean column indicated the ranked average score for the 16 statements. In terms of rating average, the lowest was 3.37 (out of a maximum score of five) on the statement "Digital games are easy to set up to facilitate classroom teaching and learning". This showed that despite these teachers' general positive attitude toward using digital games for instruction, they do not think digital games are easy to set up or to be obtained in classroom settings. The highest rating average was 4.37 on the statement "They tend to be fun, hands-on, motivating and engaging for

students”, indicating that these 116 respondents acknowledged the pronounced element of fun and motivation induced through using digital games for classroom instruction.

As mentioned earlier, the 16th statement in survey item 11 served as comprehension check and also an outlet to gauge other reasons the researcher may not have tapped into. 59.5% chose “strongly disagree” and 25.9% chose “disagree”. This showed that a combined 85.4% of survey respondents negated the statement “Honestly I don’t think digital games can be used as effective learning tools.” In sum, it appeared that the survey respondents carefully read through each statement and were not blindly clicking through them.

Perceived Self-Efficacy on Implementing DGBL. Survey item 12 to 20 are designed to gauge survey respondents’ self-efficacy, preference on game genre, and experience in using DGBL. Item 12 to 15 investigate survey respondents’ preferred game genre for DGBL when informed of what each genre generally entails with sample game titles and descriptions of game play.

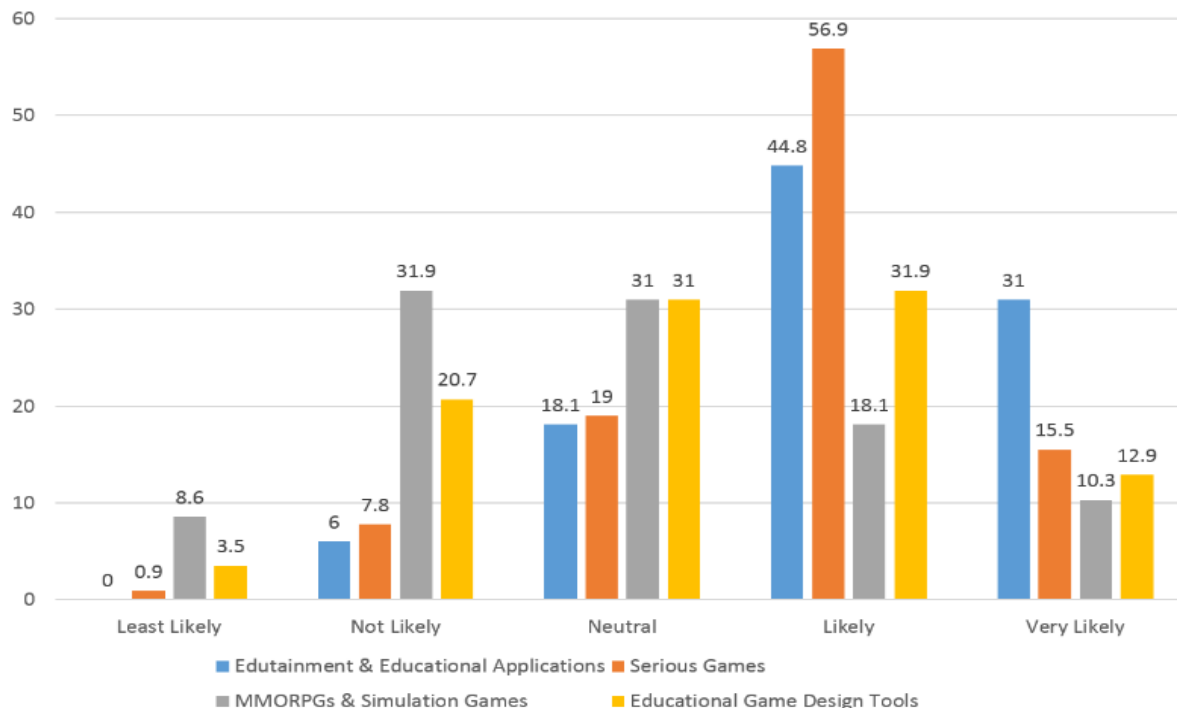
Item 12 focused on the genre “Edutainment Games and Educational Applications for Mobile Devices” that is created to both entertain and teach educational content mainly through drill and practice. The result was a large portion of 44.8% chose “likely” and 31% chose “very likely”, combining for an overwhelming 75.8% of respondents who favored the use of this genre of games for DGBL.

Item 13 described the genre “Serious Games” as designed to promote cognitively stimulating experience to aid individual learning and knowledge construction in math, science, literacy, history, or unconventional topics in healthcare, business, advertisement or training. Here a large proportion 56.9% selected “likely” and coming in second 19% selected “uncertain”.

Item 14 laid out information pertaining to the genre “Simulation and Massive Multi-Player Online Games” and depicted them as turn-based strategy and multi-player role-playing games that simulate real-life experiences or systems embedded with opportunities for analytic learning through social interactions and collaborations. The most chosen choice was “not likely” at 31.9% and the second most was “uncertain” at 31%.

Item 15 presented information about the genre “Educational Game Design” and described them as game creation tools that teach about basic game design and programming where players learn to think systematically and design a functional game space while faring through tasks related to problem-solving and construction. The choice “likely” was selected for 31.9% and coming in a close second “uncertain” at 31%. For a summary of the survey results of item 12 to 15, please see Figure 11.

Figure 11. Percentage Response to “Preferred Game Genre”



When compared by teaching status and running an independent samples t-test, 51 pre-service teachers chose edutainment and educational applications the most frequently (mean = 4.0). The next most frequently chosen game genre was serious games, then educational game design, and the least chosen was simulation and MMORPGs. The 23 internship teachers chose edutainment and educational applications the most frequently (mean = 3.8). The next most frequently chosen game genre was serious games, then educational game design, and the least chosen was simulation and MMORPGs. The 42 in-service teachers chose edutainment and educational applications the most frequently (mean = 4.1). The next most frequently chosen game genre was serious games, then educational game design, and the least chosen was simulation and MMORPGs (see Table 17).

Table 17. Mean, Standard Deviation, and Ranking for the Four Game Genres

Genre by Teaching Status	<i>M</i>	<i>SD</i>	Ranking
	Pre / Int / Ins	Pre / Int / Ins	
Edutainment & Educational Apps	4.0 / 3.8 / 4.1	.95 / .78 / .79	Unanimous 1st
Serious Games	3.8 / 3.6 / 3.9	.79 / .83 / .83	Unanimous 2nd
Educational Game Design Tools	3.4 / 3.1 / 3.3	1.0 / .81 / 1.19	Unanimous 3rd
Simulation Games & MMORPGs	3.1 / 2.6 / 2.9	.99 / 1.0 / 1.33	Unanimous 4th

Note. Pre = Pre-service, Int = Intern, Ins = In-service. Mean score ranging from 0 to 5.

Bringing together the results from item 12 to 15, it became evident that the preference of game genre for DGBL for all three groups of teachers proved to be exactly the same, ranking atop from the most favored edutainment games and educational applications, to serious games, then educational game design tools, and lastly simulation games and MMORPG games.

Responses to item 16, “I believe I am capable of using digital games to deliver educational contents in my teaching” are shown in Table 18. In result, 62.9% chose “agree” with “strongly agree” coming in second at 18.1%. Very few respondents chose “disagree” and “strongly disagree”, indicating these survey respondents’ general optimism and belief in their self-efficacy to use digital games in teaching.

Table 18. Percentage Response to “Self-Efficacy of Using DGBL”

Efficacy	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	0.9	5.2	12.9	62.9	18.1

N = 116

Building on item 16, item 17 asked survey takers about their actual experience of using DGBL by raising the question that asked whether they “have had experience using a digital game to deliver educational content or facilitate learning.” Intriguingly 66.4% chose “no” and this seemed somewhat counterintuitive to their displayed optimism shown in item 16. In other words, even though 81% of respondents expressed self-efficacy in using DGBL but only 33.6% of respondents have had actual experience using DGBL for educational purposes at the point of taking this survey.

Responses to item 18, “In this past year, I have used digital games to facilitate teaching and learning in a classroom for this many time (s)” are shown in Table 19. As a result, 57.8% chose “none”, 9.5 % chose “two times”, and 8.6% chose “one time”. Interestingly the second most chosen was “five times or more” at 16.4% and this showed that these 19 respondents already took active interest in using DGBL in the classroom.

Table 19. Times of Using DGBL in this Past Year

Answer Choices	Responses	
None	57.76%	67
One time	8.62%	10
Two times	9.48%	11
Three times	3.45%	4
Four times	4.31%	5
Five times or more	16.38%	19
Total	116	

Perceived Challenges and Barriers to Integration of DGBL. Item 21 asked survey respondents whether they “believe the following are challenges in integrating digital game-based learning in the classroom.” The three sub-items each received relatively similar distribution of response counts. The first sub-item “Lack of knowledge and skills in teaching strategies, organization, assessment, and classroom management in implementing game-based learning” is designed to denote equivalence of the lack of PK in implementing DGBL and 41.4% chose “agree”. The second sub-item “Lack of knowledge and skills to use game-based learning strategies to approach the teaching of specific content” denotes the lack of PCK in using DGBL and again the most prominently chosen at 45.7% was “agree”. The third sub-item “Lack of knowledge and skills to implement game-based learning while making justified choices of digital tool” means the lack of TPK. Here once again 45.7% chose “agree” and it was the most chosen.

Combining and weighing those that chose “agree” and “strongly agree” against those choosing “disagree” and “strongly disagree” for all three sub-items, it is observed that approximately 50% of respondents felt that their lack of PCK, TPK, and PK in implementing DGBL are internal challenges whereas about 30% felt that those knowledge and skills did not

appear to them as challenges. In sum, while about 20% of the 116 respondents chose “neutral”, almost 50% of the 116 survey respondents indicated lack of PCK, TPK, and PK as internal challenges in carrying out DGBL in a classroom setting.

Responses to item 22, “I believe the following are barriers to my integrating digital game-based learning in my classroom” are shown in Table 20. A total of 18 sub-items was laid out as potential external barriers that could impede with teachers’ implementation of DGBL in the classroom. Most survey takers chose “agree” in 12 out of the 18 sub-items and “disagree” in 5 out of the 18 sub-items. Sub-items such as “cost of purchasing games” (53.4%), “inadequate computer or technology support to run digital games in the classroom” (53.4%), and “not enough time to use digital game-based learning in short class periods” (50%) were the top-three ranking sub-items agreed upon as the most prominent external barriers to the use of DGBL. This showed that a majority of the 116 survey takers were first and foremost concerned about the budget of purchasing educational digital games. Will the school administrators be willing to finance for DGBL or do the teachers have to pay for digital games using their own budget? Also of important consideration here is to obtain the right to distribute and the licensing of digital games for classroom instruction.

Table 20. Perceived Barriers toward Integration of DGBL

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Weighted Average
Cost of purchasing games	2.59% 3	6.90% 8	17.24% 20	53.45% 62	19.83% 23	116	3.81
Most teachers seem skeptical about using video games for education	9.48% 11	18.97% 22	31.03% 36	32.76% 38	7.76% 9	116	3.10
Parents' negative perceptions of video games as educational	5.17% 6	17.24% 20	25.00% 29	44.83% 52	7.76% 9	116	3.33
Lack of administrative support to use video games for teaching	5.17% 6	11.21% 13	29.31% 34	45.69% 53	8.62% 10	116	3.41
Technology is distraction	14.66% 17	37.07% 43	25.00% 29	19.83% 23	3.45% 4	116	2.60
Low quality in graphics or audio effects in educational digital games	17.24% 20	35.34% 41	31.90% 37	13.79% 16	1.72% 2	116	2.47
Inadequate computer or technology support to run digital games in the classroom	7.76% 9	12.07% 14	12.93% 15	53.45% 62	13.79% 16	116	3.53
Playing video game may have negative influences on my students	9.48% 11	40.52% 47	33.62% 39	14.66% 17	1.72% 2	116	2.59
Low quality in the design and play mechanics of educational digital games	6.03% 7	31.90% 37	37.07% 43	24.14% 28	0.86% 1	116	2.82
Not enough time to use video games in short class periods	6.03% 7	14.66% 17	18.97% 22	50.00% 58	10.34% 12	116	3.44

Table 20. (cont'd)

▼ Administrators' negative perceptions of video games as educational	6.03% 7	14.66% 17	25.00% 29	47.41% 55	6.90% 8	116	3.34
▼ Digital game-based learning cannot meet desired learning objectives	12.07% 14	35.34% 41	26.72% 31	21.55% 25	4.31% 5	116	2.71
▼ Lack of preparation to use digital game-based learning in teacher education	7.76% 9	15.52% 18	25.86% 30	43.97% 51	6.90% 8	116	3.27
▼ Video games may pose classroom management issues	7.76% 9	27.59% 32	26.72% 31	31.03% 36	6.90% 8	116	3.02
▼ Lack of professional development on using video games for teaching	6.03% 7	13.79% 16	19.83% 23	47.41% 55	12.93% 15	116	3.47
▼ Short class period hinders long-term engagement in complex games	5.17% 6	14.66% 17	21.55% 25	47.41% 55	11.21% 13	116	3.45
▼ Lack of alignment with curriculum or state standards	5.17% 6	21.55% 25	28.45% 33	39.66% 46	5.17% 6	116	3.18
▼ Video games require additional lesson planning time	5.17% 6	32.76% 38	29.31% 34	31.03% 36	1.72% 2	116	2.91

The other first-tying sub-item was related to technology infrastructure at schools. When schools lack sufficient technology, staff, and resources, teachers with the intent to use DGBL will not be adequately supported to use digital games for teaching. Depending on the availability of financial resources in different school districts, different school cultures, and administrators'

attitudes toward technology-mediated instruction, a teacher in any given school may find him/herself in an environment that may or may not actively promote the use of technology in education. While technology infrastructure is essential to successful implementation of DGBL, it does not mean that teachers in a relatively technology-deprived context cannot start with using a digital game on a single tablet or computer to jumpstart students' attention and motivation to learn content. Another high ranking sub-item was teachers' concern over not having enough time to use DGBL in short class periods. In K-12 context of teaching where a class period typically ranges from 40 to 50 minutes, it could be difficult for teachers to select an appropriate game title and segment a full length digital game into meaningful units in order to fit into instruction. Nevertheless, teachers can purposively choose and use short-length educational digital games appropriate for teaching content or transitioning into other instructional activities.

The sub-items survey takers disagreed with and hence chose the most frequent were, "playing video games may have negative influences on my students" (40.5%), "technology is distraction" (37.1%), "low quality in graphics or audio effects in educational digital games" (35.3%), and "digital game-based learning cannot meet desired learning objectives" (35.3%). This showed that the 116 survey takers converged on and disagreed the most with the idea that playing digital games may bring adverse effects to students. Considering that only 14.7% chose "agree" and 1.7% chose "strongly agree" in response to the proposed negative influence of digital gaming, it is safe to say that a combined 50% of survey takers did not deem digital gaming as a negative activity for their students. The sub-item "technology is distraction" is related to the above-discussed notion of negative influence of digital gaming. A combined 52% of survey respondents selected either "disagree" or "strongly disagree" in response to the statement while 25% chose "neutral", indicating that more than half of the 116 participants did

not consider the use of technology as distraction in classroom settings. While the statement “technology is distraction” was generic, it served as a prompt to probe into these 116 teachers’ attitude toward the role of technology use in the classroom.

Of the respondents, 35% chose “disagree” and 17% chose “strongly disagree” when it came to the low quality in graphics or audio effects in educational digital games. This implied that 53% of respondents thought that modern day digital games or educational applications may not be sub-par in terms of graphic presentation or audio effects or that low quality educational digital games would not constitute external barriers to their implementation of DGBL. A third-tying sub-item stated that DGBL cannot meet desired learning objectives and 35% of respondents chose “disagree” and 12% chose “strongly disagree.” While 27% of respondents maintained neutral, 47% of respondents considered DGBL as a form of technology-enhanced instruction that can lead to student learning.

To this point of discussion, the analysis has focused on descriptive statistics. Using a variety of methods of statistical analysis, the below section delves more in-depth into the acquired quantitative data.

Inferential Quantitative Data Analysis

One of the main goals of this study is to develop and evaluate the survey instrument created to assess teachers' attitudes and inclination to use DGBL in classroom settings. To achieve this goal, a variety of analyses of the survey data were conducted to examine the reliability of the researcher-developed attitudinal scales, as well as the interrelationships among the constructs measured by the subscales.

After running a reliability analysis on SPSS for 22 items (demographic and open-ended items excluded), the overall reliability (internal consistency) of the administered survey is strong (Cronbach's $\alpha = .82$) as a reliability coefficient of .70 or higher is commonly deemed acceptable in most research conducted in the realm of social and learning sciences.

Survey item 11, which contains 15 sub-items, examined the perceived usefulness of DGBL. A reliability analysis was conducted and the reliability of these 15 sub-items is strong (Cronbach's $\alpha = .93$). Pearson bivariate correlation analysis was performed to examine whether the 15 sub-items were relevant measures. Findings from the bivariate correlation analysis showed that the 15 sub-items all significantly correlated with each other with low to moderate coefficients ranging from .29 to .74 ($p < .01$, two-tailed). Hence in future iterations of research, the 15 sub-items related to the perceived usefulness of DGBL could potentially be reduced to a set of fewer indices or variables.

Survey item 28 through 31 presented respondents with sub-items that correspond to four strands of contemporary teaching philosophy – behaviorism, cognitive constructivism, social constructivism, and constructionism. Each teaching philosophy was accompanied by three statements that serve to examine respondents' alignment or belief in teaching practices. In the attempt to test if the total of 12 sub-items were valid measures of respondents' teaching beliefs,

bivariate correlation analysis was conducted. The result showed that the three sub-items in each of the four philosophies are significantly correlated with moderate to high coefficients ranging from .76 to .96 ($p < .01$, two-tailed). This finding showed that the 12 sub-items are salient measures of their beliefs in teaching (see Table 19) and the three sub-items in each of the four teaching philosophies can potentially be reduced to a single index or variable.

In terms of which teaching philosophy these teachers appeared to endorse, a comparison of the mean score was conducted (see Table 21). Constructionism had the highest mean score at 4.17 (out of a max score of 5.00); cognitive constructivism was at 4.14; social constructivism was at 4.06; behaviorism came in at a low score of 2.73. Overall, these teachers seemed to share teaching beliefs the least with behaviorism whereas the other three teaching philosophies received relatively equal and favorable acknowledgment.

Table 21. Comparison of Mean Score on Teaching Philosophy

Teaching Philosophy	M	SD	N of Items	Cronbach's Alpha
Behaviorism	2.73	1.17	3	.98
Cognitive Constructivism	4.14	.62	3	.93
Social Constructivism	4.06	.60	3	.94
Constructionism	4.17	.60	3	.94

Items were rated on a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree, with a higher score indicating agreement with statements reflective of these philosophies.

In the attempt to investigate if there is alignment between the teaching philosophies and the game genres, several noteworthy findings arose from the bivariate correlation analysis (see Table 22).

Table 22. Correlation Matrix for Teaching Philosophies and Game Genres

Correlations									
		Edutainment & Ed Apps	Serious Games	Simulation & MMORPGs	Educational Game Design	Behaviorism	Cognitive Constructivism	Social Constructivism	Constructionism
Edutainment & Ed Apps	Pearson Correlation	1	.440**	.262**	.306**	.046	.226*	.205*	.069
	Sig. (2-tailed)		.000	.004	.001	.627	.015	.031	.467
	N	116	116	116	116	116	115	111	115
Serious Games	Pearson Correlation	.440**	1	.432**	.265**	-.112	.208*	.221*	.167
	Sig. (2-tailed)	.000		.000	.004	.231	.026	.020	.075
	N	116	116	116	116	116	115	111	115
Simulation & MMORPGs	Pearson Correlation	.262**	.432**	1	.470**	-.029	.184*	.155	.190*
	Sig. (2-tailed)	.004	.000		.000	.761	.049	.104	.042
	N	116	116	116	116	116	115	111	115
Educational Game Design	Pearson Correlation	.306**	.265**	.470**	1	-.300**	.250**	.229*	.319**
	Sig. (2-tailed)	.001	.004	.000		.001	.007	.016	.001
	N	116	116	116	116	116	115	111	115
Behaviorism	Pearson Correlation	.046	-.112	-.029	-.300**	1	-.061	-.209*	-.298**
	Sig. (2-tailed)	.627	.231	.761	.001		.520	.028	.001
	N	116	116	116	116	116	115	111	115
Cognitive Constructivism	Pearson Correlation	.226*	.208*	.184*	.250**	-.061	1	.568**	.439**
	Sig. (2-tailed)	.015	.026	.049	.007	.520		.000	.000
	N	115	115	115	115	115	115	111	115
Social Constructivism	Pearson Correlation	.205*	.221*	.155	.229*	-.209*	.568**	1	.508**
	Sig. (2-tailed)	.031	.020	.104	.016	.028	.000		.000
	N	111	111	111	111	111	111	111	111
Constructionism	Pearson Correlation	.069	.167	.190*	.319**	-.298**	.439**	.508**	1
	Sig. (2-tailed)	.467	.075	.042	.001	.001	.000	.000	
	N	115	115	115	115	115	115	111	115

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

1. *Behaviorism was negatively correlated with Educational Game Design Tools with statistical significance ($r = -.30, p < .01$).*

This finding seems relevant since the central learning tenet of behaviorism, stimulus and response (knowledge input and output in the form of observable behavior), is at odds with the learning objectives such as creativity and artifact creation promoted by the exploratory and design-oriented activities involved in educational game design.

2. *Cognitive Constructivism was positively correlated with Edutainment Games and Educational Applications ($r = .23, p < .05$), Serious Games ($r = .21, p < .05$), and Educational Game Design Tools ($r = .25, p < .01$) with statistical significance.*

This finding is congruent with the previously stated notion that the four game genres are not mutually exclusive in terms of the learning objectives/opportunities they are designed to afford. For instance, even though edutainment games tend to be designed to promote learning as defined

by behaviorism, these games can still be leveraged in different ways to promote cognitive learning when a teacher employs pedagogical practices in line with cognitive constructivism by emphasizing the information taken in by an individual learner through schemata activation and cognitive processing.

3. Social Constructivism was positively correlated with Edutainment Games and Educational Applications ($r = .21, p < .05$), Serious Games ($r = .22, p < .05$), and Educational Game Design Tools ($r = .23, p < .05$) with statistical significance.

This finding may seem out of place considering that edutainment games and serious games were designed to mainly promote individual learning processes and outcomes devoid the impact of social surroundings and participation. That said, it is commonly observed that contemporary educational applications running on mobile technologies such as smartphones and tablet computers not only affords solitary play but also allows for and encourages group play and social play via online player invitation, collaborative-operation mode or live scoreboard competition. Player collaboration, resource-sharing, and knowledge co-construction are hence made possible even on edutainment games or educational applications.

4. Constructionism was positively correlated with Simulation Games & MMORPGs ($r = .19, p < .05$), and Educational Game Design Tools ($r = .32, p < .01$) with statistical significance.

This finding seems pertinent to the built-in game features available in a lot of the modern day simulation and MMO games where players are required to allocate and stratify available resources, and fortify defense by constructing in-game artifacts or assets to fend off adversarial invasion, particularly in tower defense games. In sum, the play mechanics involved in most simulation games, MMORPGs, and educational game design tools are hinged on strategies and deliberate moves that entail creativity, prompt reaction, corroboration and construction.

The extraction method, confirmatory factor analysis under principal component analysis (PCA), was performed to study the relationship and filter for a latent structure underlying the 18 sub-items representing external barriers in implementing DGBL in survey item 22. As a result of the analysis, a parsimonious set of five components was extracted with 68% cumulative variance explained (see Table 23). Note that an oblique rotation was used taking into account the inherent correlations between these 18 sub-items. The factor loadings for the five components were mostly over 0.63 and all five components had Eigenvalues of greater than one. The extracted five main components were mismatch between DGBL and standardized curriculum, administrative and parental negative perceptions, lack of technology support and preparation in teacher preparation and professional support, short class periods, and low quality of educational digital games. Through confirmatory factor analysis, these five components were found to constitute the main external barriers to the implementation of DGBL within the scope of this current study.

Table 23. Principal Component Analysis on External Barriers

Rotated Component Matrix

	Component				
	1	2	3	4	5
Technology is distraction	.762	.184	.105	-.205	.174
Playing video game may have negative influences on my students	.734	.219	.144	.019	.277
Video games may pose classroom management issues	.679	.169	.244	.216	.037
Lack of alignment with curriculum or state standards	.576	.158	.161	.522	.099
Digital game-based learning cannot meet desired learning objectives	.555	.157	.097	.388	.120
Parents' negative perceptions of video games as educational	.154	.844	.146	-.079	.222
Lack of administrative support to use video games for teaching	.281	.800	.137	.234	-.071
Administrators' negative perceptions of video games as educational	.166	.744	.187	.382	-.051
Most teachers seem skeptical about using video games for education	.213	.628	.427	.026	.261
Lack of professional development on using video games for teaching	.075	.210	.738	.073	.370
Lack of preparation to use digital game-based learning in teacher education	.277	.275	.719	.104	.126
Cost of purchasing games	.014	.183	.664	.284	-.076
Inadequate computer or technology support to run digital games in the classroom	.298	.186	.552	.261	-.228
Video games require additional lesson planning time	.278	-.072	.487	.294	.174
Not enough time to use video games in short class periods	.052	.110	.241	.838	.208
Short class period hinders long-term engagement in complex games	.047	.134	.316	.790	.088
Low quality in graphics or audio effects in educational digital games	.322	.013	.178	.088	.798
Low quality in the design and play mechanics of educational digital games	.186	.231	-.003	.419	.696

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

Qualitative Data Analysis

For the purpose of gathering the "voices" of the teachers in this study, four open-ended questions were included. Also, each of 14 multiple choice survey items included a text box for survey takers to invite comments. In the following section, a discussion surrounding the analysis of the qualitative data acquired from open ended prompts will be presented.

Item 5 invited survey respondents to choose among four descriptions that best describe why they played digital games. Nine respondents added an open-ended response. Three responses stated that they do not really play any games. Worthy of notice is one elaborate response that states the following:

Not only do I play games for myself, I am interested in what my students and other students are playing. Often, I try out the demos instead of investing cash in a game. I still have games I play online with my brothers and friends that I invest real money in. *I live overseas and gaming is one environment that I share time bonding with my brothers - i.e. Diablo series, Command & Conquer, StarCraft. Other than those MP (multiplayer) games, I avidly investigate what students at my schools are playing currently.

For this particular survey respondent, who identifies as a teacher, the activity of gaming feeds into dual purposes. Firstly, being overseas, gaming has helped the teacher to socialize and bond with family members. Secondly, gaming has gone beyond being a personal leisure activity given the teacher is also interested and avidly investigates what games his/her students are playing. Although the teacher did not explicate in greater detail why he/she is interested in the

games students play, it is safe to say that the teacher treats gaming as a possible common ground where he/she can share interests and interact meaningfully with students. Both of these two responses emphasized on teachers' attempt in relating to student interest in gaming but not going far and beyond to considering incorporating digital games for purposes of instruction.

Item 6 and 7 asked about survey takers their first impressions of “digital games” and “educational digital games.” The following three main themes emerged from the 109 responses to item 6 regarding their impressions of digital games:

1. *Mobile-centric, simple, short-form and entertaining:* Popularly mentioned were gaming applications available on mobile devices such as smartphones and tablet computers. Repeatedly appearing in their responses were titles such as Angry Birds, Temple Run, Plants vs. Zombies, Words with Friends, Bejeweled, Minecraft, and Candy Crush. These gaming applications are marked by the traits of fun, highly addicting, easy to play (simple play mechanics), come-and-go and suitable distraction during short periods of spare time.
2. *Preconceived gender association:* Several remarks associated “digital games” with “gamers” and boys playing video games over girls. One observation states that girls play puzzle and learning games while boys play graphically intense and action-packed FPSs (first person shooters) and time-absorbing and obsessive RPGs (role-playing games). Some responses embodied negative connotations such as overindulgence of digital gaming replacing normal social activities, interests, and interactions.
3. *Preconceptions toward functionality of gaming:* Repeatedly mentioned negative terms associated with the act of gaming were “escapism from real life”, “time-filler”,

“addictive and time-wasting”, and “mindless”. On the other hand some described the positive image of digital gaming as a new form to “learn and engage with life”, facilitative for practicing “decision-making”, “critical thinking”, and fantasizing “alternate universes”.

The 107 responses to item 7 regarding first impressions of “educational digital games” could be categorized into three themes:

1. *Tie-in with subject area matters*: Many responses took note of the extra practices afforded by the use of educational digital games in traditional subject areas of literacy, mathematics, and science, and they also provide a venue through which non-conventional skills such as creativity, problem-solving and motor skills can be honed in.
2. *Need for teaching young learners in ways that appeal to them*: Multiple responses mentioned that nowadays educational digital games are an integral part of kids’ lives and these games are good at “tricking students into learning” and helping “kids engaging in learning without realizing that they are”. As opposed to formal learning, educational digital games can be effective tools with which to induce incidental or discovery learning. A question that remains is how valuable are incidental or discovery learning and how they can be leveraged in a way to supplement formal learning.
3. *Not seriously educational*: A number of responses pinpointed that educational digital games can be fun and informative but they are after all not “designed to achieve serious educational goals” and not “correlated to standards or the current instructional topic”. These claims ran counter to the notion that educational digital games can

provide educational merits such as extra practice and sustained interest in learning. In sum, some survey respondents perceived educational digital games as a form of entertainment, supplementary to formal instruction and cannot replace a teacher-conducted lesson.

When asked about their likelihood of incorporating digital game-based learning in their teaching (item 10), 92 respondents added an open-ended response regarding why or why not. Content analysis of the textual responses yielded the following main observations.

1. *Educational value as premise:* The premise for using student-suggested game titles is that they embody educational value. The definition of educational value can be twofold. Firstly, student-suggested games can elicit participation and motivation, and “motivation to learn is half the battle”. The interactive value of DGBL is perhaps best illustrated by the following response.

People like games because they are challenging and engaging, not because they let one’s mind sit idle. If students can find some value in a particular game then I would definitely take the time to review it to consider if it would complement content material in the classroom because the game has potential to enhance the educational experience and deepen learning.

Secondly, the appropriate use of DGBL in instruction can potentially bring forth educational value by meeting learning objectives promoted by technology standards in the common core state standards.

2. *Kids tend to be more familiar with new technologies before adults are:* Youngsters of the new generation take ownership over their learning via practicing new literacies

and using technologies. Many survey respondents were cognizant of the high penetration of technology in home contexts and mentioned that they believe gaming is one of the “windows into the interests of many of our students today” given that students are “more reliant on multimedia than previous generations”. By using student-suggest game titles, teachers are essentially leveraging students’ pre-existing interests to engage and motivate them to learn in an interactive format with rewarding challenges. More importantly, teachers can sensitize students to the notion that “learning can happen multiple ways”.

3. *Student-centered teaching and learning:* Several respondents stated that their school or they themselves endorse student-centered curriculum and pedagogy where DGBL can be potentially useful. In consequence, by adopting student-suggested game titles for instruction, these respondents emphasized that “children need to know they can be a part of their learning process”, “their opinion matters”, and as teachers they are willing to give students “autonomy in structuring their learning experience”.

Survey item 17 probed into whether survey respondents’ had actual experience in using DGBL and 39 respondents were affirmative. Among the 39 respondents, 32 left open-ended comments to briefly describe their previous experience in practicing DGBL. In summarizing their usage, most teachers used digital games to review, practice content, or use DGBL as supplement or as a reward. Repeatedly mentioned games that were used by teachers were games such as *Reader Rabbits*, *Math Blaster*, *Oregon Trail* and game applications such as *Motion Math* and *Monster Physics* that run on tablet computers. Upon scrutiny, these games were used to mainly promote behavioristic learning in literacy and model concepts in mathematics or science in lower elementary grade classrooms. In sum, many teachers used tablet computer games,

interactive web-based games and a few teachers mentioned the use of Smartboard game applications.

Some of the most valuable responses to open-ended questions were found on item 19, in which respondents were first asked to only choose one out of the four genre to incorporate into a DGBL lesson and then write a justification for their choice. The question was worded as, “If you are to design a DGBL lesson plan by choosing and using ONE type of the four types of digital games... Which type of digital games would you choose and why?” Of the 116 respondents, 107 added a response to the open-ended question of why.

Table 24 summarizes survey takers’ in terms of the number of respondents choosing each of the game genre and the potential downsides and proposed justifications they offered for their choice of that genre of digital game for DGBL.

Table 24. Chosen Game Genre, Potential Downside, and Proposed Justification

	<i>Number of Times Chosen (N = 107)</i>	<i>Potential Downside</i>	<i>Proposed Justification</i>
Edutainment Games & Educational Applications	69	*Only for drill practicing and memorization	*Familiarity and comfortableness *Fits into content area *Promote positive learning *Engaging *Simple *Easy set-up *Easily used as supplemental materials/rewards for brain-break *Least player instruction needed *Appealing to young students *Age-appropriateness since they teach very young students *Appealing to and motivating for special education students *Greater chance to reaching the CCSS (Common Core State Standards) *Most directly designed to correlate with specific content area knowledge and therefore more relevance *Free and accessible by students *Shorter so they allow time for more students to partake in activity
Serious Games	19	*Too advanced for very young students *Cost *Longer and more involved *Not as focused on content	*Develop complex thinking and problem-solving *Play over time to generate classroom discussion and comparison of choices *Already experienced in using the three other types *Suitable for teaching greater depth content to older students *Curriculum-fitting *Connecting learning to real life situations *"Serious" game denotes desirable seriousness in students' gaming to learn content *Keep students invested over longer periods of time

Table 24. (cont'd)

Simulation & MMORPG Games	7	*Interactive games may induce cyber-bullying *Difficult to implement *Too advanced for very young students *Students may not understand the concept of why they are playing *Longer and more involved *Not as focused on content	*More hands-on learning *For an ESL course, the narrative aspect in RPGs and simulation games can offer opportunities for students to explore forms of language and use language to accomplish goals. *All students can get involved and learn together *Engage with peers *Promotes cooperative learning skills *Relate what is learned to the real world *Most interactive *Applicable to school tests *Promotes critical thinking
Educational Game Design	12	*Too advanced for very young students *Longer and more involved *Not as focused on content	*Let students design and create games *Engage students in learning and check their understanding *Opportunity to create and play *Game for application

The number of respondents choosing each genre reflects ranking of the four genres of educational digital games happens to be the same as the order of preference ranking gathered from survey item 12 to 15. Here again the game type Edutainment and Educational Applications took a huge lead (69 mentions) over the other three types combined (38 mentions). In terms of ranking order, the same was found with Serious Games coming in at second with 19 mentions, Educational Game Design at third with 12 mentions, and Simulation and MMORPGs with 7 mentions. In conclusion, when it comes to these survey takers' ranked preference over game genre for implementing DGBL, the results garnered from item 12-15 and item 19 are congruent.

Parsing through the information presented in the table, the potential downsides and justifications enumerated by survey respondents in choosing a certain genre of educational digital games revolved around the issues of age-appropriateness, ease on set-up procedure, and

correlation with subject area matters and testing. While these issues are equally important regardless of which genre of games a teacher chooses to implement into DGBL, edutainment games and educational applications were by far chosen with the highest frequency. The reason may be the pre-existing familiarity and the comfortableness arising from the familiarity, as it is safe to assume that edutainment games and educational applications were heavily favored because survey respondents were far more familiar with this type of games than with other recently emerging genres of serious games and educational game design tools.

Survey item 20 further probed into survey takers' pedagogical considerations when it comes to adapting a certain genre of educational digital games for teaching. The question was "Using the type of digital game you chose from the previous question to design a digital game-based learning lesson plan, what are the considerations that would go into your lesson planning? For instance, what are your subject-specific learning objectives, instructional practices, technical implementation, student activities, outcome assessment, and alignment with standards?"

A few examples of pedagogical consideration were purposefully inserted into the question to guide thinking and serve as starting points. Similar to item 19, item 20 did not require survey takers to leave an open-ended response but 84 did respond.

Table 25 is a summary of the categorizations based on content analysis of these 84 responses. Only those responses which were elaborate, content-specific and salient to pedagogy would be documented below. A single response may contain multiple pedagogical considerations.

Table 25. Categorization of Consideration, Number of Mention, and Example Response

<i>Categorization of Consideration</i>	<i>Number of Mention</i>	<i>Example Response</i>
Fitting into content area and learning objectives (PCK)	26	■ “I would choose a game that fits what I am teaching.” ■ “(After playing games) students will be able to distinguish the three states of matter.” ■ “Organize it (game) so that students with complementary skill levels are grouped together and have them work through the game as a group activity then reflect on the experience.” ■ “Learning objectives would be to maintain measurable checkpoints and continuous challenges rather than having them just practice what is comfortable.” ■ “Using Math Blaster to differentiate instruction.” ■ “I would pick a game that scaffolds what they have already learned.”
Teacher demonstration and guidance (PK)	8	■ “Writing out the important things about the game and the goals that the games were trying to get at.” ■ “All students would need a walkthrough tutorial and then practice with the game and logging in.” ■ “I’m a fan of discovery learning and students figuring out and discussing their learning after the game.”
Supplemental to whole-group instruction or as a reward (PK)	11	■ “An instructional strategy for using technology in the classroom could be to have it (game) as a reward.” ■ “Use the digital game at the end of the lesson as a review and practice session...follow the gradual release of responsibility model.” ■ “I would make sure it (game) was supplemental and it was not the focus.” ■ “Use the game as a partner/independent practice after a mini lesson.” ■ “I feel more comfortable in using the tools (games) to help me teach a standard than having the tool be the lesson itself.”

Table 25. (cont'd)

Outcome assessment and meeting common core state standards (PCK)	27	■ “I would take students’ test scores into consideration when assigning which app would suit students best.” ■ “I view assessing outcomes...through progress monitoring of the specific tasks within the game.” ■ “The game should give immediate feedback of correct or incorrect responses/answers.” ■ “How it (the game) links to standards.” ■ “Align any game with applicable Common Core Standards.” ■ “Teacher to see how the students are performing – a quick way of formative assessment.”
Meeting individual student and group needs (PK)	8	■ “I would work on cognitive ability and social skills within special education because I believe this (game) can help to bring both aspects in.” ■ “This (game) meets individual and group needs.” ■ “I would make sure that these (games) can accommodate all learners.” ■ “I would consider when the digital games come into play, whole class or independent?”
Class time (PK)	8	■ “The practical consideration of how much time it (game) will take.” ■ “Depending on the school district I am teaching in, it might be a situation where students are given a certain amount of time before they have to switch so all students have a chance to use the program (game).”
Student interest, ability and age-appropriateness (TPK)	10	■ “Student ability to navigate technology.” ■ “Since I work with adults I have to balance games carefully.” ■ “Knowing the students’ interests that are going to be using the game.” ■ “The game provides motivation and student interest.” ■ “The age group it needs to be catered to.”

Table 25. (cont'd)

Technology infrastructure, funds and stable access (TPK)	10	■ “I teach online courses, everyone can easily access the game.” ■ “Purchase rights/licenses.” ■ “Whether or not the technology would be available to me and if it would work when all the students tried to get onto the website.” ■ “Do we have the resources, funds...in order for my students to complete this task?” ■ “I would consider how many resources are available for the children to use.” ■ “At my school, we do not have a computer lab. We have a class set of iPads but they are only available for 45 minutes a day.”
Acquiring parental consent, staff and administrative support	4	■ “I want the game to mean something so I can get support from parents and other staff and prove that the game had merit.” ■ “I feel that parents would not understand the benefits of using digital games in my lesson, so I would want a very detailed lesson plan to back up my reasoning for using digital games.”

Nine strands of considerations were extracted from a comprehensive analysis of the textual data. Eight of the nine categorizations can be associated with the PK, TPK, and PCK involved in the internal context (of a classroom) for the implementation of DGBL. Acquiring parental consent and securing staff and administrative support does not render itself directly to pedagogy since it is primarily dealing with something external to the classroom implementation of DGBL. Nevertheless, this consideration is significant in that it is considering the “external context” as delineated in the DGBL TPACK framework where DGBL may be practiced and scrutinized by parents and administrators. Pedagogical knowledge (PK) include teacher demonstration and guidance before or during game play; using DGBL as supplement or reward to instruction; meeting both individual and group needs of learning. Technological pedagogical knowledge (TPK) is associated with the consideration of student interest, ability, and age-

appropriateness in technology use; infrastructure and access of technology. Pedagogical content knowledge (PCK) refers to the match between content area and learning objectives and the use of DGBL; focus on outcome assessment through using a game and how DGBL potentially aligns with common core state technology standards. Considering the demographic finding that 64.7% of the respondents had expertise in English and language arts, attention needs to be directed specifically to games that gear toward language learning. Also there is the notion that games for language learning would be different in structure and play mechanics from games for teaching mathematics.

To summarize, two pedagogical considerations were most prevalently pronounced – Fitting into content area and learning objectives, and outcome assessment and meeting standards. The fit between a chosen game and target content area knowledge in the context of DGBL is of paramount importance since depending on the teacher's subject area matter, he/she needs to be capable of choosing a game that is appropriate in content and addresses learning objectives by incorporating the game into instruction. If choosing a game that matches the curriculum and learning objective is the founding block, then ensuring student learning and performance through in-game or out-of-game outcome assessments serves as the solidifying pillar to the construction of effective DGBL environments. Also related to outcome assessment is teachers' point of emphasis on making sure that the use of DGBL can meet technology or state standards.

The number of mention for each of the pedagogical consideration does not encompass the richness and width of these survey takers' knowledge in pedagogy since the survey question was worded in a way to orient their thinking toward pedagogy in the context of using DGBL. Nevertheless, these respondent-generated pedagogical considerations could serve as resource helpful to teachers interested in using DGBL.

Corroboration of Quantitative Results in Qualitative Responses

The analyses of respondents' qualitative responses corroborate the results of the quantitative analyses. These two sources of insights into the respondents' perceptions of the value of digital game-based learning converged in three ways.

1. Teachers' overwhelming preference for using edutainment games and educational applications and their lack of familiarity with the other three genres of educational digital games: Both the results of quantitative and qualitative data analysis point to the fact that teachers heavily favored edutainment and educational applications over the other three genres. A combination of personal and pedagogical factors may have led to their overall preference. On a personal level teachers may already have established prior experience, familiarity and comfortableness with edutainment games and educational applications. On a pedagogical level, these short-form games and applications are ideal for the attention span of younger age students (given that a majority of the survey respondents identified as K-6 teachers) and they are in general easy to set up. More importantly, edutainment games and educational applications usually come in the form of prepackaged course contents and as compared to the other three genres of educational digital games, they could be a convenient and intuitive fit for educational content delivery.

2. Mismatch between teachers' preference for edutainment games and educational applications and their endorsement in non-behavioristic teaching philosophies: A general rule of thumb is that edutainment games and educational applications are designed following learning principles of behaviorism because most of these games focus on inducing learning in the form of stimulus and response. While the majority of

teachers participating in the research indicated preference for using this genre of games, it would have been natural for the teachers to endorse behaviorism as the teaching philosophy they resonated most with. Instead, behaviorism only received a mean score of 2.73 as these teachers gravitated significantly more toward constructionism ($M = 4.17$), social constructivism ($M = 4.06$), and cognitive constructivism ($M = 4.14$). The mismatch between the chosen genre of game and teaching philosophy pointed to two interesting findings. First, teachers may not already be cognizant of the behavioristic learning principles infused in the design of edutainment games and educational applications. Their favorable attitudes toward adopting this genre of games arose mainly from familiarity, comfortableness, and the ease of set-up. Second, considering the noticeable discrepancy between mean scores, the teachers apparently felt more in line with the learning principles in constructionism, cognitive constructivism and social constructivism, but not as prominently in behaviorism. The fact that the teachers favored edutainment games and educational applications but the teaching philosophy they endorsed is not compatible with the chosen genre of educational games leads to a mismatch between teaching material and pedagogy, hence potentially rendering DGBL less effective. From teachers' point of view, finding suitable games to use for the skills needed to be taught is of critical importance. To achieve this, teachers need to find resources and become educated in the genres of educational digital games and the corresponding learning theories inherent in its design, so that they can better leverage their teaching philosophy, knowledge and skills to teach in tandem with a compatible genre of educational digital game.

3. *Faring through both internal challenges and external barriers to the implementation of DGBL:* Quantitative analysis via the method of confirmatory factor analysis yielded five main external barriers and they include mismatch between DGBL and standardized curriculum, administrative and parental negative perceptions, lack of technology support and preparation in teacher preparation and professional support, short class periods, and low quality of educational digital games.

Qualitative analysis produced eight key internal challenges teachers would have to cope with in the adoption of DGBL. These eight challenges can be associated with the PK, TPK, and PCK involved in the context and implementation of DGBL. Pedagogical knowledge (PK) include teacher demonstration and guidance before or during game play; using DGBL as supplement or reward to instruction; meeting both individual and group needs of learning. Technological pedagogical knowledge (TPK) is associated with the consideration of student interest, ability, and age-appropriateness in technology use; infrastructure and access of technology. Pedagogical content knowledge (PCK) refers to the match between content area and learning objectives and the use of DGBL; focus on outcome assessment through using a game and how DGBL potentially aligns with common core state technology standards. Consolidating both the results of quantitative and qualitative data analyses, a well-rounded picture of the internal challenges and external barriers to the implementation of DGBL in the classroom is delineated.

CHAPTER 6

DISCUSSION & CONCLUSION

Discussion

What is the role of teachers in the environment of using DGBL? To make DGBL an effective learning process, it is imperative that the teacher takes on the role of a facilitator by providing timely elements of support, analysis and reflection (Gros, 2007) that promote contents and learning objectives of the target game. It is expected that teachers at different levels would react differently to the proposition of using DGBL in the classroom as mediated by their disparity in gaming experiences, attitudes, self-efficacy, and perceived challenges and barriers. Will understanding the complexities involved in the adoption of DGBL sensitize and encourage, or intimidate and prevent teachers from practicing and their commitment in using digital games for classroom teaching?

Gibson, Halverson and Riedel (2007) studied the differences in the values and attitudes held among gamer and non-gamer pre-service teachers (N = 228). They categorized these teachers based on the age of the respondents considering that children born before and after video games became ubiquitous shared stark different perceptions about the world, thinking patterns, ways of evaluating tasks, and interacting with people. They found that gamer teachers were more receptive towards using digital games in teaching, reinforcing Jones, Copeland, & Kilanowski's (2007) finding that active gamer teachers are inclined to have favorable attitudes towards digital games. Gibson et al. also found that gamer teachers valued active learning, individualized and customized teaching more than their non-gamer counterparts. Put another way, it seems likely that teachers who have prior background in gaming may value, or promote, instructional methods or learning objectives differently from teachers without. Considering that

the teachers participating in this study are solely light or non-gamers, their overall favorable attitude and self-confidence toward using DGBL is an encouraging sign and perhaps could be a foundation to build on.

It is equally important to consider students' learning preferences and styles when teachers think about adopting DGBL. Squire et al. (2005) contended that the critical issue is not whether learning can be based on using digital games. They posed the question as to how could educational technologists and educators approach a new generation of students, digital natives, who are raised on and immersed in a slew of digital multimedia including interactive digital games who would anticipate similar experiences learning from teachers using educational media in the classroom (p. 34). Hence the learning profile of digital natives plays a role in deciding the effectiveness of the use of DGBL in the classroom.

Asakawa and Gilbert (2003), Bain and Newton (2003) and Prensky (2005) suggested that the game generation has developed a new cognitive learning style marked by multitasked learning which relies on hypothesis-testing, exploration, and discovery, aspects of learning that have been paid less attention to in formal school learning contexts where standardized testing has long taken center stage. Oblinger and Oblinger (2005) depicted the learning profile of today's youth as born communicators, intuitive, and visual, partially due to their spatial and visual aptitudes trained through the practice of video games. Shaffer, Squire, Halverson and Gee (2004) stated that the use of video games modified ways young people learn. Online games, according to van Eck (2006), offers our digital natives the chance to exercise inductive reasoning, to access multimodal information, and to strengthen their spatial and visual abilities. Consequently, our digital natives are primed to inspire themselves perhaps more intuitively in a constructivist or constructionist approach through which they form and test hypothesis,

experiment through trial and error, interact with social groups, comprehend and synthesize findings, and generalize and apply what they have learned to new contexts. That said, the findings of this study revealed teachers' preference of edutainment games and educational applications over the other three genres and it is fair to ask what implications we can derive from this finding. Depending on content, context and compatibility, how these four genres of educational digital games can be applied effectively in instructional practices in a given classroom also vary from case to case.

Returning to Research Questions

Four main research questions were posed in this study. A brief discussion of the findings with respect to these research questions and sub-questions will be presented in the following discussion.

Research question one asked, "What are teachers' current gaming experiences as defined by hours spent on digital gaming per week, enjoyment, platform, frequency in game-related practices, and gaming orientations?" The findings indicate that 79% of survey-taking teachers were light gamers or non-gamers who engage in game play less than one to three hours on a weekly basis. 58% of respondents expressed enjoyment on digital gaming and only 16 respondents indicated otherwise. In terms of favored platform for gaming, 84% of respondents chose cellphones and tablet computers as the main interface, indicating the high penetration and utility-for-gaming rate on mobile technologies among this particular age group of teachers. As for frequency of game-related practices, since the majority of survey takers were light or non-gamers, the most common game-related practices they engaged in do not go beyond visiting game websites, reading reviews, and helping others when playing. Other game-related practices such as highly technical modding, using cheat codes and creating mini-games were not chosen

because these activities are marks of habitual gamers. For gaming orientations, of the 90% of respondents described the activity of gaming solely as one to pass time when bored or during transition to an ensuing event. Evidently the other available gaming orientations involving elements of competitive gaming and persistence in gaming do not apply to this group of survey respondents.

Research question two posed the question, “What are teachers' attitudes toward implementing DGBL in the classroom?” with five sub-inquiries (below in italics). Responses to each of the sub-inquiries based on survey findings will be laid out below.

a. Are teachers comfortable with the idea of using digital games for teaching?

Survey findings indicate that 78% of participating pre-service, intern, or in-service teachers are comfortable with the idea of using digital games as tools for classroom teaching.

b. What are teachers' perceived usefulness of using digital games for teaching?

Survey findings revealed the higher ranking usefulness of DGBL to be “Promote learning objectives that meet common core standards”, “Digital games can bridge the gap between what students do at home and at school”; “They can be used as supplemental learning materials”; “They tend to be fun, hands-on, motivating and engaging for students”.

c. What are teachers' perceptions of educational digital games?

Three main perceptions related to educational digital games emerged out of textual analysis. Educational digital games are perceived as having a tie-in with subject area matter. These games meet the need for teaching young learners in

ways that appeal to them, and lastly a counter narrative that in some cases these educational digital games are not seriously educational.

- d. *What do teachers believe is the likelihood of them using digital games in current or future teaching?*

78% of respondents are affirmative to strongly affirmative about the likelihood of their implementing DGBL in current or future teaching.

- e. *How likely would teachers consider using student-suggested game titles for digital game-based learning?*

86% of respondents agreed and strongly agreed to the concept of using student-suggested digital games for classroom teaching and learning and this implicates a great likelihood.

Research question three asked, “What are teachers’ perceived self-efficacy on integrating DGBL?” There are five sub-questions and responses based on survey data analysis would be provided to address each question respectively.

- a. *Which type of educational digital game would teachers prefer to use for DGBL?*

The preferred game genre for implementing DGBL for all three groups of teachers proved to be the same, ranking atop from the most favored edutainment games and educational applications, to serious games, then educational game design tools, and lastly simulation and MMORPG games.

- b. *Do teachers’ game genre choice align with their teaching philosophy?*

An overwhelming majority of teachers favored the genre of edutainment games and educational applications for classroom instruction but when asked about the teaching philosophy they endorsed, they generally gravitated toward the three

non-behavioristic philosophies. The mismatch is illuminating in two ways. One is that these teachers' lack of understanding of how different genres of educational digital games are designed based on varying underlying learning principles may put them in a position where they are not so well-prepared to carry out DGBL. Another point of emphasis and perhaps a direction for future research, could be to what extent is the importance for teachers to match a game genre with their teaching philosophy so as to produce optimal teaching effectiveness and learning outcomes.

c. What do teachers believe is their capability of using DGBL in the classroom?

81% of teachers expressed optimism and belief in their perceived capability to incorporate digital games in their teaching. This means a great majority of the survey respondents believed that they were capable of using DGBL in their current or future classroom teaching.

d. Have teachers used DGBL in the classroom before? How frequently do they use DGBL?

Only 34% of respondents have had actual experience using DGBL for educational purposes at the point of taking this survey. In terms of frequency of the use of DGBL, 9% of respondents indicated one time in this past year, 9% indicated two times, and 16 % indicated five times or more.

Despite that 81% of teachers showed self-perceived capability in using DGBL, only 34% of them had actual experience in practicing DGBL. However, the number 34% makes sense considering that only 56% of respondents were intern

teachers and in-service teachers who may have an established presence and freedom of choice over instructional practices in a classroom.

- e. What are teachers' considerations in drafting a DGBL lesson plan?

Nine strands of considerations were extrapolated. Eight are associated with the PK, TPK, and PCK involved in the internal context of practicing DGBL. PK includes teacher demonstration and guidance before or during game play; using DGBL as supplement or reward to instruction; meeting both individual and group needs of learning. TPK encompasses the consideration of student interest, ability, and age-appropriateness in technology use; infrastructure and access of technology. PCK consists of the match between content area and learning objectives and the use of DGBL; focus on outcome assessment through using a game and how DGBL potentially aligns with common core state technology standards. The ninth strand, acquiring parental consent and securing staff and administrative support, addresses the importance of considering the external context of practicing DGBL.

Research question four posed the question, "What are teachers' perceived challenges and barriers toward using DGBL in the classroom?" Findings showed that half of the respondents felt that their lack of knowledge and skills in teaching strategies, outcome assessment, and making justifiable choices of digital tools to match subject area matters are internal challenges to the implementation of DGBL. External barriers were boiled down to five main components – Mismatch between DGBL and curriculum, administrative and parental negative perceptions, lack

of technology infrastructure and preparation in teacher education and professional development, short class periods, and low quality of educational digital games.

Significance of Study

This study attempts to replicate findings across population by probing into pre-service, intern, and in-service teachers' current gaming experience, attitudes, self-efficacy, and perceived challenges and barriers towards using DGBL in the classroom. Theoretical contributions of this study include the articulation of a conceptual framework for approaching the implementation of game-based learning in the classroom. The proposed conceptual framework could provide validation of the original TPACK model as well as the value of knowing and applying the framework for teaching using digital games.

This study also fills the gap in the literature in studying the use and inculcation of DGBL in teacher education programs (Franklin & Annetta, 2011). It is anticipated that the typology of educational digital games can assist teachers' understanding of the importance of matching instructional practices with the learning theories embedded and learning objectives promoted in their chosen games used for DGBL. Consequently the conceptual framework, typology of educational digital games, and the attitudinal scale could serve as tools and foundation on which to bridge theory to practice in teachers' pedagogical usage of educational digital games in a classroom setting.

Limitations of Study

Several limitations should be considered in interpreting the findings of this current study. First of all, the subjects under study are by no means fully representative of the overall teaching force considering that subjects are limited to a pre-determined pool of pre-service, internship, and in-service teachers from a Midwestern region of the USA. Secondly, this study

is by nature exploratory in that the attitudinal scale was piloted and used to gauge 116 teachers' perceptions toward DGBL and the scale has not been extensively tested beyond the confines of the current study. Namely, the findings of this study may not be replicated with another subject population. Thirdly, as with all studies involving investigation of participant perceptions, the collected data were self-reports that are necessarily subjective. This leaves the possibility of response biases. A fourth limitation is that the findings were about presenting correlational relationships among the possible factors affecting teachers' attitude toward DGBL and no attempt was made to establish causal relationships. A fifth limitation lies in the game genre order presented in the survey. Order effect and pre-existing familiarity could have confounded how respondents chose which of the four game genres they would like to adopt for DGBL.

Directions for Future Research

Continuing research in the use of DGBL is important because DGBL supports students' growing interests, constructs new areas of technological and knowledge base, and sustains student motivation to learn (Caperton, 2010; Gee, 2007; Papastergiou, 2009; Rankin, McNeal, Shute & Gooch, 2008; Richter & Dawley, 2010; Squire, 2004). Despite a growing number of studies on using educational digital games to support student learning in K-12 subject content areas (Charsky & Barbour, 2009; Connolly, Stansfield & Hainey, 2011; Gros, 2007; Ritzhaupt, Higgins & Alfred, 2010; Squire, 2005), there is still lack of evidence that shows DGBL is effective and compatible with formal learning contexts in most schools and districts.

Adding to the issue of incompatibility, the variety of game genres, different methods for integrating games into instruction, and poor quality of many educational games further complicate the issue of adopting DGBL in the classroom (Gee, 2003, 2007; Tobias & Fletcher,

2011; Young, Slota, Cutter, Jalette, Mullin, Lai... & Yukhymenko, 2012). The diversity of educational games, the different ways of incorporating games into instruction, and the complexity of measuring game-based learning all add to the challenge of using digital games for teachers, requiring them to have “more than a superficial understanding of game elements to make informed decisions about their use” (Hayes & Ohrnberger, 2013, p. 155). On one hand, we need more empirical studies documenting the processes and pedagogies of incorporating digital games into K-12 curricula. On the other, the field of study in DGBL needs a guiding framework with which we can reference in tackling problems arising from the integration of DGBL in the classroom.

The manner in which teachers navigate to understanding different genres of educational digital games, the embedded learning principles and the design implications behind them can be a challenge that potentially influences their choice, pedagogy, and implementation of DGBL in a classroom. To address this challenge, this study conceptualized the DGBL TPACK framework to help teachers understand the crucial interaction of the different knowledge bases involved in the implementation of DGBL. The proposed typology of educational digital games serves to assist teachers in understanding the pedagogical implications of adopting the four genres of games and how their teaching philosophy may factor in depending on their chosen game genre. The survey results of 116 teachers completing the attitudinal scale revealed these teachers’ current experience, attitudes, self-efficacy, perceived challenges and barriers, and inclinations when it comes to using DGBL in a classroom. In sum, the findings of this study replicates previous findings and concurrently contributes to the challenge of effective classroom implementation of DGBL.

Stemming from the findings of this study, one future direction for research is to investigate whether the match or mismatch between teachers' choice of game genre and their teaching philosophy has an impact on their teaching using DGBL and students' learning outcomes. While extant research does not address the issue of teaching philosophy and game genre, the importance for teachers to understand the different design and learning principles embedded in the four genres of educational digital games cannot be over-emphasized because teachers need to be cognizant of their choices of technology tools and how their choices would subsequently weigh in on their approach in the set-up, instructional practices, delivery of subject area contents, and outcome assessment. Another research direction is to emulate large-scale studies (Millstone, 2012) by augmenting the sample size to a national level where the survey used in this study can be further validated so ensuing results can reflect a comprehensive picture of the nuances in teachers' experience, attitudes, self-efficacy, and perceived challenges and barriers toward the implementation of DGBL.

Given the increasingly widespread use of games both in the realm of personal leisure activities and academic contexts, more research in the area of using educational digital games and how the use of such environments can contribute to teaching and learning is needed.

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