

VIDEO GAME TECHNOLOGY AND LEARNING
IN THE MUSIC CLASSROOM

by

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ABSTRACT

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Game-based learning, or the process of adapting an educational concept into a game-based structure, has been studied by researchers for nearly a century. Over the last several decades, new technologies have allowed digital media to create a multibillion-dollar entertainment industry commonly known as video games. Video games have become a tool for many educators who have the potential to engage and motivate students to learn in various subjects and disciplines.

The purpose of this study was to determine the effectiveness of digital game-based learning in comparison to other teaching methods as related to music education and to explore the perspectives of young students regarding video games both in school and in their personal lives. Ninety-two ($n = 92$) fifth and sixth grade students in a northeastern U.S. elementary school completed a mixed-method experimental study consisting of a pretest/posttest control group, surveys, and in-depth interviews.

Results showed that students who had access to educational video games combined with the assistance of an instructor achieved higher mean scores compared

with students who had access to either video games without instruction or instruction without video games. Survey and interview data suggested that students enjoyed playing video games on a regular basis for reasons such as enjoyment, socialization, and distraction. The majority of respondents believed that video games can and should be used in educational practices, including music education, but current educational games are inadequate because they do not possess the qualities of entertainment that are inherent in commercially designed games.

These findings suggested that educational video games may be potentially used as an effective tool in the music classroom to teach musical concepts and skills. In addition, benefits may also include increased student motivation, engagement, and a hands-on approach to learning that is based on the students' individual needs. However, it may be necessary for video games to be used in combination with a qualified teacher to prevent confusion, distraction, and possible frustration. Pairing quality instruction with engaging technology that is relevant in children's lives may be highly beneficial for the continued development of music education.

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DEDICATION

This scholarly work is dedicated to the following people,
without whom this would not be possible:

Megan Lesser, devoted wife:

You are my rock and my guiding star. You have never wavered in your confidence in me,
and have always given me your full support regardless of the challenges.
I love you, now and always.

Gale Lesser, loving mother:

Throughout my entire life you have encouraged my dreams and dared me to achieve
higher than what I thought possible. My success is a reflection of your
love and belief in me. Thank you.

David Lesser, dedicated father:

Though you now look down on me from Heaven, I wish you could have seen the
completion of this journey. You were there at the beginning, and I am proud to be the
man I have become because of your guidance. I miss you.

Ron and Arlene Boerum, my second parents:

You may have been a part of my family only since my adult life, but I feel as if you have
been with me for much longer. I cherish you as I would my own blood, and I hope to
continue living up to the honor of being included in your family.

And finally, to all the gamers out there who continue to chart new courses:

‘May the light illuminate your path.’
- *The Legend of Zelda: Breath of the Wild*

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And to all of the students, parents, and faculty of the fifth and sixth grade classes involved in this study at the Wilbur Watts Intermediate School, City of Burlington Public Schools, New Jersey:

You are the reason why I do what I do. As it is written on the back of our shirts:

‘We are the music makers, and we are the dreamers of dreams.’

- Arthur O’Shaughnessy

A. J. L.

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Chapter I

INTRODUCTION

Overview

Game-based learning, defined as the incorporation of game design elements within non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011), has been an emerging source of new and innovative opportunities for educational practices (Dicheva, Dichev, Agre, & Angelova, 2015; Lee & Hammer, 2011; Russell, 2016). Within the last 30 years, game-based learning has been applied to the medium of computer technology, specifically in the use of digital media. The development of digital game-based learning in application with standard educational objectives has the potential to lead to greater student motivation, engagement, and an alternative to traditional educational methodologies (Brown, 2008; Gee, 2007; Prensky, 2001; Shaffer, 2006).

Researchers exploring the benefits and shortcomings of digital game-based learning have stated that although video games have not been fully embraced by educators as a viable tool in the classroom, the influence of the video game industry is growing at a rapid rate (Barab, Gresalfi, & Arici, 2009; Bösche & Kattner, 2011; Criswell, 2009; Van Eck, 2006). The Entertainment Software Association (ESA, 2018) averaged that 64% of U.S. households have at least one person who plays video games 3 or more

hours each week. The report also stated that consumers spent a total of \$36 billion dollars on games in 2017.

Compared with the \$30.4 billion dollars consumers spent on games in 2016 (ESA, 2017), evidence has suggested that the video game industry will continue to thrive and grow within the foreseeable future. It is also likely that young students' ability to manipulate technology will also increase, given the exponential rate at which it is being developed (Chuang, Chen, Chen, Shen, & Tsai, 2011). These seemingly irreversible trends have propelled video games to become highly accessible and enjoyable across a multitude of ages, demographics, and cultures (King, 2002).

The educational implications of video games can be used to provide new and engaging opportunities for students spanning a variety of academic disciplines (Kersten, 2006). Games can elicit an intense interest that induces learners to think creatively, persist on challenging tasks, and connect educational objectives to relevant, meaningful goals that transcend the boundaries of the classroom. The application of video game technology (VGT) to music instruction may potentially assist in the development of knowledge and skills while remaining cost-effective and technologically user-friendly for music teachers (Rajan, 2014).

Author's Background

My introduction to video games began during the mid-1980s, following the aftermath of the video game crash of 1983. Due to the overwhelming popularity of arcade games in the 1970s and early 1980s, such as Atari's *Pong* (Alcorn, 1972), Taito's *Space Invaders* (Nishikado, 1978), and Namco's *Pac-Man* (Iwatani, 1980), home game console

sales flourished with over a dozen companies striving to enter into the gaming market (Herz, 1997). In an attempt to gain leverage over competing businesses, many fledgling companies released home consoles with collections of low-quality, substandard games that frustrated and bored players. The Atari game *E.T. The Extra-Terrestrial* (Warshaw, 1982), based on the Steven Spielberg film of the same name, performed so poorly that thousands of cartridges were shipped to Alamogordo in New Mexico and dumped into a landfill (Donovan, 2010).

The poor quality of games that flooded the market combined with the increasingly low demand resulted in video game sales plummeting throughout 1983. Atari, known then as the flagship of video game home entertainment systems, reported a loss of \$536 million dollars by the end of the year (Kent, 2001). The following year, the entire company was sold by its parent organization, Warner Communications. With the downfall of Atari, many other companies soon followed suit, leaving the future of the formerly prosperous video game industry in jeopardy.

In 1983, while the video game crash wiped out most developers, a former playing-card manufacturer based out of Kyoto, Japan named Nintendo began to focus on the struggling video game market. The result was a new game console called the Family Computer, or Famicom system, which was later released in North America in 1985 under the name Nintendo Entertainment System (NES) (Kent, 2001). The console was an immediate international success, particularly because the system was bundled with the inclusion of one of the most popular games of all time, *Super Mario Bros.* (Miyamoto, 1985). Nintendo had singlehandedly revived the gaming industry with additional games

such as *The Legend of Zelda* (Miyamoto, 1986) and *Metroid* (Kano, Yokoi, Kiyotake, & Sakamoto, 1986).

This is where I began my history as a gamer and future researcher of game-based learning. With the release of the NES, I was immediately captivated by the gameplay and challenge that video games provided. I soon acquired other games in multiple genres, including action, adventure, sports, puzzle, and simulation titles. Through the many advancements that the video game industry has made over the past several decades, my enjoyment has not diminished and I still play games from a variety of time periods, from some of the earliest games released on the Atari to the sophisticated games of today.

As a teacher of elementary school children, I am constantly searching for new and innovative methods to engage and immerse my students in music. Based on my experiences and discussions with both current and former students, I have discovered that video games are a major part of today's youth culture. The ESA reported in 2018 that 30% of game players in the United States are under 18 years old, with a difference of 61% male players to 39% female players. To diversify my instructional methods, I began to include iPad game applications into my lessons, the result of which was an increase of student motivation, engagement, and an understanding of musical concepts that remained strong over time.

These observations prompted me to begin researching the capability of video games to motivate students as well as their potential to teach musical skills and knowledge. While the majority of research of VGT as applied to music education has focused on commercial-off-the-shelf (COTS) games such as Harmonix's *Guitar Hero* (LoPiccolo & Kay, 2005) and *Rock Band* (LoPiccolo, Lay, & Teasdale, 2008), these

games were primarily designed for entertainment value and not originally meant to achieve an educational purpose. The focus of this research centered on games created to teach musical concepts while retaining the aspects of game design that create immersion and enjoyment through content and gameplay. By doing so, I examined the effectiveness of video games as a viable tool for the future of music education.

Rationale for the Study

Many current educational practices still rely on a system of standardized measures for knowledge dissemination and assessment rooted in certain types of academic ability (Robinson, 2011). Basing education on student experiences that mirror their own culture may create personal connections which will, in turn, allow students to become more motivated and successful (Dewey, 1938). One of the major aspects that is becoming more of a necessity in today's job market is the need for independent, creative thinking that can be used to innovate new products and technologies (Robinson, 2011). The digital world of the 21st century is an encompassing environment that facilitates communication, problem solving, and alternative perspectives essential to the advancement of knowledge (Johnson, 2005).

The use of computers in educational environments has been considered a necessity for several decades. Their ability to provide immediate information and feedback, in addition to the ability to be programmed to match students' strengths and weaknesses, were identified as having profound effects as early as digital technology became available to consumers (Suppes, 1966). However, it is only recently that digital games have been considered viable as a source for learning (Johnson, 2005). Originally

designed for entertainment, video games still hold the stigma of a symbol of popular culture, especially when contrasted to more conventional materials such as textbooks, worksheets, and standardized tests (Johnson, 2005).

With the advent of “serious games” (Abt, 1970), defined as an umbrella term that encompasses training or the achievement of a defined purpose other than pure entertainment (Backlund & Hendrix, 2013), researchers dedicated to the study of digital game-based learning have ascertained its value in various learning environments from the classroom to professional corporate training (Prensky, 2001; Tawfik, Moore, He, & Vo, 2012; Tobias & Fletcher, 2011; Vorderer & Bryant, 2006). These researchers have determined that video games are most effective when using the same design principles of COTS games due to their ability to engage, immerse, and create intrinsic motivation within the user (Egenfeldt-Nielsen, Smith, & Tosca, 2016).

Within the last 20 years, music performance games such as the *Guitar Hero* and *Rock Band* series have enjoyed immense popularity in international culture due to their gameplay mechanics. The interactive controllers, which are shaped like guitars, drumsticks, and other instruments, allow players to feel as if they are creating music through pressing a series of buttons in rhythmic sequence with the video interface. While these types of games can assist in motivating students to pursue further studies in music, any actual learning of musical knowledge or skills is unintentional and purely coincidental (Arsenault, 2008).

Regardless, music educators have used COTS games as a way to help engage students to supplement formal instruction (Jenson, De Castell, Muehrer, & Droumeva, 2016; Mercer, 2009). This may be because games that attempt to teach concepts while

retaining the design principles of COTS entertainment products, commonly known as edutainment, have not achieved the same kind of widespread success (Miller, 2013). This may be due to their reliance on skill-and-drill learning, simple gameplay, and a complete absence of immersion (Egenfeldt-Nielsen et al., 2016).

Further attempts have been made to adapt commercially popular games or create new edutainment games using design principles that simultaneously engage the student and foster learning. Gee (2007) identified several qualities of these intrinsic design concepts as encouragement of active learning, manipulation of constructs as part of a larger system, the freedom to take risks and fail without consequence, immediate and relevant feedback, appropriate levels of challenge, and multiple pathways to success. Games that utilize these features have the potential to interest players to the point where a state of extreme engagement is attained through a fluid structure of immersion and interactivity (Csikszentmihalyi, 1975; Douglas & Hargadon, 2000; Gregory, 2008; Koster, 2014).

The development of games for teaching has at present created multiple communities of educators, designers, researchers, and game enthusiasts. Organizations such as Games for Change and Games2Teach offer forums where authors can offer their perspectives and opinions regarding the gaming industry and its ability to be incorporated in education. The majority of these articles revolve around the application of VGT into general education, such as STEM and language arts, but there are increasing examples of games that use music as its core mechanic.

Music education may have the potential to benefit from VGT, though research that delves specifically into the field is limited. The principles of game-based learning

directly apply to the conditions that video games instill in the player, including creativity, challenge, feedback, and engagement. Researchers who have conducted studies involving music performance-based video games have noted that they promote a sense of positive self-identity, self-esteem, and enjoyment (Cassidy & Paisley, 2013; Denis & Jouvelot, 2004; Tobias, 2012).

Though several studies in the field have dealt with commercially available performance titles such as the *Guitar Hero* and *Rock Band* series, educational objectives may be achieved through more classroom-oriented games. In doing so, the question of how the incorporation of VGT may be employed as an effective instructional technique for music teachers can be empirically addressed.

Definitions of Key Terms

Because of the variety of research on game-based learning accumulated within the past several decades, it is necessary to clarify specific terminology in order to eliminate any ambiguity about the nature of these concepts. The term game, for example, has been described by multiple researchers in many ways based on its characteristics. Koster (2014) compared some of these definitions as systems in which a player or players engage in an act of intellectual or physical challenge, such as puzzles to solve or patterns to deduce. Kapp (2012) defined a game as a specific or series of events within a system that provides feedback resulting in a quantitative outcome.

One major aspect that theorists seem to agree on regarding the nature of games is that it is a system based on rules. Rules, described by Egenfeldt-Nielsen et al. (2016) as “governing the interaction of game elements and possible outcomes” (p. 125), is a

primary characteristic of games that defines the nature of the interaction. These rules, along with objectives, feedback, and voluntary participation, are the required traits that constitute a game (McGonigal, 2011).

Salen and Zimmerman (2004) further clarified rules in that they give limitations to player action, are shared by all players, are explicit and unambiguous, and are binding within the context of the game itself. For the purposes of this study, their definition of what constitutes a game was used, such that a game “is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome” (p. 72).

In the case of digital games, this artificial conflict can exist between two or more human players, or with an artificial intelligence provided by the system itself. Digital games do not necessarily have to contain a video interface, such as in the Milton Bradley game *Simon* (1978). *Simon*, created by Ralph Baer (who also designed the Magnavox Odyssey console in 1972), consisted of four touch panels that, once activated, emit a series of pitches that the player must repeat in order to progress. If the player touches a pad in the incorrect order, the game is over; if the player successfully plays the sequence, more buttons are added until the player commits a mistake and must start over from the beginning of a new sequence.

Most popular digital games are known in the present industry as video games, which generally refer to games played on a console or computer screen that uses a video display with which the player interacts (Archbell, 2009). The interactivity is controlled by the player actions and the responses of the game system, which results in the manipulation of active game elements and ability of the game to command the player’s attention (Egenfeldt-Nielsen et al., 2016).

The principles of game design, mostly present in COTS games used for entertainment purposes, have been harnessed in an attempt to create games to train users on a specific skill set. Serious games designed for educational purposes present learning objectives as part of the game system that are clear and relevant to the desired task to be mastered. Edutainment games can be considered as bridging the gap between COTS and serious games, though most of these games fail due to their inability to reconcile educational goals with player enjoyment (Tobias & Fletcher, 2011).

The distinction between COTS, serious games, and edutainment lies in the specific uses of each medium. While all three are constructed with the characteristics of a game, the differences that exist have created a divide in perspectives among stakeholders (Russell, 2016). Clarifying the unique aspects of these terms is vital to prevent ambiguity about the purpose of video games in both commercial and educational situations.

Problem Statement

Teachers must continuously adapt their instructional methods to fit the needs of their students in an ever-changing world. Technology has become an indispensable aspect of life in the 21st century, and children are growing up with digital media as an integral part of their development (Johnson, 2005). In addition, researchers have shown that video games are a source of engagement and motivation among students (Archbell, 2009; Backlund & Hendrix, 2013; Biamonte, 2011; Bourgonjon, Valcke, Soetaert, & Schellens, 2010; Fromme, 2003; Gee, 2005a; Gregory, 2008; Olson, 2010; Prensky, 2006; Rigby & Ryan, 2011; Ryan, Rigby, & Przybylski, 2006; Shaffer, 2006; Squire, 2005).

However, although increasing empirical evidence points to the benefits of digital game-based learning, the educational community remains generally reluctant to develop strategies in embracing video games as a source of instruction (Prensky, 2006; Squire, 2003; Young et al., 2012). This may be due to the minimal amount of research in the educational effects of video games, which has been described as “disappointing, lamentable, and inconclusive” (Tobias & Fletcher, 2011, p. 253).

Music education has been the focus of several studies in digital game-based learning; however, the majority of these studies have been conducted with non-educational COTS games on university students (Jenson et al., 2016; Paney, 2014; Pasinski, 2015; Richardson & Kim, 2011). Other studies have focused solely on the ability of music performance video games to increase motivation in students to pursue more formal instruction in music without accounting for their ability to teach musical knowledge or skills (Denis & Jouvelot, 2004; Miller, 2013; Smith, 2004; Wechselberger, 2016).

These laboratory studies cannot draw any meaningful conclusions about the correlation of VGT and music learning due to their lack of evidence of success in the natural classroom environment. The limited amount of research that has been performed in these settings have centered on interview and survey research, which can only vaguely suggest achievement in teaching educational objectives through student and teacher perceptions (Cassidy & Paisley, 2013; Gomez, Figueiredo, & Bidarra, 2014; Gower & McDowell, 2012; Jenson, De Castell, Taylor, & Droumeva, 2008).

Without an increase in experimental studies specifically designed to test the effectiveness of VGT in music education compared to other instructional methods, the

validity of using such technology will forever be in question. While educational games have been designed for music education, few empirical studies to date have been conducted to ascertain their effectiveness or to suggest any correlation between the game structure and the acquisition of musical skills (Hämäläinen, Mäki-Patola, Pulkki, & Airas, 2004; Manzo, 1984; Paney & Kay, 2014). Contributions to this field of knowledge could potentially lead to greater understanding concerning the application of VGT and music education.

Statement of Purpose

The purpose of this study was to investigate the educational possibilities of video games designed to teach musical knowledge and skills in an elementary school classroom environment. Selected games were compared with more conventional instructional methods, including discussion and performance-based formats, to ascertain their effectiveness in reaching educational objectives. In addition, perspectives from students were also explored for common themes leading to a better understanding of what motivates young people to play games and how games can be used as learning aids in music education.

While most studies of this nature have focused on university students with COTS games, this analysis was conducted in the natural environment of the elementary general music classroom. General music was defined as a graded course with required participation by all students at regular intervals during the school year. The elementary public school in the United States can vary between grade levels ranging from

kindergarten through sixth grade. For the purposes of this research, students from Grades 5 and 6 with ages spanning 10-12 years were involved in the research design.

The themes presented in the conceptual model reflect the overall direction of the research, such as how products of VGT can influence affective behavior and pedagogical practices, and how stakeholder perspectives can create opportunities or barriers for music education based on empirical evidence. Finally, design aspects of successful COTS and educational games were analyzed to create a framework for future attempts to produce effective video games for the music classroom.

Research Questions

The central questions that guided this study involved the analysis of both quantitative and qualitative data. Data were collected in a two-phase process in the form of an explanatory sequential mixed-method design. This design consisted of the accumulation of quantitative data, which informed the second, qualitative phase (Creswell, 2014). The following research questions are presented in the order of the temporal progression of the study.

Research Question #1: Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?

Research Question #2: How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?

Research Question #3: What are the perceptions of elementary school students regarding VGT in their personal lives?

Research Question #4: What are the perceptions of elementary school students regarding VGT in educational environments?

These research questions were answered according to the sequential nature of the study; data analysis of each item informed the subsequent questions (Tashakkori & Creswell, 2007).

Conceptual Framework

The application of VGT in education presents a series of considerations that are interrelated to multiple aspects within and outside the field of game-based learning. Figure 1 illustrates six factors of VGT as related to its use inside the classroom as a learning tool. Each item is then separated into three subcategories of what entities are affected by these concepts.

As discussed earlier, video game industry products include three divisions of gaming genres. Commercial-off-the-shelf (COTS) games are by far the largest and most popular group of gaming products and what accounts for 92.2% of revenue within the industry (ESA, 2018). These are games designed to entertain and provide an immersive experience for the player through gameplay, narrative, and challenge. COTS games that provide any opportunities for learning are subordinate to the priority of player enjoyment. For example, the *Assassin's Creed* series by Ubisoft (Désilets, Raymond, & May, 2007) presents the player with historical facts ranging from the Medieval to Industrial Revolution periods throughout the game's storylines, but any knowledge that is absorbed is haphazard and inconsequential to completing the game.

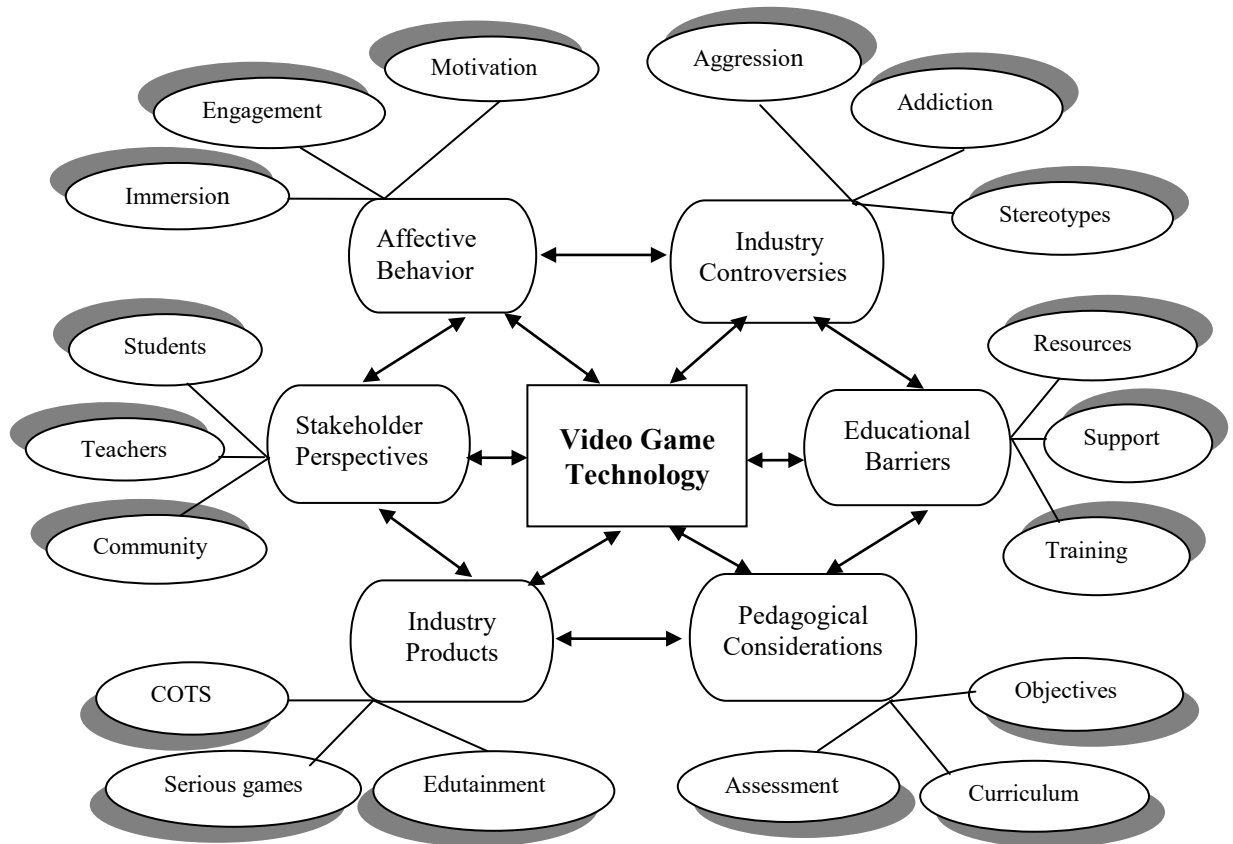


Figure 1. Conceptual model of VGT in education

Serious games and edutainment contain similar objectives in their inherent design to teach concepts or skills to the user. Developed within the last several decades as a subcategory within the video game industry, the market for serious games and edutainment products remains relatively small compared to COTS games (Backlund & Hendrix, 2013). Several COTS games have been adapted for educational purposes, such as using the Nintendo character Mario to teach typing (*Mario Teaches Typing*; Interplay, 1991), geography (*Mario is Missing*; Radical Entertainment, 1992), and history (*Mario's*

Time Machine; The Software Toolworks Radical Entertainment, 1993). While it has been suggested that educational games cannot be successful due to the assertion that games are voluntary as opposed to assigned play (McGonigal, 2011; Prensky, 2011), supporters of game-based learning remain steadfast in their commitment to create games that support a balance between enjoyment and learning.

Distinct partisan lines can be drawn between perceived benefits of digital game-based learning and barriers that prevent video games from being accepted into mainstream educational practices. Supporters of VGT (Annetta, 2010; Gee, 2007; Prensky, 2006) have claimed that playing video games naturally increases engagement and intrinsic motivation, leading to what Csikszentmihalyi (1990) referred to as a “flow” state. Characteristics of the flow state are brought about through engaging in a task consisting of realistic and clear goals, immediate feedback, and a chance of completion. When flow is attained, the player will experience a loss of the sense of time and duration, an intense focus on the task, a removal of doubt and anxiety, and a sense of heightened control over their actions.

By contrast, critics of VGT have suggested that playing video games possesses inherent addictive qualities, which, if not monitored, can lead to increased amounts of aggression and violent behavior (Anderson & Bushman, 2001; Gentile, 2009; Ravaja, Saari, Laarni, Kallinen, & Salminen, 2005). The controversy of negative effects on affective behavior was particularly evident in 1993, when the U.S. Senate launched a hearing against violent video games such as Midway’s *Mortal Kombat* (Boon & Tobias, 1992), *Doom* (id Software, 1993), and Hasbro’s *Night Trap* (Digital Pictures, 1992).

While *Mortal Kombat* and *Doom* were criticized for their depiction of realistic and brutal violence, *Night Trap* was singled out for its stereotypical portrayal of women as defenseless sex objects (Porter & Starcevic, 2007). Though the Senate's efforts eventually led to the creation of the Entertainment Software Ratings Board (ESRB), many researchers are still convinced of the dangers that unsupervised gaming holds (Böshe & Kattner, 2011; Kutner & Olson, 2008).

These divided opinions extend to pedagogical applications as well. Researchers of COTS games, serious games, and edutainment agree that when following educational objectives, seamless integration into an existing curriculum, and providing clear, unambiguous assessment of specific tasks, video games have the opportunity to be an extremely effective tool for teachers (Barab et al., 2009; Kapp, 2012; Loftus & Loftus, 1983; Squire, 2005).

However, a number of barriers remain a concern for educational stakeholders, such as the need for teacher training to implement any new gaming software, financial resources to purchase games and appropriate interfaces, and administrative and community support in incorporating VGT in the school curriculum (Archbell, 2009; Baek, 2008; Bensiger, 2012). These theories, which can be directly applied to the medium of music education, formed the basis of the conceptual model and influenced the research construct of the present study.

Plan of Research

The mixed-method design of this study proceeded as illustrated in Table 1. Details of the study are discussed more thoroughly in Chapter III. Table 1 presents an

outline of the major aspects of the experimental design. Research questions were categorized by type, while measures of data collection were sorted into an approximate timeline and method of analysis. From the circulation and reception of consent forms by both the participants and parent/guardians of the participants to the completion of data collection, the study spanned a total of 10 months, or the length of an entire school year. The data were compiled and analyzed immediately following the conclusion of the study.

Table 1

Outline of Research Questions and Procedures

Research Questions	Research Type	Data Source	Timeline of Data Collection	Data Analysis
1. Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?	Quantitative	Pre- and post-test of student musical knowledge and skills	Pre-test was given in January 2018. Post-test was administered after approximately 6 weeks	Measures of tendency, paired <i>t</i> -test, and ANCOVA between each of the three experimental groups
2. How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?	Mixed Method	Comparison of data from quantitative experimental design and qualitative research using descriptive statistics	Analysis of data occurred following data collection (May-June, 2018)	Measures of tendency, standard deviation, ANOVA, and ANCOVA analyses.
3 & 4. What are the perceptions of elementary school students regarding VGT in their personal lives and in educational environments?	Mixed Method	Survey and exit interviews of selected fifth and sixth grade students using TC Qualtrics Survey Software	Survey and interviews were administered between April and May of 2018	Descriptive statistics using SPSS software and constant comparison

Summary

This chapter outlined the conceptual framework for the basis of this study. As video game technology continues to evolve, it will become more of an influential factor in the lives of young people in an increasingly digital culture. Perceptions of stakeholders such as students, parents, and society at large reveal that VGT contains a number of beneficial and detracting qualities that, in turn, impact its use in educational environments. Music education is no exception, as performance-based COTS games, though primarily designed for entertainment purposes, have been used in the attempt to teach musical concepts and skills. Serious games and edutainment have also been created specifically for such purposes, though they have not enjoyed the popularity of COTS games at present.

While a number of studies have explored the use of digital game-based learning in the classroom and in music education, the amount of current research remains fairly limited and inconclusive. Only a select few studies have focused on students in school settings below the collegiate level with games designed to teach musical knowledge and skills. Chapter II next explores these studies as well as the history of games and play as a vital aspect of human development, and chronicles the rise of video games as a major influence in today's culture and society.

Chapter II

LITERATURE REVIEW

Overview

Research focusing specifically on video games in music education has been considerably sparse when taking into account the increasing amount of digital media available for learning activities. Music production software such as sequencers (Garageband, Mixcraft), notational programs (Finale, Sibelius), and audio editors (Audacity) can be used to create music technology environments in the classroom by using just one computer, a few computers, or an entire network of computers. iPads have also become available to educators—the portability of which can assist in more accessibility (Frankel, 2010). Even though the availability of these technological resources has increased significantly in recent decades, examinations of video games in the music classroom have been relatively meager by comparison.

A survey of the literature conducted in March 2016 using the key terms ‘music education,’ ‘video games,’ and ‘digital game-based learning’ yielded limited results. Online databases including ACM Digital Library, IEEE Xplore, SCOPUS, ERIC, Google Scholar, Digital Dissertations, ProQuest, The Music Index Online, and psycINFO collectively revealed approximately 20 studies within the last four decades exploring the link between music education and video game play. A larger amount of empirical data

was found when the search was expanded to include video games and general pedagogy, though prior literature surveys have acknowledged that individual research in these areas is also inconclusive (Backlund & Hendrix, 2013; Dondlinger, 2007; Young et al., 2012).

To understand the theories underlying the connections between video games and music education, it is necessary to broaden this review to take into account the development of play and games as a source of human development and learning. A brief history of video games is then detailed, along with the tributaries of serious gaming and edutainment. An exploration of affective behavior, including engagement, motivation, and immersion, assists in describing why video games have become such an influential industry among multiple demographics.

Both COTS and educationally-based games currently in practice within the music performance genre are examined for common themes, along with stakeholder perceptions of video games within education and society. These perspectives include studies regarding controversies and barriers to the widespread use of video gaming in education.

Play and Game Theory

The phenomenon of play and games has been present in human society since mankind's earliest recorded civilizations. Early examples of games have been documented through artifacts dating back over two millennia, including illustrations originating from Sumerian, Egyptian, Mesopotamian, and Greek cultures (Avedon & Sutton-Smith, 1971). Reasons for the invention and practice of games can be explained by the same incentives for why games are played in present societies—namely, the need for competition, frivolity, creativity, and self-satisfaction (Sutton-Smith, 1997).

Considerable debate regarding the nature of play and games has occupied researchers, such as its characteristics, its role in society, and its capacity to influence human behavior. The terminology itself has created ambiguity over whether the terms *play* and *game* describe the same entity, or if they are mutually exclusive. Theorists who have separated the two have contended that play does not contain the rule-based structure inherent to games, but is defined by its voluntary nature evocative of joy and amusement (Caillois, 1958; Huizinga, 1950). Caillois (1958) further clarified the differences between play and games as *paidia* and *ludus*, respectively, where *paidia* represents an active, tumultuous spontaneity free of goals and rules, while *ludus* relies on calculation and a dependence on some predetermined structure. Salen and Zimmerman (2004) stated nearly 50 years later that games could be considered a part of all play activities, while play is a necessary component of all games.

Of primary concern is the importance of play in human development as both a psychological and social construct. Though play has been labeled as imaginary, voluntary, and unproductive (Huizinga, 1950), it is also considered vital to the advancement of cognitive ability (Piaget, 1962; Vygotsky, 1978). Vygotsky (1978) in particular identified play as a leading factor in childhood development, in which the child creates an illusory world through interactions with the environment, and it is within this world where problem-solving skills are developed by reconciling the unrealizable desires of imagination. Piaget (1962) identified play as a way for children to feel power or mastery over their actions, and further classified these actions as sensorial, motor, intellectual, or social.

Caillois (1958) presented a categorization of games into four main rubrics. *Agôn*, or competitive games, are the most common and influential form of play in society. The desire to challenge oneself, to prove one's superiority, and to overcome obstacles is an inherent aspect of competition, which is a significant influence in both learning and society. *Alea*, defined as games of chance such as dice games and slot machines, do not present a significant challenge as the player has no control over the outcome. *Ilinx*, as well, has no particular objective except to cause vertigo, as in games such as ring-around-the-rosie or spinning. *Mimicry*, or playing make-believe, is frequently combined with *agôn* to create imaginary situations where players can act out fantasies that exist separately from reality. These imaginary constructs contain rule-based structures that, once violated, destroy the very fabric of the game itself.

Recent explorations in game theory have expanded on these earlier views as to what constitutes game play activities. Present scholars agree that games are systems that require the use of rules, provide challenges to overcome, and give immediate feedback in a quantifiable outcome (Juul, 2005; Kapp, 2012; Koster, 2014; McGonigal, 2011). Kapp (2012) argued that results of engaging in meaningful game play can be instructional for declarative knowledge (verbal or factual knowledge), conceptual knowledge (grouping of similar thoughts or ideas), rules-based knowledge (relationships between concepts), procedural knowledge (performing a particular task), and soft skills (guidelines for dealing with social interactions).

With the advent of VGT, the interaction of rules with fictional worlds is fundamentally a learning experience, as the player will overcome challenges and obstacles in order to complete or 'beat' the game (Juul, 2005). The interactivity that

results from this competitive structure can be experienced individually (player vs. system) or socially (player[s] vs. player[s]). The skills generated from game play increases the participant's knowledge to become more proficient at the game. In this sense, games can be used as teaching devices that may be played as collaborative or solo activities (Koster, 2014). As game studies progress, philosophies identifying play as a teaching agent will most likely expand through the further classification of games, particularly in the case of digital technology.

A Brief History of Video Games

The project considered to be the first electronic game was *Tennis for Two*, designed by William Higinbotham at the Brookhaven National Laboratory in 1958 (Vorderer & Bryant, 2006). The game was designed on an oscilloscope for analog equipment and featured a two-player game play that would be incorporated into the design of *Pong* (Alcorn, 1972) over a decade later. The game's success inspired MIT student Steve Russell to create an interactive game on the new PDP-1 (Programmable Data Processor-1) computer called *Spacewar!*. Though popular among students, the game could not be played anywhere else other than the MIT laboratory because the PDP-1 cost \$120,000 and was the size of a large automobile (Kent, 2001).

The ability for games to be played on a portable system was made possible by Ralph Baer, who worked with Magnavox to create the Odyssey console in 1972. While moderately successful, the video game industry achieved widespread acclaim when developer and entrepreneur Nolan Bushnell founded the Atari Corporation the same year. One of Bushnell's programmers, Allan Alcorn, had designed a table tennis simulator

called *Pong*, which became the first international arcade hit (Herz, 1997). Home consoles soon began to produce *Pong* clones, which along with games such as Taito's *Space Invaders* (Nishikado, 1978), Atari's *Asteroids* (Rains, Logg, & Walsh, 1979), and Sega's *Frogger* (Konami, 1981), fueled the home consumer market and made video gaming a multimillion-dollar industry.

The plethora of companies attempting to enter the gaming market resulted in hundreds of substandard games being recalled for lack of demand (Egenfeldt-Nielsen et al., 2016). Referred to as the video game crash of 1983, the future of the industry was ultimately saved by a Japanese company named Nintendo, a former manufacturer of playing cards. The company's Nintendo Entertainment System (NES), released in 1985, brought video games back from the brink of extinction with games including *Super Mario Bros.* (Miyamoto, 1985) and *The Legend of Zelda* (Miyamoto, 1986).

Over the next decade, other companies began to follow suit, such as Sega, Sony, and Microsoft. The competition for dominance among video game consumers increased the sophistication of each subsequent console's hardware capabilities and the quality of games produced by both large and independent developers. Online games, where millions of people can exist in a collective fantasy experience, have provided an alternative reality using synthetic worlds. A study conducted in 2001 found that 20% of online players considered the virtual world as their true home (Castronova, 2007).

At the time of this writing, video game consoles are considered to be in the eighth generation—the three most dominant being Nintendo (Nintendo Switch), Sony (Playstation 4), and Microsoft (X-Box One) (ESA, 2018). Further innovations in virtual reality technology are available for home consumers, such as the Playstation VR, Oculus

Rift, and HTC Vive. With new products entering the market at an exponential rate, it is not difficult to assume that the video game industry will continue to grow in popularity within the foreseeable future.

Serious Games and Edutainment

The first uses of digital technology for educational purposes date back to the PLATO (Programmed Logic for Automated Teaching Operations) computer system, developed in 1960 by programmers at the University of Illinois (Sheldon, 2012). The system ran until 2006, offering assistance in a variety of courses, including chemistry, Latin, and mathematics. Computer-assisted instruction (CAI) soon became available on many government and university-run mainframes. In an effort to increase the enjoyment of CAI, university students began designing games on the PLATO system to enhance the learning process.

This new breed of programs, labeled “serious games” (Abt, 1970), had a specific educational purpose and were not intended to be played primarily for amusement. The rationale for creating video games as teaching agents stressed the ability to make quick decisions, develop an understanding of cause-and-effect relationships, and reward self-restraint by delaying instant gratification (Abt, 1970). Games were also found to have a high degree of intrinsic motivation, provided that the implementation of the game matched the educational objectives and allowed sufficient time for the student to learn how to manipulate the system effectively (Groff, Howells, & Cranmer, 2012).

One of the most popular and enduring examples of educational video games was MECC’s *The Oregon Trail* (Rawitsch, Heinemann, & Dillenberger, 1971), written by

three student teachers to help children understand the difficulties of life during a 19th century westward migration (Tobias & Fletcher, 2011). Players would have to make choices based on environmental considerations in order to travel from Missouri to Oregon. If players made the wrong choice, their party could be wiped out from starvation, disease, or exhaustion. The game was an immediate success; many school computers came bundled with the game, and it is now available on cell phones and tablets.

Many other developers continued the tradition begun by *The Oregon Trail* with series titles such as *Math Blaster!* (Davidson & Associates, 1983), *Reader Rabbit* (The Learning Company, 1986), and *Where in the World Is Carmen Sandiego?* (Brøderbund, 1985). Even mainstream entertainment companies such as Nintendo entered the market, illustrated in games including *Donkey Kong Jr. Math* (Nintendo, 1985) and *Brain Age* (Nintendo, 2006). Simulation, or ‘god’ games, where the player constructs and manipulates entire worlds, can teach a variety of concepts such as history (*Sid Meier’s Civilization*; Meier, 1991), social studies (*SimCity*; Wright, 1989), and physics (*Minecraft*; Persson & Bergensten, 2011).

Research conducted by analyzing the outcomes of CAI using popular game titles has suggested that these games can form the basis of new skills and identities by creating worlds, solving problems, and learning to accept failure while attempting new avenues of success (All, Castellar, & Looy, 2015; Annetta, 2010; Annetta, Murray, Laird, Bohr, & Park, 2006; Barr, 2017; Gee, 2005b; Ibrahim, Vela, Rodríguez, Sánchez, & Zea, 2012; Sáez-López, Miller, Vásquez-Cano, & Garrido, 2015; Squire, 2005, 2008).

Music Performance Games

The development of music in video games has experienced diverse growth since the availability of sound technology within digital media. The earliest games did not have the capability for creating sound until games started becoming a viable commercial industry during the 1970s. *Pong*, for example, only contained one sound, recognized by the virtual ball making contact with the paddle. *Space Invaders* was one of the first examples of music as directly related to gameplay, where the music would increase in tempo in accordance with the number of aliens the player destroyed. Programmers designing games between 1977 and 1983 did not have musical composition experience, and usually wrote music that was unoriginal or extremely basic (Newcomb, 2012).

After the video game crash of 1983, the sophistication of cartridge technology as opposed to disks allowed soundtracks to be recorded using digital tracks instead of analog (Newcomb, 2012). Video game companies soon began hiring composers to increase the enjoyment of games using original music and sound effects. Koji Kondo's soundtracks of *Super Mario Bros.* and *The Legend of Zelda* remain two of the most iconic examples of video game music that continues to be familiar even to those who have never played either game (Collins, 2008). Background music in video games have become so popular that they are often featured in stand-alone events, such as the Video Games Live or Distant Worlds concert series.

Over the next several decades, video game music has been divided into two primary classifications, referred to as diegetic and non-diegetic (Collins, 2008). Diegetic music is all sound that takes place within the game world and is part of the interactive experience. Characters within the game react and respond to musical or sound cues

initiated by the player or through the game's narrative. For example, Square's *Final Fantasy VI* (Square, 1994) contains a scene in which the player must choose the correct lyrics in a 19th century-style opera, while *The Lord of the Rings Online* (Turbine, 2007) allows players to create and perform their own music that can be heard by other online players (Cheng, 2014). Non-diagetic music describes all music and sound that are only heard by the player and does not affect the game world, such as the background music previously described.

Music as a defining aspect of game play developed into the genre known as music performance games in the late 1990s, where the creation and manipulation of musical sounds are the core mechanic of the system (Pichlmair & Kayali, 2007). Music performance games are fundamentally different from music-making software, such as Garageband and Mixcraft, in that composition software does not provide immediate goals or feedback, nor does it motivate players with challenges or rewards through competition (Arrasvuori, 2006). Most music performance games are based on a structure requiring the player to activate a certain combination of controller buttons in quantization with a predetermined musical score. The most defining examples of this genre are the *Guitar Hero*, *Rock Band*, *Rez* (United Game Artists, 2001), and *Dance Dance Revolution* series (Konami, 1998).

The popularity of the music performance genre has led many music educators to explore the pedagogical implications of using COTS games in the classroom. Supporters of integrating music performance COTS games into the music curriculum claim that playing these games may increase rhythmic and aural musical skills, such as beat matching in various meter patterns, sight reading, and focused listening (Biamonte, 2011;

Smith, 2004; Tobias, 2012). Although these games are not designed to reinforce musical concepts, the potential of these games to meet educational objectives merits further investigation (Mercer, 2009; Miller, 2013; Reyher, 2014).

A 2011 study conducted at a Midwestern Boys & Girls Club tested the ability of the game *Rock Band* (Figure 2) to serve as a gateway for students to learn formal music skills (Pepler, Downton, Lindsay, & Hay, 2011). The researchers introduced a ‘*Rock Band*’ club which convened two to three times per week. The participants, averaging ages 10-11, had little to no experience with rhythm video games prior to the start of the study. A traditional music assessment adapted from MacMillan/McGraw Hill’s 2005 textbook was created to test rhythmic skills and administered to all participants after a period of 9 months.



Figure 2. Screenshot of Harmonix’s *Rock Band* (LoPiccolo, Kay, & Teasdale, 2008)

Results indicated that as the number of *Rock Band* sessions increased, a correlation emerged with overall improved scores on the traditional music assessment. Though the study was not conducted in a traditional school environment, music represented in performance-based video games such as *Rock Band* may potentially be a catalyst to build student interest in more formal music instruction. In addition, the alternative music notational form presented in *Rock Band* may also assist in bringing music literacy to a wider audience.

Though the design and game play of music performance games may merit their potential use as CAI tools, limitations exist that can hinder the viability of COTS games in music education, as noted by Auerbach (2010) in a study of *Dance Dance Revolution* (DDR). As is the case with most console games, only a limited number of students can play at a time. In addition, the teacher would need to purchase a game system, such as a PlayStation or X-Box, the game, a gamepad, and an interface (TV). Students also require consistent practice to get better at DDR, which may not be possible for large class sizes that meet sporadically, such as once per week.

Arsenault (2008) illustrated that the mechanics presented in the *Guitar Hero* series were not conducive to learning how to play a real guitar. Though the differences in the *Guitar Hero* controller prevent game players from understanding the concept of playing a real guitar, this does not reflect the objective of the game. Games do not perfectly simulate any one dimension of music and guitar playing because they favor the entertainment quality of the simulation rather than realism. Consequently, while COTS music performance games are not considered a substitute for music education, it is

plausible that these games can serve to inspire and engage students to pursue more formal music studies (Feola, 2010).

Games using a formula similar to that of the *Guitar Hero* series have been adapted to interface with real instruments, such as *Rocksmith* (Ubisoft, 2011) and *Yousician* (Thür & Kaipainen, 2010). Both of these programs allow users to play on their own instruments, including guitar, bass guitar, piano, ukulele, and voice, through either a USB cable or an external microphone. The system recognizes when notes are played correctly in terms of pitch and rhythm and accordingly scores the player based on available pre-recorded backing tracks. However, neither game currently has the ability to detect musicality, such as style interpretation or emotional depth; instead, the game's feedback relies completely on quantifiable criteria. Though factors such as the cost of the software, instruments, and students' ability to access the program outside of the classroom may limit its appeal, *Rocksmith* and *Yousician* may be the first examples of a new generation of music education software products that use game-based learning as its primary mechanism.

Music, Games, and Motivation

In 1983, jazz pianist and sociologist David Sudnow described his experience learning to master the Atari game *Breakout* (Bushnell, Bristow, & Wozniak, 1976). The game was originally a present for his teenage son, but after noticing the immense time and effort placed in playing the game, Sudnow attempted to discover what made the game so addicting by playing it himself. The resulting narrative, entitled *Pilgrim in the Microworld* (Sudnow, 1983), detailed the process in which Sudnow became enamored

with the game, turning a pastime of lighthearted entertainment into a consuming obsession. Playing for several hours each day, Sudnow eventually determined that the addictive qualities of *Breakout* extended beyond mere enjoyment. The need to master challenges that lie just beyond the reach of ability presented an intrinsic desire to pursue those goals, even if that goal was to simply clear the screen of pixilated blocks.

This phenomenon, which Vygotsky (1978) referred to as the zone of proximal development and Gee (2007, 2013) referred to as a regime of competence, has been a defining factor in understanding intrinsic motivation. A previous study conducted by Malone (1980) on computer games determined that video games such as *Breakout* present users with three areas that can foster intrinsic motivation: challenge, fantasy, and curiosity. These qualities will lead players to experience emotional responses from meaningful game play and work hard to achieve goals, even when the quality of enjoyment is absent. This “hard fun” (Lazzaro, 2004) is sought for the experience of an adrenaline rush, memorable experiences, or the satisfaction felt when reaching a difficult objective.

Self-determination theorists attributed the high amount of intrinsic motivation when applied to video games to their degree of interactivity and immediate feedback (Pink, 2009; Rigby & Ryan, 2011; Ryan, Rigby, & Przybylski, 2006). Perceived autonomy and competence are associated with enjoyment and changes in well-being. This is influenced by the player’s sense of immersion, defined as the level of engrossment and involvement in game play (Brown & Cairns, 2004). Background music in various genres of games can be considered as a design tool to create immersion (Linek, Marte, & Albert,

2011), and music performance games can create a similar state when compared to the act of playing an instrument (Missingham, 2007).

Characteristics of playing video games have been identified with assisting in creating a 'flow' state, described as an optimal experience that is felt as deep enjoyment and fulfillment (Csikszentmihalyi, 1975a, 1975b, 1990). Csikszentmihalyi (1975b) described games as 'obvious' flow activities, as long as they provide the player with appropriate challenge and immediate feedback without the risk of boredom. While Csikszentmihalyi did not specifically mention video games as a catalyst for entering a flow state, game researchers have found that design aspects such as clear goals, immediate feedback, deep concentration, player control, and intrinsic rewards can create the conditions for optimal experience (Douglas & Hargadon, 2000; Gregory, 2008; Inal & Cagiltay, 2007; Kiili, 2005; Sweetser & Wyeth, 2005).

The same qualities of video games that promote deep immersion and engagement have been shown to be present in musical activities. Children observed in the music classroom suggested that the combination of high challenge with high skill led to behavioral indicators of flow (Custodero, 1998). Games that seek to exploit these qualities, such as music performance games, have been successful in creating flow among players through competition and the players' ability to customize difficulty levels. Future attempts at developing educational games for music education may benefit from incorporating these design concepts to instill intrinsic motivation and deep engagement among students.

Pedagogical Music Games

The effect of games on the conceptual learning of music skills had been examined before the incorporation of digital technology into educational environments. A study conducted in 1984 used crossword puzzles, word searches, and matching games on a group of fourth and fifth grade elementary school students to determine an understanding of rhythmic values and music terminology recognition (Manzo, 1984). After a pretest/posttest control group design, results showed a statistical difference in favor of the experimental the iPad groups, opposed to students not using the games. This may suggest that gaming in music education can promote higher levels of intrinsic motivation and the ability to foster learning, compared to non-game usage.

These results may also be applied to VGT, especially in the case of K-12 students born in the 21st century. Technology such as the internet, portable media devices, and video games have been available for generations born after the year 2000. These “digital natives” (Prensky, 2001, p. 46) are much more comfortable with manipulating digital technology than “digital immigrants” (p. 46) who were born before such technology was available. As a result, students in today’s educational environments may more likely be motivated and achieve academic success with materials they are familiar with in their personal lives.

Digital media adapted for music education have also evolved to suit the needs of today’s net-generation. Sources such as the internet, CDs, musical websites and videos, and interactive computer games can be used to provide new and engaging opportunities for students (Kersten, 2006). iPads also contain many different applications for music training, such as aural development, compositional practice, and terminology review, that

can be customized for multiple ages and grade levels (Riley, 2013). These games also have the ability to teach alternative forms of music notation, mostly through rhythmic exercises and motor skill development (Shultz, 2008).

Music educators and researchers have attempted to create their own pedagogical VGT that mirrors the effects of COTS games. A game called *Lipa's Festival* consisting of *Super Mario Bros.*-type levels was created to teach chordal structures in jazz arrangements (Denis & Jouvelot, 2004). The player would select the correct chord as part of an animation where multiple choices scroll downward across the screen. Though experimental designs could suggest evidence of the game's ability to teach musical concepts, there is currently no substantiation that the game currently exists, nor are there any other sources of research referencing that specific game.

There are several similar examples based on games originally designed to teach musical skills and knowledge (Denis & Jouvelot, 2005; Hämäläinen et al., 2004; Jenson et al., 2008; Karlsson, Liljeström, & Juslin, 2009; Wechselberger, 2016). *PlaySingMusic*, developed by Elmorex Ltd. in 2000, required the player to sing so that an animated character would stay on a predetermined path in sync with the music (Hämäläinen et al., 2004). *Tafelkids: The Quest for Arundo Donax* mirrored the gameplay of *Guitar Hero*, though presented with Baroque music (Jenson et al. 2008), and a Swedish program named *Feel-ME* tasked the player with recording several different performances of a guitar melody to match a sequence provided by the computer (Juslin, Karlsson, Lindström, Friberg, & Schoonderwaldt, 2006).

While all of these games showed participants' increased motivation to play, there was no evidence to suggest that the games could teach musical concepts and skills

compared to other instructional methods. In addition, all of the studies cited were completed outside of the United States, and none of these games are commercially available. The participants were also tested in laboratory settings; no mention of real-world applications or testing in a natural learning environment was suggested. If VGT applied to music education is to gain credibility, then future studies must demonstrate the relevance and reliability of VGT in the classroom with commercially available games.

Stakeholder Perceptions

The incorporation of VGT into educational curriculum necessitates the agreement of stakeholder groups to confirm its effective potential as a learning tool. Currently, there is much debate among students, parents, and teachers of the role that VGT plays in home environments, in education, and in society (Kutner & Olson, 2008). One of the primary factors which may influence this is the difference between parents' and children's understanding of digital technology. As theorized by Prensky (2001, 2006) in his concept of the digital native as opposed to the digital immigrant, children's skills in manipulating VGT are much better than their parents.

Because adults who have not grown up with digital media are required to learn through necessity, many parents are concerned with how to maximize control over their children's game-playing behavior (Chaung et al., 2011). Recognizing VGT as a positive instrument for learning requires parents to develop knowledge in this area so that they can make informed decisions about what types of games their children play. Since most gaming occurs in the home environment, parents are responsible for monitoring the games their children play and for how long they are played (Chuang et al., 2011).

Surveys studying the behavioral responses of children reflecting on video games have provided insight into youth digital culture through their own generational perspectives. Motivations for playing video games among both girls and boys include passing time between activities and as a pleasant diversion to avoid unpleasant responsibilities such as chores and homework (Fromme, 2003). Gaming seems to be integrated into peer-to-peer relationships, with friends being the most important advisors or mediators in game-related matters. Gaming does not necessarily indicate a predictor of social isolation, though children do often prefer playing with the same members of their own gender identification (Fromme, 2003).

Boys are generally more likely to play than girls for fun, for competition, and for the challenge of solving puzzles and completing objectives (Olson, 2010). In a survey conducted in South Carolina and Pennsylvania, participants reported that teaching others to play is a source of satisfaction, along with the added effects of relaxation and coping with stress (Olson, 2010). However, boys and girls generally disagreed on what constitutes an effective game, with boys preferring competition and challenge and girls preferring exploration and puzzles (Peppler, Warschauer, & Diazgranados, 2010).

Students' perceptions of using video games in the classroom are affected by a variety of factors, including the usefulness and relevance of the game, its ease of use, and its ability to teach concepts while promoting a sense of enjoyment (Bourgonjon et al., 2010). Students viewed learning in school and playing video games as comparable, as they involved improvement with practice, challenge, and education. While the teacher was responsible for the learning in the classroom, the student was responsible in the video game setting. Students noted that the trial-and-error strategy employed by video

games is more appropriate for learning than in the classroom setting (Blumberg & Altschuler, 2011).

Teachers' use of video games in the classroom was influenced by several factors. Lack of time to create and customize video games, relevance to the curriculum, expense of acquiring video games, and lack of professional development and training have created a general reluctance among educators to implement VGT (Baek, 2008; Ertzberger, 2008). In addition, some educators were concerned that VGT adapted for educational purposes focuses more on experience and motivational aspects than the learning objectives driving the lesson (Russell, 2016). Pre-student teachers seem to be the most enthusiastic about using VGT in their classrooms, though finding appropriate educational video games, receiving technical assistance in installation, and affording the cost of buying games and consoles were mentioned as potential detriments (Bensiger, 2012).

Conclusions that could be drawn from these perspectives suggest that as more digital natives become teachers and administrators, the use of VGT will increase due to its positive reception by younger stakeholders. Defining factors of future implementation will depend on the quality of games designed for education and their ability to reconcile entertainment with predetermined curricular objectives.

Barriers and Controversies

The potential benefits of digital game-based learning have been overshadowed by negative perceptions of video games, such as increased aggressive behavior, addictive qualities, and other health risks like seizure, depression, and obesity (Böshe & Kattner, 2011). Researchers identifying causalities of these affective behaviors have stated that

unless children's game play is not specifically regulated, exposure to certain types of video games can create negative physical and emotional effects (Anderson & Bushman, 2001; Anderson & Dill, 2000; Buchman & Funk, 1996; Carnagey & Anderson, 2005; Funk & Buchman, 1995; Gentile, 2009).

Teacher adoption of educational games has been hampered by these negative perceptions, particularly in the wake of the 1999 Columbine High School massacre, where it was discovered that the two shooters had played the violent game *Doom* extensively, even creating customized levels known as 'modding' (Kutner & Olson, 2008). Studies focusing on violent affect in video games have suggested that rewarding in-game violent actions may result in increased hostile emotion, aggressive thinking, and violent behavior (Carnagey & Anderson, 2005). Proponents of the theory that video game play influences aggressive thinking or causes violent behavior are apt to consider the entire video game industry as responsible for delinquency and lowered academic performance (Anderson & Bushman, 2001; Anderson & Dill, 2000; Gentile, 2009; Sheese & Graziano, 2005).

In December of 2017, the World Health Organization (WHO, 2018) classified gaming addiction as a mental health disorder, based on studies identifying symptoms such as significant impairment of daily interests and activities due to an increased priority to play video game. This spawned a strong negative reaction from many researchers, who cited the classification as premature and having the potential to stigmatize gaming and the way it is perceived by consumers (McKenzie, 2018).

Even background music was considered a source of physical excitement in violent games, as interactions between game content and music genre have a role to play in

affecting aggressive behavior (Zhang & Gao, 2014). However, studies involving children and current video games considered violent by the ESRB are limited and offer no correlational evidence to the link between violent behavior and excessive video game use (Kutner & Olson, 2008; Porter & Starcevic, 2007). Until empirical research can offer further evidence, the interpretation between exposure to violent video games and aggression remains open to critical inquiry.

The assertion that video games promote negative gender stereotypes has also been examined and scrutinized as lacking empirical evidence (Feng, Spence, & Pratt, 2007; Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010; Hamlen, 2010). While males average twice as much time playing games than females, the two primary gratifications for both sexes are competition and challenge (Greenberg et al., 2010). Hamlen (2010) reported that a survey of elementary school students that girls feel equally competent as boys when playing video games, but have reported a preference to play less. As a result, game designers have created strong female characters to encourage female gamers, such as Lara Croft in the *Tomb Raider* series (Crystal Dynamics, 2013) and Chell from the *Portal* series (Valve Corporation, 2007).

Controversies surrounding video games have not detracted from their consumer appeal. Though organizations now provide ratings systems to inform consumers of game content, such as the ESRB, Pan European Game Information (PEGI), and the Computer Entertainment Rating Organization (CERO), supporters of digital media regulation will continue to link video games to negative phenomena (Kutner & Olson, 2008). The implications for educational video games will thus be influenced by these perspectives as long as games that include violent content are marketed. As action and shooter games

were reported to be the top-selling genre of games in 2017 (ESA, 2018), it is unlikely that controversies of this nature will recede in the near future.

Summary

Video game technology has experienced major changes and struggles over its relatively brief existence as a potential educational tool. While supporters of VGT cite its ability to engage and motivate students as a relevant aspect of youth culture, detractors continue to hold the video game industry responsible for its ability to cause addictive and aggressive behavior. Although research is slowly contributing evidence to the positive uses of music games, both in the COTS and edutainment genres, progress in the implementation of VGT remains limited among music educators.

As more digital natives enter the field of education, it is likely that the perception of VGT in the music classroom may become more positive, leading to innovations in digital technology that can help teach musical concepts and skills. The methodology presented in the next chapter utilized this technology to test its effectiveness with elementary school students in the natural classroom environment.

Chapter III

METHODOLOGY

Overview

The purpose of this study was to investigate the educational possibilities of video games designed to teach musical knowledge and skills in an elementary school music classroom. The study was designed to answer the three following research questions:

Research Question #1: Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?

Research Question #2: How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?

Research Question #3: What are the perceptions of elementary school students regarding VGT in their personal lives?

Research Question #4: What are the perceptions of elementary school students regarding VGT in educational environments?

As discussed in the previous chapter, the majority of studies of this nature have focused on COTS games in laboratory settings with undergraduate students. The present study aimed to emulate the natural general music classroom environment using games designed to assist the instruction of musical concepts and skills.

Participants and Setting

Participants were recruited from the fifth and sixth grades of an elementary school located in southern New Jersey. All fifth and sixth grade students were invited to participate in the study as per consent obtained from their parents/guardians (see Appendix A). Participating students were between the ages of 10 and 12 and represented a variety of demographics. The most recent demographic information available within the participating school was taken during the 2017-18 school year by the State of New Jersey Department of Education (NJDOE), and included 92 students in fifth grade and 93 students in sixth grade (NJDOE, 2018). Specific details are notated in Table 2.

Table 2

Demographic Information of Participating School

	Students	Male	Female	White %	Black %	Hispanic %	Other %
Grade 5	92	45	47	34	57	4	5
Grade 6	93	41	52	39	49	11	1
Total	185	86	99				

The report also stated a student mobility rate within the school at 28%, with 65% of students receiving free or reduced lunch (NJDOE, 2018). These data represent a general estimate of the target population from which the sample originated. All students were considered for the study regardless of sex, race, or gender identification. Participating students must have been present for the entire study for the data to be considered, including the pretest session, three instructional periods, and the posttest.

Students placed in special education classes were also involved in the study as the school structure normally allowed these students to travel with inclusion classes. Students with individualized education plans (IEPs) were reviewed with the assistance of their individual teachers. Aides also traveling with these students as per their normal schedule were available to assist them during any phase of the study in accordance with their specific accommodations. Test data from these students were included in the overall analysis and were not analyzed separately as a comparison group, as this was beyond the scope of the study.

Students involved in the experimental phase of the study were eligible for the survey and exit interview, which were given after the experimental phase was completed. The sample representing the qualitative data was taken from the quantitative population.

Procedures

The study commenced in September of 2017 with approval from the participant district's Board of Education and school principal. Parental/guardian consent forms were then sent out through district mail; students submitting both a Parental Consent Form and Student Assent Form were considered for the study.

The quantitative quasi-experimental phase began in January of 2018 after the Winter Break holiday. The roster of each fifth and sixth grade class had previously been sorted by the school administration into each group prior to the beginning of the experimental design. Students in each grade level were sorted into classes at the school principal's discretion before the school year began. Criteria for the placement of students

into each class included sex; balance of numerical population; and recommendations from teachers, the school behavioral specialist, and the school guidance counselor.

Students in each group completed a pretest/posttest control group design (Wiersma & Jurs, 2009), the results of which were concealed from the students during the course of the study. The pretest/posttest were divided into three categories: aural perception (pitch matching), rhythmic perception (beat matching), and pitch/rhythm identification (see Appendix B). Students were administered the test equally and allotted 20 minutes to complete the exam. Assessment objectives of the pretest/posttest were designed around the New Jersey Visual and Performing Arts Standards 1.1.5.B.1 and 1.1.5.B.2 (New Jersey Department of Education [NJDOE], 2014) and National Association for Music Education (NAfME, 2014) standards MU:Pr4.2.5.a, MU:Pr4.2.5.b, and MU:Pr4.2.6.b, as defined in Table 3.

Table 3

State and National Standards Assessed in the Study

Standard	Description
1.1.5.B.1	Identify the elements of music in response to aural prompts and music notation.
1.1.5.B.2	Demonstrate the basic concepts of music notation and differentiate structures.
MU:Pr4.2.5.a	Demonstrate understanding of the structure and elements of music.
MU:Pr4.2.5.b	Read and perform using standard music notation.
MU:Pr4.2.6.b	Read and identify by name standard symbols for rhythm and pitch.

Students met in music class for three lessons once every 6 school days for 40 minutes each session. Each lesson consisted of exercises promoting the above skills in individual classes. Lessons were based on skills and knowledge presented as part of the normal elementary general music curriculum, as approved by the participating district's Board of Education (BOE, 2012). Students in the iPad group manipulated preselected iPad video game applications designed to teach these skills and knowledge. The researcher gave a brief tutorial explaining how to manipulate the game and assisted individual students as needed while they worked independently. These iPad apps are detailed in the Instrumentation section of this chapter. Students had limited verbal instruction, except for assistance for students on a case-by-case basis.

Students in the non-technology control group were given performance-based exercises using body percussion and call and response. Activities included responding to printed flashcards, improvisation using short rhythmic and melodic phrases, and composing on music staff whiteboards. More verbal instruction was given to the class with a greater emphasis on interaction between students and the teacher. Students in the hybrid group used both iPad applications and received instruction with performance exercises, such as reading rhythms on flashcards, composing and improvising melodic themes, and responding to aural prompts using an electronic keyboard. Direct instruction was implemented for the first half of the class time (20 minutes), while iPads were used for the second half.

After the three lessons were completed, a posttest consisting of the same material from the pretest was administered in a separate class meeting. Students were informed of their scores from both the pretest and posttest after the conclusion of the study. Only

students who had completed both tests and all three instructional lessons were considered for the data analysis. Students who were absent for the posttest only were considered for a make-up test only if they had completed the previous lessons.

Test/retest reliability was established by using the same experimental tools with all groups, the same observer within all groups, the same measuring instrument (Appendix B), repetition over a short period of time, and the evaluation of all students on the same objectives. After the posttest was completed, students who had finished the quantitative phase of the study were administered a survey circulated online through TC Qualtrics. Students completed the survey during class in the school computer lab. The survey took approximately 10 minutes to complete and consisted of 20 questions on video game use, preferences, and its potential role in music education (see Appendix C).

Although teacher bias existed as a natural limitation of the study, the risk of subjectivity was reduced by adherence to the approved General Music curriculum as approved by the participating district's Board of Education. Activities that had been approved as part of the school curriculum were used without deviation. The researcher took field notes using an audio recorder following each class session; the researcher and a faculty member not affiliated with the study analyzed them using constant comparison (Boeije, 2002) after the conclusion of the study. This assisted in the collection of qualitative data regarding students' experiences within each group.

After completion of the survey, individual students were selected for semi-structured interviews (Slavin, 2007) about perspectives of their personal use of video games and thoughts on VGT in music education (see Appendix D). Two male and two female students in each experimental group from both fifth and sixth grade ($n = 12$) were

selected randomly using the website www.random.org. A faculty member other than the researcher conducted the interviews and assisted in the coding process. Interviews were transcribed by text using the web-based transcription service www.rev.com and coded using the constant comparison method (Boeije, 2002) and compared with the results of the survey.

Coding was analyzed through the development of keywords that arose frequently within the interview data (Gorden, 1992). These terms were defined between the researcher and the third-party faculty member. Quantitative and qualitative results were analyzed after all data collection had been completed. Table 4 illustrates each aspect of the study and the timeline detailing completion of each phase.

Table 4

Timeline of Study

Phase	Method	Research	Timeline	Frequency
1	Quantitative	Quasi-Experimental	January-March 2018	Six 40-minute sessions once every 6 school days
2	Mixed	Survey	March-April 2018	Once per class over three-week period
3	Qualitative	Interview	April-May 2018	Scheduled individually by availability

Pilot Study

The instrumentation was tested for reliability and validity during the months of April through June during the 2016-17 school year. One sixth grade class was randomly selected from a total of six classes using the online website www.random.org. A total of

14 students ($n = 14$) signed and returned both consent forms and were given permission to take part in the study. Details of the study were explained to the participants; they were informed that they would take part in a written exam lasting 20 minutes, followed by an online survey that would be completed during class in the school's computer lab.

The students were informed that the results on the test would not impact their grades in General Music class and the survey would be anonymous. Students were also informed that two boys and two girls would be randomly selected to participate in a brief interview that would be conducted by a teacher not directly affiliated with the study. The selected students would be taken out of class for approximately 10 minutes to complete the interview. Completed tests were securely locked in a file drawer and all interview files were transferred to a password-protected computer.

Two students were unavailable to take the Music Skills and Knowledge Test ($n = 12$). All participating students completed the test without ambiguity. Aural questions were broadcast using the classroom's speakers, which were located at the front of the room. After completion of the test, students were informally asked if they experienced any difficulty taking the test. While no difficulties were reported, it was noted that the volume of the musical tones were at a lower volume than the audio speaker's directions. This, however, did not hamper the students' ability to complete the test effectively, though a new recording was made after the conclusion of the pilot study.

Descriptive statistics were calculated using Microsoft Excel 2007. Out of a total score of 20 points (see Appendix B), the mean of the scores was 13.58, with a range of 15 (Figure 2). The median and mode of the total scores was 13, with a standard deviation of 4.1 and a variance of 16.99. The test and accompanying recording were sent to three

elementary school music educators in the southern New Jersey area, who concurred that the test was age-appropriate for the developmental music skills of fifth and sixth graders, and the test was consistent with the New Jersey State Standards for Visual and Performing Arts.

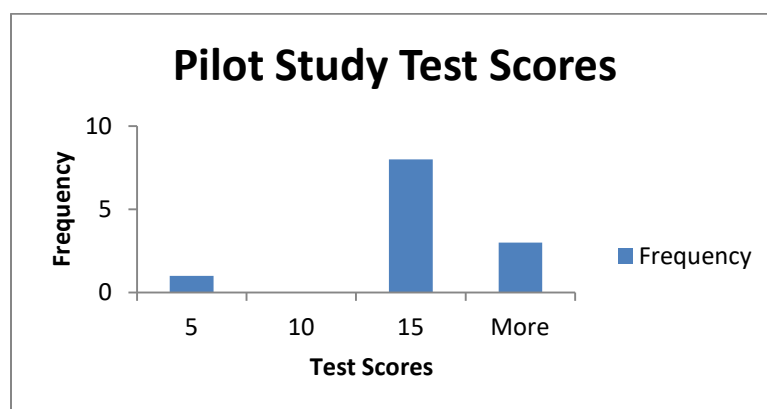


Figure 3. Analysis of pilot study test scores

All students were available to participate in the survey portion of the pilot study ($n = 14$). The survey was created through TC Qualtrics and administered in the school's computer lab (see Appendix C). For the purposes of the pilot study, group names were not used as there was no comparison or control group. Students had a total of 40 minutes to complete the survey; all participants finished in less than 15 minutes. The survey was designed with no open-ended or leading questions. All questions allowed for only one answer to be notated; nine of the questions were presented in 5-point Likert scale format, with 11 multiple-choice options.

Six males and eight females participated in the survey, with nine identifying themselves as White/Caucasian, four as Black/African American, and one as Other. All of the respondents reported having experience in playing video games, with 11 playing for more than an hour per week. The most popular genre of games played were shooters,

sports, and strategy games, with puzzle games being the least number played. The most desirable aspects of video games in order of importance were considered to be challenge, gameplay, and story. Music performance games were not played as often as other genres, with only four participants playing these games on a regular basis.

Ten students believed that video games could be used to gain knowledge, with four noting that they felt neutral toward the educational possibilities of games. Responses were more widespread when considering the application of video games to music, though 12 agreed that educational video games can be fun and enjoyable. Six respondents felt neutral about the possibility of introducing more video games in school, while only three agreed and five disagreed. Finally, six participants felt that they wanted to learn more about music through video games, while three disagreed and five were of a neutral opinion.

Though the survey was conducted using a fairly limited number of students, the results of this pilot test suggested that video games, particularly COTS games, are very much a part of young society. Educational games have not yet begun to take a hold on students' interests, though students may be open to the possibility of exploring these resources as part of a general music class. None of the questions demonstrated an overwhelming response in either direction, even when compared by gender identification. No student reported having difficulty with the language of the survey or any ambiguity in how to answer any singular question.

The purpose of the survey was to accurately report the video game behavior of students and their perspectives of educational video games in both their personal lives and in a music classroom environment. While the expansion of participants in the formal

study would add further evidence to the qualitative data, these initial results presented valuable information on the opinions of students and their affective behaviors in gaming.

The pilot study concluded with interviews conducted by a certified music teacher not directly affiliated with the study. Interviews were held in a neutral classroom and were not attended by the primary researcher. Four students (two boys, two girls) were selected randomly using the website www.random.org and asked to participate. After securing consent from all four students, each was given an individual appointment with the interviewer; no other individuals were present in the classroom during the time of the interview.

Interviews were recorded using the application Voice Record Pro on an iPhone 6 device. Recorded files were reviewed for audio quality and transferred to the researcher's personal computer. Files were sent to the transcription service www.rev.com for text translation and were kept under password-protected security software. No names or any other identifiable features were recorded aside from gender identification as notated by the participant.

All four interview subjects noted that they played video games regularly, both with friends and by themselves. The two male participants stated that they enjoyed playing action games, such as *Battlefield 1* (EA Dice, 2016) and *Call of Duty 4: Modern Warfare* (Infinity Ward, 2007), though the females enjoyed adventure and strategy games because they could "roam around the world." None of the participants played music games outside of music class, though one male had experience playing *Guitar Hero*.

Three of the four participants declared that they enjoyed playing the video games on the iPads during music class because of their interactivity and the ability to create music, though one considered them “boring” because they lacked challenge or a basic storyline.

All four participants agreed that video games should be used for educational purposes, including in the music classroom. Qualities that each participant prioritized when describing an effective music game for the classroom included a sense of fun, the ability to create and customize musical compositions, an engaging storyline or plot, interactivity with classmates, and a variety of gameplay options and activities. Compared with learning from a textbook, all participants agreed that video games were preferable because they presented information in a more enjoyable way that promoted a sense of immersion that traditional textbooks did not achieve.

After the conclusion of the pilot study, all students were thanked for their participation and offered the opportunity to give feedback or ask any questions about the process. Students were requested not to openly discuss their experience with students from lower grade levels as they would be involved in the formal study the following year. No questions or concerns were raised by either students or adults following the pilot study through to the end of the school year. As these students would be advancing to the district high school prior to the beginning of the formal study, revealing the experimental design to the participants of the formal study was not considered a risk and the formal study proceeded with the same instrumentation as the pilot study.

Instrumentation

Materials were used sequentially according to the chronological structure of the study. Phase 1 consisted of quantitative quasi-experimental data collection (Wiersma & Jurs, 2009), which occurred in the natural environment of the General Music classroom. All three groups initially took a pretest, which was identical to the posttest after the three instructional periods were completed (see Appendix B).

The pretest/posttest was implemented to all groups using a pre-recorded track which was played on the classroom speaker system located in the front of the room. Additional audio devices were available in the event of technical difficulties, but were not needed as no technical difficulties occurred during any of the exam periods. The aural perception aspect of the test was recorded using a computer-generated neutral tone to avoid bias between each group.

During the instructional periods, the technology group manipulated selected iPad applications representing edutainment video games. These applications consisted of the following games:

- *Rhythm Cat* (LMuse Limited, 2016): Requires the player to tap the screen in the correct rhythm as the displayed score, shown in music notation.

Background music is played during each round so that the player can develop a steady tempo. Early levels include simple notation such as quarter notes and half notes in 4/4 time, but later levels involve varied time signatures and different combinations of rhythms, requiring the player to demonstrate ability in both recognizing and performing rhythms in order to progress.

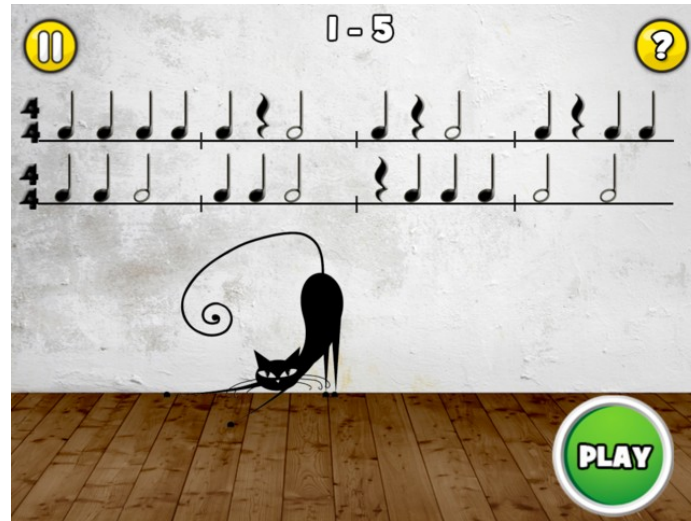


Figure 4. Screenshot of *Rhythm Cat* game

- *Flashnote Derby* (Luke Bartolomeo, 2014): Various pitches appear on the screen which the player must identify. Taking too much time to answer or selecting the incorrect pitch will result in the computer taking the lead in a simulated horse race. Answering enough questions correctly will cause the player's horse to take the lead and win the race. Difficulty levels can be customized for a larger range of notes and a smaller amount of time for the player to answer.



Figure 5. Screenshot of *Flashnote Derby* game

- *Staff Wars* (TMI Media, LLC, 2014): This is similar to *Flashnote Derby*, though there is no end to the game until the player commits three mistakes. Notes scroll across the screen in either treble, bass, or alto clef, depending on which clef the player chooses before the beginning of the game. Identifying 10 notes correctly will level up the game, where the notes will scroll faster, creating a heightened challenge for more experienced musicians.



Figure 6. Screenshot of *Staff Wars* game

- *Blob Chorus* (Lumpty Learning, 2014): This ear-training app matches different individual pitches sung by ‘blobs’ to one pitch sung by ‘King Blob.’ Players must match the correct pitch to receive a higher score. Levels can be customized from two blobs for beginners up to eight blobs for advanced players.



Figure 7. Screenshot of *Blob Chorus* game

- *Melody Melody* (Currach Software, 2013): This game expands the concept presented in *Blob Chorus* and applies it to short melodic figures that the player must aurally identify and match to identical melodies from a series of different melodic options. Players who choose the correct match without making an error will receive a higher score. Advanced players can increase the difficulty level by adding pitches with more complicated rhythms.

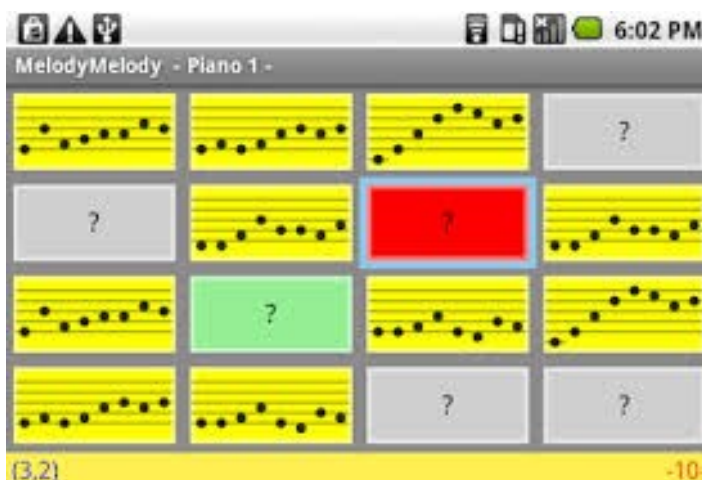


Figure 8: Screenshot of *Melody Melody* game

These specific games were chosen based on recommendations from members of the New Jersey chapter of Technology In: Music Education (TI:ME). In addition, the applications were selected on criteria that included how each individual game conformed to the New Jersey Visual and Performing Arts and NAFME standards. This involved whether the application possessed an embedded assessment within the game's structure and its ability to provide a real-time instant feedback scoring system. Other considerations included the game's user-friendliness; ease of use; challenge level; and the potential enjoyment factor stemming from gameplay, graphics, sound, and overall thematic concept.

Each app was used in the instructional sessions, as described in Table 5. Additional iPads were available in the event of technical difficulties. Participants in the control group did not have access to any of the iPad games, and the hybrid group had less time to work on the apps as compared to the technology group. Participants were not informed of the experimental construct or the existence of separate groups until the end of the study to avoid a Hawthorne effect (Slavin, 2007).

Phase 2 involved the collection of qualitative data through survey and interviews given to those students who completed Phase 1. All students who participated in the experimental phase were considered to complete a survey administered in the computer lab of the participating school. Surveys were created and distributed through TC Qualtrics; individual survey questions are presented in Appendix C. The survey presented a cross-sectional single stage over a period of 6 school days (Creswell, 2014). Individual interviews were recorded using Voice Record Pro for iPhone 6. A secondary recording device, M-Audio Microtrack 24/96, was also used in the event of technological

difficulties. Interviews were then transcribed using www.rev.com transcription services and coded with Microsoft Word. All electronic files, both written and audio, were stored in password-protected files on a computer owned by the researcher.

Table 5

Classification of iPad Applications in Instructional Sessions

iPad Application	Session	Educational Objective	NJ Standard	NAfME Standard
<i>Rhythm Cat</i>	1	Reading notation	1.1.5.B.1, 2	MU:Pr4.2.5.b
<i>Flashnote Derby</i>	2	Pitch identification	1.1.5.B.1, 2	MU:Pr4.2.5.a
<i>Staff Wars</i>	2	Pitch identification	1.1.5.B.1, 2	MU:Pr4.2.5.a
<i>Blob Chorus</i>	3	Aural perception	1.1.5.B.1, 2	MU:Pr4.2.5.a
<i>Melody Melody</i>	3	Sequence perception	1.1.5.B.1, 2	MU:Pr4.2.5.a

Plan of Analysis

Data were analyzed using descriptive statistics; validity and reliability were achieved through triangulation and member checking (Creswell, 2014). Four sources of data, including pretest and posttest scores, field notes, survey responses, and interviews, were analyzed and coded for common themes. In addition, an independent external auditor reviewed the data and confirmed the accuracy of transcription and the level of data analysis from the raw data to the interpretation (Creswell, 2014).

Data collected from the results of the pretest and posttest scores were measured for central tendency, variance, and standard deviation (Wiersma & Jurs, 2009).

Comparisons between groups were analyzed using a paired sample *t*-test (Slavin, 2007).

Survey data involved an analysis of variance (ANOVA) and analysis of co-variance

(ANCOVA), including frequency and percentage response distributions, measures of central tendency, and dispersion measures (Gingery, 2016). All quantitative data were computed through IBM SPSS Statistics version 24 software.

The inclusion of all fifth and sixth grade students combined with the quasi-random dispersion of participants into classes assisted in the reduction of selection bias (Slavin, 2007). Quantitative data within comparison groups were also analyzed in terms of sex and grade level. All identifiers were available through the participating school district's student data system and were not available for public viewing. Names and any other participant identifiers were kept in a secure location and any tangible or digital record will be destroyed or deleted after 3 years following the conclusion of the study.

Any ethical considerations and/or conflicts of interest were addressed prior to the beginning of the study by the sponsoring institution's Internal Review Board (IRB) and the participating school's Board of Education. This allowed the research design to be as unbiased and fair as possible so that the presentation of data was considered reliable and valid (Wiersma & Jurs, 2009).

Limitations of the Study

As stated earlier, many experiments of this nature have been conducted with university students because parental consent to participate is not required. Eliminating this potential hindrance can ensure a larger sample size. Given the nature of this study, however, the participation of elementary school students was essential to replicate the natural classroom environment as accurately as possible. Therefore, parental consent was needed as part of the ethical considerations before proceeding. Results may have possibly

varied if all students in the population had participated; further studies of this nature should attempt to include all students in a given population, if possible.

In addition, absentee rates were another consideration when determining the sample size. Participants must have been present for all five sessions of the experimental design in order for their results to be considered valid. However, illness and other mitigating factors prevented some students who had turned in a parental consent form from having their scores considered in the data analysis. Students who were involved in activities, such as tutoring and other academic assistance programs, were not available to participate as they conflicted with the General Music schedule.

Researcher bias was also a major consideration when designing the parameters of the study. Efforts were taken to ensure an impartial collection of data, including having the pretest and posttest administered by audio recording and interviews given by a staff member not directly affiliated with the study. However, it is possible that the method of knowledge dissemination may vary in effectiveness depending on the instructor. Although each lesson plan was designed with replication in mind for future related studies, researchers or other qualified music teachers may present the material in an alternative fashion.

The present research was required to be conducted with the students enrolled in the district of the researcher's employment because of the time necessary to complete the study. Further research should consider the availability of randomly selected school districts to maintain impartiality.

Summary

This chapter outlined the premises of the study as it pertained to sample selection, setting of the study, procedures, and data analysis. A pilot study verified the instrumentation as valid in preparation for the actual experimental design. All students who participated were given permission by their parent/guardian and consented to be in the study. Materials and technology were used that are generally accessible to classroom music teachers, and data were collected impartially using a variety of measures. The next chapter outlines the results of both the quantitative and qualitative data, in addition to an analysis of field notes taken during the experimental phase.

Chapter IV

RESULTS

Overview

Examining the nature of VGT in the educational environment and the perspectives of elementary school students required a multiphase study to explore the facets of how VGT can potentially be effective in the music classroom. Each phase was guided and informed by the following research questions:

Research Question #1: Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?

Research Question #2: How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?

Research Question #3: What are the perceptions of elementary school students regarding VGT in their personal lives?

Research Question #4: What are the perceptions of elementary school students regarding VGT in educational environments?

Results of the mixed-method study were analyzed using a variety of quantitative and qualitative measures. Scores from the pretest/posttest entered into IBM SPSS Statistical Software version 24 were examined using descriptive statistics, including a

comparison of means, standard deviation, and variability, in addition to a paired *t*-test and ANCOVA to determine population means of the sample. Data from the survey were analyzed using an analysis of variance to ascertain any statistically significant differences between fifth and sixth grade students, in addition to gender differences.

Qualitative information was collected from interviews taken from a smaller sample of the participant group. Twelve students were randomly selected using a list generated from the website www.random.org ($n = 12$). The selection process included two students, one male and one female, from each grade level. Students were asked permission verbally to participate; those who did not wish to take part were specifically informed that it would not affect their standing in the General Music class. The next student on the list was then asked until 12 participants had been confirmed. Interview transcripts were made using the web service www.rev.com and circulated to two independent researchers not directly affiliated with the study. Data were coded using constant comparison (Boeige, 2002) and analyzed for common themes.

Field notes taken during the three sessions between the pretest and posttest were coded for commonalities. Specific areas where observations were most focused were student ability levels with or without teacher guidance, student motivation and engagement, student opinions regarding effectiveness of technology compared with no technology, and social interaction between students during each session. Quantitative data and qualitative data were then compared for internal consistency as related to the primary research questions.

Participants and Setting

Data obtained from the New Jersey State Department of Education (NJDOE, 2018) showed a total of 185 students enrolled in fifth and sixth grade at the beginning of the 2017-18 school year, with an allocation of 92 students in fifth grade and 93 in sixth grade. Student assent and parent/guardian consent forms were circulated to all fifth and sixth students by mail in October of 2017; students were given until the end of December to return both signed forms in order to be accepted into the study. Due to mobility rate and number of forms collected, a total of 92 participants completed the study, 40 of whom identified as fifth graders and 52 as sixth graders in the survey ($n = 92$). This represented 49.72% of the total population of fifth and sixth grade students in the participating school at the time of the study. Table 6 illustrates the demographic information of all students who participated in the study.

Table 6

Demographic Information of Participating Sample

	Students	Male	Female	White	Black	Hispanic	Other
Grade 5	40	19	21	18	13	2	7
Grade 6	52	20	32	24	10	3	14
Total	92	39	53	42	23	5	21

Regarding grade level, there was a difference of 43% to 57% between fifth grade and sixth grade students, respectively. Of the fifth grade students, 49% identified as male and 51% identified as female, while 40% identified as male in sixth grade and 60% as

female. This resulted in a total of 43% male students and 57% female, which demonstrated a relatively similar distribution of gender.

Further demographical analysis showed similarities between racial identifications from both fifth and sixth grade participants. Forty-six percent of the total participants identified as White/Caucasian in the survey, with 25% identifying themselves as Black/African American. Six percent of participants identified as Hispanic/Latino and 23% as Other. One student neglected to answer the question; therefore, racial information was calculated based on a total of 91 students.

Seven students representing fifth grade and 14 students in sixth grade who answered in the Other category identified as mixed-race and did not feel a particular identification toward an individual demographic. Future surveys may benefit from including a 'Mixed' category for obtaining demographic information. It would possibly be necessary to include a brief description or definition of these categories to prevent confusion, especially in the case of younger participants. This was not considered as an analysis of race was beyond the scope of the present study.

Of these 92 participants, 82 completed the experimental pretest/posttest design, including attendance at all six sessions. Students who were absent or could not complete both the pretest and posttest were not included in the data analysis. Racial identifiers were not included in the analysis of quantitative data. Table 7 displays the categorization of grade level and gender identification as assigned to each of the three experimental groups.

Table 7

Identification of Participants by Experimental Group

Group Assignment	Students	Male	Female	Grade 5	Grade 6
iPad group	30	14	16	14	16
Non-technology group	23	8	15	7	16
Hybrid group	29	12	17	13	16
Total	82	34	48	34	48

The iPad group represented students who used the iPad applications for the duration of the entire session. Limited instructions save for a brief operating tutorial were given by the instructor; students were then allowed to work independently with limited to no teacher guidance. The control, or non-technology group, did not have access to the iPad games and were instructed directly by the teacher for the duration of the lesson. In-class activities involved class discussion, lecture, and composition and performance of original musical works based on the instructional objective of each lesson. The hybrid group involved both aspects of iPads and non-technology. The first half of each instructional session was whole-class, lecture, and discussion-based format. The second half consisted of access to the iPad games, where the instructor offered assistance as needed. Each group participated in three class sessions between the pretest and posttest once every 6 school days.

The setting of the study was a single school located in southern New Jersey. At the time of the study, the school district consisted of three elementary K-2 grade level schools which fed into one intermediate grades 3-6 school. The study focused on the fifth

and sixth grade students of the intermediate school; students in third and fourth grade were not requested to participate due to the chosen scope of the study.

Pretest and Posttest Data Analysis

Pretest and posttest scores were recorded immediately after all students completed each exam. A total of 82 participants completed this portion of the study ($n = 82$). Students could achieve a total score of 20 points, which was divided into four sections (see Appendix B). Section 1 was comprised of three questions and required participants to correctly identify a recorded rhythm from three notated options. Section 2 also consisted of three questions and maintained the same structure, though the participants were to identify a short recorded melody out of three options.

Participants used aural perception in Section 3 to match a single pitch to one of three options. Section 3 contained four questions, while the final section contained 10 questions. Students were able to work independently on Section 4, which displayed a single note on the staff and required students to correctly identify the note using the treble clef. In addition, students had to identify the correct rhythmic name based on the example shown on the staff. Sections 1-3 were controlled by a previously recorded track played through the classroom's speaker systems.

The pitches used in the recording were electronic tones generated by an electric keyboard and did not represent any known instrumental sound. Directions were provided by a recorded voice narration provided by the researcher. Students later reported that they did not experience any confusion regarding the directions and no issues in being able to hear the instructions or musical tones properly. The technology functioned properly for

all test sessions; interruptions were minimal and did not affect the test environment. Test papers were collected at the end of each session and placed in a locked filing cabinet after grading. Scores were notated in Microsoft Excel 2007 and then analyzed with SPSS Statistical Software version 24.

Confidence intervals for both the pretest and posttest were set to 95% for the mean. Comparisons were made between each experimental group, grade level, and sex. Means recorded for the pretest total score were 12.03 for the iPad group, 11.65 for the non-technology group, and 11.00 for the hybrid group. The total mean for all three groups combined was 11.56 with a standard deviation of 4.196 and a standard error of the mean of .463. A comparison of all three groups in boxplot form is illustrated in Figure 9.

Means were within close parameters in all sections, though the hybrid group's performance in Section 4 was noticeably lower than the iPad or non-technology groups. Participants showed the highest success in Section 1, Rhythmic Perception, while the most difficulty was evidenced in Section 4, Music Notation.

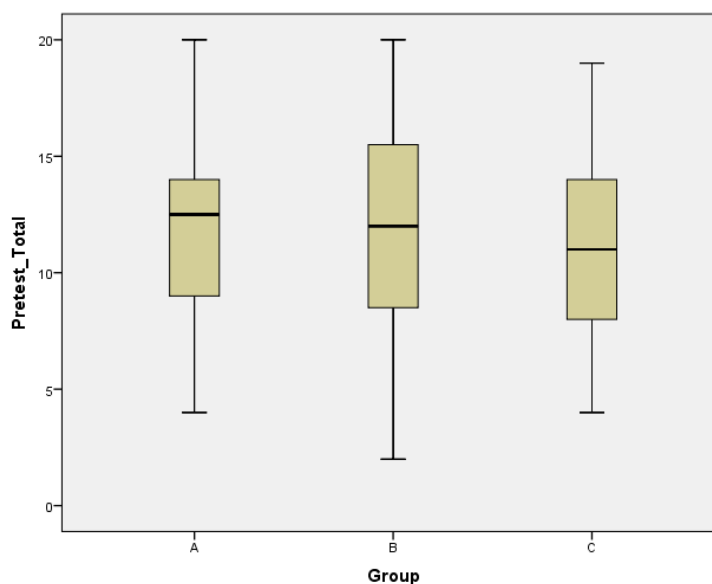


Figure 9. Boxplot of pretest scores for all three experimental groups

Posttests were administered approximately 5 weeks after the pretest. Students in all three groups participated in three lessons between the exams, meeting once every 6 school days in accordance with the district schedule. Each lesson focused on a different aspect of the exam, including rhythmic and melodic identification, recognizing pitch and rhythmic notation, and aural perception. The posttest was administered in the same fashion as the pretest with the same recording and time constraints. Students who missed the posttest but were present at all other sessions were given the opportunity to take a make-up test. As with the pretest, no students reported difficulties understanding the directions or hearing the recording, and no technical issues occurred during any of the test sessions.

The hybrid group demonstrated the most improvement in the posttest score mean, followed by the non-technology group and the iPad group, respectively. Figure 10 illustrates the data shown in boxplot form.

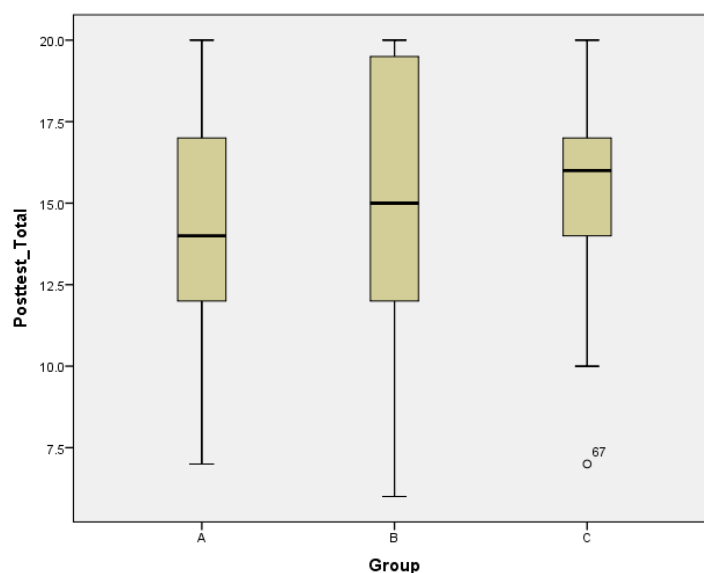


Figure 10. Boxplot of posttest scores for all three experimental groups

Though the data in the non-technology group showed the highest overall scores, the mean of the hybrid group resulted in the highest for all three groups. A comparison of the means between the pretest and posttest, as shown in Table 8, revealed that the mean of the hybrid group increased the most out of the three groups. Due to the similar number of participants in each group, it is reasonable to determine that the number of participants was not a factor in the difference of the resulting scores.

Table 8

Comparison of Pretest and Posttest Means by Group

Group	Students	Pretest Mean	Posttest Mean	Pretest Std. Deviation	Posttest Std. Deviation
iPad	30	12.03	13.93	3.882	3.991
Non-technology	23	11.65	14.96	4.987	4.205
Hybrid	29	11.00	15.41	3.901	3.235

A paired *t*-test was conducted for all individual groups and the total of all three groups (Table 9). Data showed that all *p*-values were less than .05 ($\alpha = .001$ for the iPad and non-technology groups; $\alpha = .000$ for the hybrid group), showing that the difference between the pretest and posttest mean for each group would not be statistically significant ($H_0 \geq .05$). Though the hybrid group showed the most improvement in mean scores, all three groups demonstrated a statistical significance ($H_1 < .05$) in increasing mean scores between the pretest and posttest.

Table 9

Paired t-test Statistics by Group

	Number	Mean	t	df	Sig. (2-tailed)
iPad	30	-1.900	-3.861	29	.001
Non-technology	23	-3.304	-3.913	22	.001
Hybrid	29	-4.414	-6.619	28	.000
Total	82	-3.183	-8.097	81	.000

A comparison of data was also performed between grade level and sex of the participants. Sex was identified by each individual student's demographic information notated on the participating school's intranet system. Due to the uneven number of males to females between groups, data were analyzed from total scores on the pretest and posttest to ascertain if any gender bias existed. Mean scores and descriptive statistics are notated in Table 10.

Male and female pretest means contained a total difference of .25 points, with the posttest means slightly in favor of males with a difference of .03 points. Though both sexes demonstrated a statistical significance in the increase from pretest to posttest scores, these results suggested evidence that sex was not a factor in the use of VGT for music learning.

Table 10

Descriptive Statistics by Sex

Sex	Number	Pretest Mean	Posttest Mean	t	Sig. (2-tailed)
Male	34	11.71	14.76	-16.150	.000
Female	48	11.46	14.73	-21.824	.000

Likewise, grade level differences were calculated as a whole regardless of group designation. Differences in posttest mean scores showed a greater increase in the fifth grade participants, as displayed in Tables 11 and 12.

Table 11

Comparison of Pretest and Posttest Means by Grade Level

Grade	Number of Students	Pretest Mean	Posttest Mean	Pretest Std. Deviation	Posttest Std. Deviation
5	34	11.62	15.53	4.486	3.413
6	48	11.52	14.19	4.026	4.014

Table 12

Paired Posttest Statistics by Grade Level

Grade	Number	Mean	t	df	Sig. (2-tailed)
5	34	-10.529	-17.987	33	.000
6	48	-8.188	-14.131	47	.000

These results suggested that grade level and sex were not major factors in mean scores between the pretest and the posttest. Though the hybrid group demonstrated a higher rate of growth (+4.41), followed by the non-technology group (+3.31) and the iPad group (+1.90), all scores showed a statistically significant increase.

A one-way ANOVA conducted on the pretest scores resulted in a significance level of .640, showing that the results of the pretest were not statistically significantly different across the levels of the three groups. A homogeneity of regression also was not statistically significant at a level of .166. Because the covariate met the significance assumptions, an ANCOVA was conducted on the pretest and posttest scores of all three groups. Results showed a statistical significance of .030, revealing a .086 movement between variables, as presented in Table 13.

Table 13

ANCOVA Statistics by Group, Grade Level, and Sex

Source	Type III Sum of Squares	df	Mean square	F	Sig.	Partial Eta Squared
Group	63.601	2	31.800	3.660	.030	.086
Grade	33.040	1	33.040	3.685	.059	.045
Sex	.205	1	.205	.022	.883	.000

Similar tests were run for grade level and sex. A one-way ANOVA conducted for grade level resulted in a significance level of .919, while a significance level of .794 was recorded for sex. Homogeneity of regression scores resulted in a non-statistical significance for both variables, with a significance of .146 for grade and .192 for sex. When tested for ANCOVA, calculating by grade level resulted in a significance of .059,

showing that grade was not a major factor in the differences of test scores. Likewise, sex was also not a significant factor in test score differences, leaving the group assignment as the primary variable affecting test scores.

Field Notes Analysis

Field notes were taken during the three lesson portions of the pretest/posttest experimental study. Each lesson lasted approximately 40 minutes, or the total of one class period, and were given once every 6 school days in accordance with the school schedule. Observations were recorded, coded, and summarized for common themes based on the behavior of each individual group. Common areas where behavior was observed consistently included student ability levels with or without teacher guidance, student motivation and engagement, student confidence in learning the material through the specific methodology assigned to each group, and social interaction between students during each session.

The iPad group, which were given the iPad games for the full duration of each session, received limited teacher instruction or guidance after being given a brief tutorial on the mechanics and game play of each game. Assistance was only given when needed in the form of how to play the game rather than tips or techniques in order to progress and increase the game score. Students played independently without an objective to complete the game or reach a certain score.

Students were observed enjoying the games, evidenced by exclamations of excitement and triumph when completing levels (“I’m a boss!”) and disappointment and frustration when losing (“This is so hard!”). When encountering a difficult level or

challenge, some students became visually upset, but this did not deter them from playing. Nearly all students in the iPad group demonstrated an emotional response to the challenge aspect of each game; a small amount said they were ready to “rage quit,” or stop the game entirely out of intense frustration due to lack of progress. Students who were achieving success began assisting other students on their own without any teacher suggestions. Students who received help began asking the helper if they could finish the level for them, a process they referred to as “cheesing,” or an easy or cheap way to accomplish a goal outside of the mainstream directions.

Students who demonstrated high ability levels began to interact with each other, mostly to brag (“Yo, I beat the highest level!”) and compare scores. Competition was a common theme among students as they tried to finish a level as quickly as possible, even though they were specifically informed there would be no reward for finishing first. Students would sometimes take a break from playing and walk around the room, checking each other’s scores. The interactions never became negative or inappropriate, as students would encourage each other or joke in a friendly way (“Want me to do it for you?”).

It was also noted that male participants showed more competitive behavior than females. While the boys engaged in bragging and external displays of frustration when not achieving a desired score, the majority of females sat quietly and played the games independently. Some girls who were sitting near each other began to socialize while playing, but it was not noticed that this behavior resulted out of a competitive nature. Both sexes reported enjoying the games equally and mentioned a desire to continue playing even after the session had concluded.

Most students reported that they would play the games again given the opportunity, though they required assistance regarding certain mechanics of each game. *Rhythm Cat*, designed for learning rhythmic notation and performance, would not allow players to progress unless they pressed the correct button for the exact amount of time the music required. This would lead to confusion as the players would believe they had performed correctly. In addition, higher levels created a sudden difficulty increase, especially when tempos became faster and players had to use two hands instead of one.

When asked directly which games were their favorite, students preferred *Staff Wars* and *Blob Chorus* the most, which was demonstrated by the amount of time students devoted to these games, as opposed to *Rhythm Cat* and *Flashnote Derby*. *Melody Melody* was the least popular of the games as the participants spent a minimum amount of time playing when compared to the other games. This was mostly due to a lack of challenge, as students started pressing buttons randomly and would eventually make a match, regardless if they recognized similarities in the melodic contour. This eventually led to players exclaiming that *Melody Melody* was “boring,” which resulted in questions such as “Do we have to play this?” and “Can I play something else?” *Blob Chorus* was the most popular of the games, as students enjoyed the animation, customizable difficulty, and the instant feedback system that allowed them to view their progress in real time. One student in particular who was consistently attaining high scores began to refer to himself as the “Blob Chorus King.”

The non-technology group was assigned as the control group; participants did not play any games in any of the three sessions. During the first session, students practiced rhythmic dictation using music staff whiteboards after a review of musical notation.

Students then composed their own basic rhythmic figures and wrote them with other rhythms. The students were then played one out of the three melodies, which they had to identify correctly. The students demonstrated enjoyment participating in the activity, particularly the compositional aspect and the challenge of correctly identifying which rhythm was played from multiple options. After approximately 30 minutes, students began to show signs of distraction, including engaging in side conversations, talking without permission, and doodling on the whiteboards.

The second session proceeded similarly to the first, but focused on melodic contour and pitch identification. Students were tasked with correctly identifying a matching pitch from three options using aural perception, then composing their own brief melodies, which were presented with other student compositions. Students then had to identify which melody was played on the piano out of the three options. The final session began with a review of the notes of the treble clef staff from first line E to top line F. Students composed melodies while writing the correct names of notes above or beneath the staff. Students were then given Orff xylophones and played their own and their classmates' melodies.

Note names were clearly marked on the instruments to make it easier for the students to read and perform their melodies. However, some classes contained students who were more interested in playing around on the xylophones, sometimes frenetically striking the keys so hard that the instrument had to be removed for the safety of the equipment. Some students reported confusion with the assignment, though many students thought they had increased their knowledge of pitch identification by the lesson's conclusion.

The third group was designed as a hybrid group, combining both the aspects of the iPad and non-technology groups. The first half of the class was dedicated to group instruction, using a truncated version of the activities presented in the non-technology group. The second half was devoted to playing the iPad games, though teacher assistance was given more freely than in the iPad group. As in the case with the iPad group, students were circulating throughout the room freely encouraging and assisting students who were having trouble while playing the games. Many did not want to stop playing as the hybrid group had significantly less time to play than the iPad group. Since the iPads were set up at the beginning of class for a more efficient transition, some students already began to play before the first half was concluded and expressed their interest in playing from the very beginning of the lesson.

When asked at the end of each session, most students felt they had increased their skills by the end of each lesson, demonstrating excitement and animated behavior when achieving a high score (“Who got the highest score?”; “Can you tell the other classes what score I got?”). This was considered to be a major point of motivation, as students wished to broadcast their scores not only to the class, but to the entire grade level. In addition, students from all three groups felt confident that they had performed better on the posttest than on the pretest. This may be because the pretest and posttest were identical or because they understood the directions more clearly.

When informed of the nature of the experiment and the methodology after the conclusion of the study, students in the non-technology group expressed disappointment that they did not have the opportunity to play the games (“Can we play next time?”;

“How come they got to play and we didn’t?”). Most students in the non-technology group were upset that their group was selected as the control group, as they did not have the opportunity to play any of the iPad games. Several students complained that it was “unfair” that other classes in their grade level could play video games when they themselves could not.

These students suggested that they should be allowed to play the games as a way of restoring equality among student groups. Students in the hybrid group did not seem bothered by the fact that the iPad group was able to play for the entire class session as opposed to half of the period (20 minutes). This may have been an ideal period of time as it satisfied the students’ desire to play, but not so long as to become bored or frustrated. Both the iPad and hybrid groups wished to know when they would be able to play the games again, and expressed a desire to try new games as well.

Survey Data Analysis

Further details of student opinions were collected and analyzed in the survey and interview phases of the study, which were conducted in the session following the completion of the experimental treatment. The survey was completed by a total of 92 participants (n = 92). The survey consisted of 20 questions (see Appendix C) and were completed by the participants using the school’s computer lab. Participants were informed that all responses would be anonymous and kept confidential. Students were given 40 minutes, or the equivalent of one full class period, to answer all the questions; no student required extra time to finish.

The researcher circulated throughout the room to ensure that students were working independently and not influencing each other's responses. There were no questions during the survey to clarify any items; participants finished efficiently and were visually observed to have put forth a serious effort to answer all questions thoughtfully.

Of the total participants, 39 identified as male and 53 as female. No option notated a non-specific gender identification and the participants made no inquiries. While this option may be useful for older students and adults, this may not be necessary for elementary students aged 10-12. Forty participants identified as fifth graders, with 52 identifying as sixth graders. Racial distribution consisted of 42 as White/Caucasian, 23 as Black/African American, five as Latino/Hispanic, one Native American, no Asian/Pacific Islander, and 20 as Other/Mixed. Gender identification was included in the overall analysis; race was not considered, given the chosen scope of the study.

The next eight items (Q5-12) on the survey focused on participants' personal video game use in the home environment. This included the frequency of video game use in a certain period of time (Q5-6), time spent playing with friends (Q7), preferred video game genres and constructs (Q8, Q10-12), and the number of people who play in the household (Q9). Descriptive statistics, displayed in Table 14, revealed that students play video games on a regular basis, generally between 1-5 hours per week. Students will sometimes play games with friends, with a focus on action/adventure, fighting, shooter, sports, and strategy games. Educational, music performance, puzzle, and simulation games were among the least popular of gaming genres. Music performance games, such as *Guitar Hero* and *Rock Band*, were played rarely.

Table 14

Descriptive Statistics for Survey Questions 5-12

Question	Number	Missing	Mean	Std. Dev.
5. How often do you play video games?	91	1	3.80	1.07
6. How much time per week do you play?	92	0	3.57	1.16
7. How often do you play video games with friends?	92	0	3.24	1.18
8. How often do you play specific gaming genres?	90	2	2.11	1.29
9. How many people play video games in your home?	92	0	2.50	1.21
10. What is the most important part of a game to you?	90	2	2.12	1.34
11. Do you play online multiplayer games?	92	0	1.22	.41
12. How often do you play music performance games?	92	0	1.77	1.07

Challenge accounted for 43% of preferred gaming design, with gameplay following at 29%. The game's story, graphics, and musical soundtrack were ranked as the least motivating factors when choosing to play a game, at 11%, 9%, and 8%, respectively. Seventy-eight percent of participants reported playing multiplayer games, and approximately 1-2 individuals in the participants' household also play games in addition to the participant.

When gender identification was factored into the overall results of item 5-12 (Table 15), descriptive statistics showed that males played video games more often and at greater frequencies per week. Males also played more video games with friends, though females reported that more individuals played video games in their households. Males and females both preferred the same types of genres in games, particularly

action/adventure, fighting, sports, and strategy games. Females, however, preferred the element of challenge (51%) over males (32%).

Table 15

Descriptive Statistics for Survey Questions 5-12 by Sex

Question	Male Mean	Female Mean	Std. Dev.
5. How often do you play video games?	4.28	3.44	1.07
6. How much time per week do you play?	4.02	3.24	1.16
7. How often do you play video games with friends?	3.59	2.98	1.18
8. How often do you play specific gaming genres?	2.26	2.00	1.29
9. How many people play video games in your home?	2.13	2.77	1.21
10. What is the most important part of a game to you?	2.32	1.98	1.34
11. Do you play online multiplayer games?	1.15	1.26	.41
12. How often do you play music performance games?	1.74	1.79	1.07

A one-way analysis of variance noted a statistical significance in items 5, 6, 7, and 9 (Table 16). Both males and females played multiplayer games relatively equally, and neither sex played music performance games regularly. These results suggested that although males play video games more often than females, there are similar preferences between genders about the genre of video game played, the aspect of game design, and the ability to play with others in a multiplayer context.

Table 16

Analysis of Variance for Survey Questions 5-12

Question	Sum of squares	df	Mean square	F	ANOVA sig.
5. How often do you play video games?	104.44	90	15.71	15.76	.000
6. How much time per week do you play?	122.46	91	13.68	11.31	.001
7. How often do you play video games with friends?	126.73	91	8.32	6.32	.014
8. How often do you play specific gaming genres?	148.88	89	1.52	.908	.343
9. How many people play video games in your home?	135.00	91	9.35	6.70	.011
10. What is the most important part of a game to you?	161.56	89	2.46	1.36	.246
11. Do you play online multiplayer games?	15.65	91	.273	1.60	.209
12. How often do you play music performance games?	104.20	91	.054	.046	.830

Table 17 illustrates the descriptive statistics for items 13-20. Item 13, “I think video games can be used to learn things,” received a favorable response with the majority of participants notating the ‘neutral’ or ‘agree’ option. Students also demonstrated a similar response for item 14, “I think video games can help teach me about music.” It is possible that these answers may have been influenced by the participants’ experience based on which group they were assigned during the experimental treatment. A comparison of means was conducted on each group, displayed in Table 18.

Table 17

Descriptive Statistics for Survey Questions 13-20

Question	Number	Missing	Mean	Std. Dev.
13. I think video games can be used to learn things.	91	1	3.64	1.02
14. I think video games can help teach me about music.	91	1	3.25	1.05
15. I only play video games when I am bored and need something to do.	90	2	3.08	1.40
16. I think educational video games can be fun.	92	0	3.12	1.24
17. Playing music video games make me angry.	92	0	2.25	1.15
18. I want to see more educational video games in school.	92	0	2.84	1.26
19. Playing video games makes me want to learn more about music.	92	0	2.57	1.15
20. Playing games like <i>Guitar Hero</i> and <i>Rock Band</i> makes me want to play a real instrument.	92	0	2.78	1.34

Overall, the means compared between each group showed relatively similar perspectives among participants, regardless of the treatment to which they were assigned. The largest difference between group means occurred in item 18: “I want to see more educational video games in school” between the iPad group (iPad treatment) and the non-technology group (control treatment), with a difference of .69.

Table 18

Comparison of Means by Group for Survey Questions 12-20

Question	iPad group mean	Non-technology group mean	Hybrid group mean
13. I think video games can be used to learn things.	2.00	1.55	1.73
14. I think video games can help teach me about music.	3.59	3.79	3.53
15. I only play video games when I am bored and need something to do.	3.44	3.17	3.13
16. I think educational video games can be fun.	3.21	3.03	3.43
17. Playing music video games make me angry.	2.15	2.24	3.33
18. I want to see more educational video games in school.	3.21	2.52	2.73
19. Playing video games makes me want to learn more about music.	2.58	2.52	2.60
20. Playing games like <i>Guitar Hero</i> and <i>Rock Band</i> makes me want to play a real instrument.	3.00	2.69	2.63

Table 19 displays the frequency detail for each item as organized by individual responses. Item 15, “I only play video games when I am bored and need something to do,” received a more balanced response rate, with a maximum difference of five students between the highest and lowest frequency. A similar response to items 13 and 14 was recorded for item 16, “I think educational video games can be fun and enjoyable.” However, the majority of students disagreed that playing video games made them angry (Q17).

Although many students answered in the affirmative regarding the ability for video games to teach educational concepts, most students felt neutral about the potential to see more educational video games in school (Q18). In addition, most students also felt neutral or disagreed with item 19, “Playing video games makes me want to learn more about music.” Finally, answers were greatly varied for item 20, “Playing games like *Guitar Hero* and *Rock Band* makes me want to learn a real instrument,” with no answer receiving a clear majority.

Table 19

Response Frequencies for Survey Questions 13-20

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
13. I think video games can be used to learn things.	4.4%	6.6%	30.8%	37.4%	20.9%
14. I think video games can help teach me about music.	7.7%	11%	40.7%	29.7%	11%
15. I only play video games when I am bored and need something to do.	18.9%	16.7%	22.2%	22.2%	20%
16. I think educational video games can be fun.	16.3%	8.7%	35.9%	25%	14.1%
17. Playing music video games make me angry.	29.3%	37%	19.6%	7.6%	6.5%
18. I want to see more educational video games in school.	17.4%	23.9%	28.3%	18.5%	12%
19. Playing video games makes me want to learn more about music.	20.7%	28.3%	31.5%	13%	6.5%
20. Playing music games like <i>Guitar Hero</i> and <i>Rock Band</i> makes me want to play a real instrument.	22.8%	22.8%	19.6%	22.8%	12%

An additional analysis of variance was conducted on the Likert scale items by sex at a 95% confidence level. Results showed a similar response rate from both males and females for all items (Table 20). None of the items yielded a statistical significance in terms of comparison of means, suggesting that both sexes hold similar opinions regarding video games usage and the incorporation of video games in educational practices. Item 15 demonstrated the largest difference of mean (.54), with females noting a greater affirmation of only playing video games as a result of boredom as opposed to a greater motivation to play in males. The greatest similarity in mean score was shown in item 14, where both sexes largely agreed that video games, when designed properly, could be used to teach educational concepts and skills.

Both boys and girls equally expressed enjoyment playing music-based COTS games on iPads, most notably games such as *Magic Piano* and *Piano Tiles*. Girls were more interested in games that contained a definite storyline and recognizable characters, while boys preferred the ability to play with friends both online and in-person. The survey data also showed that both sexes were interested in the possibility of including more video games in school, and agreed that it could be used to teach musical concepts and skills.

Table 20

Analysis of Variance for Survey Questions 13-20 by Sex

Question	Sum of squares	df	Mean square	F	ANOVA sig.
13. I think video games can be used to learn things.	95.03	90	.206	.193	.661
14. I think video games can help teach me about music.	99.18	90	.059	.053	.819
15. I only play video games when I am bored and need something to do.	174.45	89	6.55	3.43	.067
16. I think educational video games can be fun.	141.68	91	2.39	1.54	.217
17. Playing music video games make me angry.	121.25	91	.225	.168	.683
18. I want to see more educational video games in school.	144.55	91	.846	.530	.469
19. Playing video games makes me want to learn more about music.	120.60	91	.412	.309	.580
20. Playing games like <i>Guitar Hero</i> and <i>Rock Band</i> makes me want to play a real instrument.	165.65	91	.538	.294	.589

Interview Analysis

Selections for the interview process were made after the pretest/post-test experimental design and survey portions of the study were completed. All students who returned a parent/guardian consent form and signed the Student Assent Form were considered to participate, even if they did not complete the prior phases of the study. Student lists were categorized by grade level, sex, and group designation, forming 12 distinct lists. Each list was separately entered into the website www.random.org to randomize names in no specific order.

The first student on each list was then contacted and asked to participate in a brief, 10-minute interview which would be kept confidential and anonymous. Students who chose not to participate were informed that their decision would not elicit any negative consequences. The next student on the randomized list was then contacted until assent was given. The 12 students were then scheduled for interviews during the normal school day with administrator approval. The interviews were scheduled in no particular order except based on the participant's availability during school.

Interviews were conducted with an Internal Review Board (IRB)-certified faculty member at the participating school not directly affiliated with the study to assist in the reduction of researcher bias. Each interview contained 10 questions, which varied based on the responses of the participant (Appendix D). Interviews generally lasted approximately 5-10 minutes long and were recorded with the Voice Record application on an iPhone 6. There were no reported technical issues with the recording process or students' understanding of the interview questions. Transcriptions were provided by the web-based service www.rev.com and were saved onto a password-protected computer.

Students were informed that they would not receive a reward upon completion of the interview, and no questions or concerns were submitted by the participants, parents/guardians, or school faculty and administration.

Coding of the interviews was performed by the researcher, the interviewer, and the principal of the school building. Each interview was analyzed individually and collectively using the constant comparison method (Boeije, 2002), which determined categories based on common themes throughout interview summaries. In addition, coding was verified independently through discussions with each evaluator in order to develop a consensus. After analysis, four primary categories emerged through each independent and collective interview summary. These thematic areas of commonality included entertainment, socialization, learning, and game design constructs/specific game titles.

Ten of the 12 interview participants reported that they played video games regularly. One fifth grade male did not play because he believed that games are generally not designed for education and are largely “not for kids.” A fifth grade female did not play games because of prioritizing other activities: “I have a lot of stuff to do after school, like sports, and homework, and stuff.” The majority of participants played video games solely for entertainment purposes, which was the basis of their choices regarding specific games to play and the majority of their views on video games in educational practices.

Other views regarding motivations for playing included immersion, relaxation, and relief from boredom. Another fifth grade female mentioned playing because “Sometimes if I’m mad, it relaxes me,” while a sixth grade female played because “Sometimes when I’m bored, I just feel like playing them.” Another sixth grade female

enjoyed playing games “to have a fun adventure,” or to escape reality and indulge the imaginative qualities of fantasy.

Another significant quality of the enjoyment of playing video games included the ability to play with friends, whether in-person or online. Eight of the 12 participants reported a greater sense of enjoyment when playing with friends, which frequency ranged from once per week to every day. Students were not specific about the medium in which they socialized through play, whether it was playing together in the same physical space or through online cooperative play (“When they come over to my house”; “When I want to versus others”). Many current games involve options for multiple people to play simultaneously, or players can engage through cyberspace and speak to each other through text chat, headsets, or a webcam. Those who did not enjoy playing with friends preferred games with single-player campaigns in order to accomplish difficult goals on their own (“I just like to do it by myself”; “I just want to beat the game”).

When asked what specific games or game genres students enjoyed playing, the majority of male respondents actively chose first-person-shooter (FPS) games, such as the *Call of Duty* series. Sports simulators, such as football and racing games, were highly prioritized among both sexes. Males and females also enjoyed action/adventure games, such as the *Grand Theft Auto* and Warner Bros.’s *Batman: Arkham* (Rocksteady, 2009) series, in addition to ‘brand’ titles like the *Sonic the Hedgehog* (Sega, 1991) and *Super Mario Bros.* series. The participants did not mention any educational games or edutainment titles.

Music games were mentioned as a source of entertainment outside of school, though educational titles were not among the specific examples played by the

participants. Three of the participants played console-based games such as the *Guitar Hero* and *Just Dance* (Ubisoft, 2009) series, but the majority of students who played music games outside of the classroom environment preferred a game titled *Piano Tiles* (Cheetah Mobile, 2014). *Piano Tiles* is a mobile game played on devices such as Smart phones and tablets that involve black squares resembling piano keys as they rapidly descend to the bottom of the screen. The player must tap each of these squares in rhythm with the background music, which is logged into a scoring system. If the player makes a mistake and presses the wrong area on the screen, the level must be restarted.

Piano Tiles can be considered COTS due to the game's primary design for entertainment purposes. However, a case could be made for practicing motor skills and rhythmic integrity, but this cannot be applied to a real keyboard, nor does the game teach any aspect of music notation or theory ("They're just fun and you listen to music"). Enjoyment of *Piano Tiles*, like many of the specific game titles mentioned, largely comes from the challenging game play and thrill of overcoming difficult obstacles to increase the score. This is illustrated in the game's 'endless tiles' round, in which the music gets incrementally faster and players must increase their reflexes until they commit an error.

The majority of participants who had the opportunity to play the iPad games during the pretest/posttest experimental portion of the study enjoyed playing the games during class. Once again, the theme of entertainment was the primary motivation behind the students' reasons, but other concepts were brought up in relation to educational skills. One fifth grade male described his preference for playing the iPads because "you have fun with them. If you have a score, you can versus your friend to see who has the higher score."

A fifth grade female believed that the “hands-on experience” of playing made learning more interactive and less passive. However, a sixth grade male acknowledged that the games were not as fun as COTS games: “They’re not really as fun as regular games would be.” A sixth grade female reported that playing on the iPads were not enjoyable because “it’s too much strategizing” and “kids can get off topic and forget what they’re learning in school.”

As consumers of interactive media, children can often provide valuable insight into critiquing video games for new design innovations. One such question posed to the interview participants was to highlight specific game features that would increase educational potential while maintaining the enjoyment and immersion featured in many COTS games. Nine of the 12 participants agreed that video games could be used in educational environments effectively, as long as the game itself possesses a sense of fun. Other responses included that the game should be able to run so it’s “not slow,” engaging graphical design (“how it looks”; “something to actually focus on”), maintaining an instant feedback scoring system so players are kept apprised of their progress (“I like to beat the game”), and challenging yet fair difficulty that can be customized for individual ability levels (“freedom of choice”).

Those who disagreed that video games can be adapted for educational strategies claimed that the games “take away from teacher instruction,” “it’s not good for your eyes,” and students would “probably get off task.” An even split in opinion was recorded when students were given a choice between playing video games in class or learning from a teacher directly. Those who responded that they would rather play games cited fun as their primary motivation, in addition to a desire to compete against friends for a high

score, the visual appeal of games, and a greater sense of involvement and immersion. Those who would rather participate in other activities preferred to learn from a teacher, be given the option of various activities, or said that video games simply “don’t help.” One participant mentioned that the attempted combination of education and entertainment “takes the fun out of video games” entirely.

Design aspects of games were also solicited to create a game designed specifically for music education. A common theme among participants was creating music on their own, using notation and musical terms to advance through challenges and tasks. The act of virtually designing and playing an instrument was also a popular choice, along with facts about the instrument family and its use in historical contexts. A sixth grade female suggested putting these concepts in the form of goal achievement or adding a storyline to increase immersion:

I would probably make it about naming what note it is. I would probably make it, like, you’re a mountain climber and if you get this wrong note you fall down a little bit and if you get it right you move up to the top, you’re trying to climb mountains. . . .

Another sixth grade female expressed an interest in adding familiar characters, such as “Disney characters singing or something.” Participants also noted a desire to play online with friends with the option to compete against fellow players.

Ultimately, fun seemed to be the driving force behind students’ motivation to play and learn. All student responses contained some mention of fun as guiding concepts toward the design of a game that uses music education as its core impetus. However, the need for instructional variety was also preferred, specifically the assistance of a teacher and differentiated instruction; one fifth grade female mentioned that video games were detrimental in education “because it takes away from the teacher’s actual job who’s

teaching.” It is also noteworthy that none of the respondents mentioned aggression, violence, or addiction as reasons not to play video games or include them in the classroom. A further discussion of these perspectives is presented in the next chapter.

Comparison of Data

Data obtained from the field notes of the pretest/posttest experimental design, surveys, and interviews were analyzed for common themes regarding student perspectives in video game use in the classroom and in the home environment. Based on the statistical analysis of the survey data, it was determined that video game technology is viewed favorably among elementary school students of both sexes. COTS games played for leisure are regarded as extremely popular, particularly the action/adventure, FPS, and sports genres. Students enjoy playing and discussing video games with friends, especially those games that have online components where students can compete against each other.

Competition was also identified as a major theme across all aspects of data collection. Students preferred games that possess an instant feedback scoring system that they can compare with other players. This motivated students to play for longer periods of time in order to achieve the highest score, which gave them an enhanced social status and respect among other gamers. Students often bragged about their gaming prowess, remarking that “I never got sniped” or “I reached level 50” in online combat “battle royale” games such as *Overwatch* (Blizzard, 2016) and *Fortnite* (Epic Games, 2017).

Educational games presented on the classroom iPads were also seen as popular among students, but not nearly as popular as COTS games. Of all of the games used in the experimental sessions, *Blob Chorus* and *Staff Wars* were the most engaging. This may

directly be related to the competition aspect of playing, as students would often compare their scores with other members of the class and even offer to assist students who were having difficulty. One student even referred to himself as “the Staff Wars king” after being informed that he had attained the highest score of all of the participants.

Opinions were split, however, regarding the use of video games in education as opposed to more traditional teacher-based instruction. Some participants in the iPad group were content to simply play the video games for the entire length of class, while others were quick to express their boredom after having played for an extended period of time. Some students who preferred to play the games did not seem to be interested in learning any music concepts or skills, but simply wished to entertain themselves without consideration of the educational purposes of these games. Others in the iPad group expressed disappointment that the teacher was hardly involved in instruction, which was limited to providing assistance only when needed.

The largest concern regarding the introduction of VGT into the classroom environment was the fact that games designed for education, such as ‘edutainment’ games, did not approach the engagement or immersion level present in most COTS games. This did not mean that students would not enjoy games designed to teach musical concepts, but simply that they did not enjoy them as much as games solely designed for entertainment purposes. The overall concept that served to motivate students to play any type or genre of game was the sense of fun. This often came in the form of the thrill of overcoming challenges and accomplishing difficult tasks. Even though they were appreciated by students, gameplay features such as graphics, sound, music, and story/plot were less prioritized.

Participants were very interested in the possibility at creating a game designed to teach, but only as an option for learning and not as the sole method. While some students preferred to be more solitary in the learning experiences, many participants desired to have a shared experience that was rooted in social activity. Musical concepts such as learning note and rhythm identification, composition activities, instrument knowledge, and piano practice were the most favored learning objectives presented by the participants. These concepts were put into the context of overcoming obstacles, such as progressing through a maze, finding the combination of notes, or competing against other students for the fastest and most correct answers in a quiz format.

Regardless of the particular method of instruction, whether it be digital game-based learning, lecture-based learning, class discussion, performance activity or otherwise, participants preferred active, hands-on learning that allowed them to manipulate materials and have more control over their own learning processes. Most students responded positively to challenges presented, especially when they had the opportunity to work together with classmates either cooperatively or competitively. When the design of music curriculum is taken into account, these responses could be vital to the effectiveness of instruction, motivation, and the accomplishment of learning objectives.

Summary

This chapter described, analyzed, and compared the data obtained from the pretest/posttest experimental design, surveys, and individual interviews. It was determined based on a comparison of means, ANOVA, and paired *t*-tests that the hybrid

group, which received both VGT and teacher-driven instruction, increased their scores between the pretest and posttest higher than both Groups A and B. The iPad group, which solely used VGT without the guidance of a teacher, obtained the smallest increase in scores, while the non-technology group, which used no VGT, scored in the middle. All three groups did increase their scores at a statistical significance of a 95% confidence interval.

Survey and interview data showed that students have an affinity for playing video games, particularly those in the action, adventure, and sports genres. Participants noted an interest in playing with friends, especially when given the option to compete for a high score. The aspect of challenge was a major factor in the appeal of VGT. COTS games designed with this feature were noted as extremely popular. Although the participants showed enjoyment when playing the classroom iPad music games, their educational design did not present as much of an interest as games played outside of the school environment.

Students also expressed interest in helping educational games become more like COTS games through the incorporation of design aspect such as customizable challenge levels, the ability to play with and compete against fellow students, and a plot or storyline to help students become more immersed in the game. No feedback was reported if a game currently available exists for music education, but students suggested that one may eventually be designed that combines the entertainment qualities of COTS games with the learning capabilities of edutainment. The next chapter focuses on analyzing these perspectives, in addition to drawing implications for the future use of VGT in music education.

Chapter V

DISCUSSION

Overview

The purpose of this study was to investigate the educational possibilities of video games designed to teach musical knowledge and skills in an elementary school classroom environment. Qualitative and quantitative measures were employed to collect data regarding the effectiveness of educational video games designed to teach musical concepts to students representing a variety of demographics in fifth and sixth grade. In addition, a survey was conducted with all participating students, and randomly selected students took part in an interview session. These data served to determine the perspectives of elementary-aged students in regards to video game use at home and in the classroom.

Ninety-two students consented to participate in the study; due to absences and other mitigating factors, 82 of these students completed the pretest/posttest experimental design. Students were separated into three groups by homeroom; the composition of these homerooms had been predetermined prior to the beginning of the school year by the school's administration. All students took a Music Skills and Knowledge pretest (Appendix B) designed with elements of the New Jersey State Standards for Visual and

Performing Arts (NJDOE, 2014) and standards from the National Association for Music Education (NAfME, 2014).

Three lessons were conducted with each group following the pretest once every 6 school days in accordance with the school schedule. The lessons were designed prior to the experimental design and covered information presented on the pretest/posttest. The iPad group was given preselected iPad applications to work for the duration of the sessions; the instructor gave limited guidance. The non-technology group did not use the iPads for any session; lessons were conducted using lecture, class discussion, and performance-based activities. The hybrid group was composed of a hybrid of the previous groups; students participated in similar activities to the non-technology group for half of the period (20 minutes), while the second half was devoted to the iPad games. After three sessions, all students took the Music Skills and Knowledge test a second time.

Following the pretest/posttest experimental design, all 92 participants took part in a survey given online in the school's computer lab. The survey was designed using TC Qualtrics and covered information including participants' video game preferences, habits, and views regarding the viability of video games in both general educational settings and specifically adapted to music education. Twelve students ($n = 12$) were randomly selected to participate in individual interviews to gain further in-depth information. The interviews took approximately 5 minutes each to complete, and were recorded with an iPhone and transcribed by a professional web service. Survey and interview data were analyzed by the researcher and other faculty members not directly affiliated with the study using the constant comparison method (Boeije, 2002).

This study was guided and informed by the research questions presented in Chapter I. Each question focused on a different aspect of video game use in teaching practices as related to music education.

Research Question #1: Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?

Research Question #2: How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?

Research Question #3: What are the perceptions of elementary school students regarding VGT in their personal lives?

Research Question #4: What are the perceptions of elementary school students regarding VGT in educational environments?

Data were collected in an explanatory sequential mixed-method design (Creswell, 2014), of which the quantitative data of the pretest/posttest and survey phases informed the qualitative interview phase. The research questions were explored in the order of the experimental design.

This chapter analyzes the results of the quantitative and qualitative data in comparison with previous research to provide historical context for the potential changes in effectiveness of digital game-based learning in the music classroom.

Industry Products

If COTS games have not yet demonstrated their effectiveness in teaching musical knowledge, then educators must rely on serious and edutainment games to accomplish

these objectives. There remains a difference between serious games and edutainment, as Annetta (2010) and Prensky (2001, 2006) described; that is, serious games do not contain any inherent entertainment value and are merely used as training tools. In fact, Prensky's experience with serious games as a learning tool is largely limited to the corporate training environment for adults.

Considering that fun was the most important factor in students' perceptions of why they choose to play video games, playing games without the aspect of enjoyment would not only be ineffective in the classroom environment, but also detrimental to the learning process as students would easily become bored and unmotivated. Adapting popular COTS games to serve educational purposes has demonstrated some success in other educational subjects, such as Squire's (2005) use of *Civilization III* in social studies or *Spore* in science (Klopfer et al., 2009). However, attempts to replicate the engagement quality of COTS games with educational games in the music field have proven thus far to be unsuccessful.

Games such as *Lipa's Festival* (Denis & Jouvelot, 2004), *PlaySingMusic* (Hämäläinen et al., 2004), *Feel-ME* (Juslin et al., 2006), and *Tafelkids: The Quest for Arundo Donax*' (Jenson et al. 2008) were all designed with the concept of promoting musical skills while using entertaining concepts as animated characters and similar game play mechanics to *Super Mario Bros.* and *Guitar Hero* to engage students. None of these games are currently commercially available, possibly because the designers never intended to test the game's viability outside of the laboratory environment or because the game's popularity never became strong enough for mass production.

This suggests that simply trying to incorporate entertaining characteristics of commercially successful games does not guarantee a successful blend of engagement and education. Elements of games as suggested by the participants of the present study may include features such as familiar characters and an immersive storyline, but also need to include the player's ability to control and manipulate the game's environment. The element of challenge was also an important aspect of game design for 43% of survey respondents, but not so much to become frustrating and cause the player to "rage quit," or ending the game due to frustration.

The participants perceived the edutainment music learning games used in the present study largely as engaging and entertaining. This is possibly because, with the exception of *Melody Melody*, each app involved animated characters, a structured challenge system, instant feedback, and a scoring system that allowed players to compete with their classmates. It may be this reason why *Melody Melody* in particular failed to achieve the desired results, as it contained none of these features and instead relied on randomly matching flashcards. *Rhythm Cat*, *Blob Chorus*, *Flashnote Derby*, and *Staff Wars* all presented these aspects in different forms, but with a musical learning concept at the core of its design.

While the evidence presented in Chapter IV suggested that examples of edutainment video games can effectively teach musical concepts and skills, there may be no clear and definitive answer for whether games can be more effective than other methods of teaching. Although all three groups achieved higher mean scores on the posttest as compared to the pretest, the group that received both teacher-delivered and technology-delivered education showed the most growth.

This, in comparison with the group that only used the iPad games for the duration of the three sessions and the group that did not use any iPad applications, may suggest that the use of games combined with a knowledgeable and qualified teacher is the best formula for success. Effective games without a dedicated teacher who is familiar with the technology, or a highly qualified teacher working with poorly designed games, will most likely result in a failure to meet educational objectives. It is more likely that when these games combine with effective teaching, the potential of digital game-based learning can be realized.

Student Perspectives

One purpose of this study was to ascertain the perceptions of students regarding VGT in their personal lives and in educational environments (Research Questions #3 & #4). While the perceptions of the students involved in the surveys and interviews cannot be generalized to the entire population of elementary school students, the information gathered from these measures are essential for understanding the basic motivations of VGT engagement and popularity.

The most frequently appearing reason for why video games are so popular among students is the enjoyment factor. Fun, or entertainment quality, seems to be the highest motivating force in playing video games, which mirrors the primary design of most COTS games. The fundamental question as related to how to adapt video games to serve an educational purpose then becomes what makes them fun in the first place.

Responses from students in both the surveys and interviews revealed several aspects of video games that foster engagement. Among these reasons, challenge and the

ability to compete with others were the most cited as contributing to the enjoyment experience. From a video game design standpoint, this can be potentially complicated depending on the difficulty of the game combined with the player's ability. A game designed to be too easy will cause a player to be bored and uninterested, while a game with an unrealistic challenge level will be stressful and frustrating, thus alienating the player.

As observed during the lesson portions of the study with the groups that had access to the iPad games, challenge was an integral part of the social interactions between students. Many students found the challenge aspect invigorating, especially when given the opportunity to compete against other students. While it is possible that students may have become frustrated and quit the games if they were playing by themselves, the ability for students to encourage each other may have played a role in the overall experience.

Playing with friends was also mentioned in both the survey and interview data as a strong source of motivation. However, the preference to play multiplayer games online was not noted as a motivating factor, suggesting that children would rather play with friends who are in the same physical location. This may be because to play and communicate online, players need peripheral accessories such as a headset that requires access to a phone line or internet connection. Also, students participating in the study were all from the same district, in which their residential proximity to each other could permit more personal contact.

One finding that could be interpreted from these data is that incorporating VGT into the music classroom should be largely based on social interaction. During the sessions with students who were given access to the iPad games, socialization between

students was a major aspect of play. This was observed not only by the act of students competing against each other, but also students assisting each other with more difficult levels. Though it was not available in this study, an online component could also allow students to communicate within the context of the game itself, similar to MMOs (Massive Multiplayer Online games). Games such as these require cooperation from players to complete tasks that one individual could not achieve by oneself (Castronova, 2007).

Another finding resulting from the survey and interview data is that although students perceive a disconnect between the entertainment value of COTS games and educational objectives of serious/edutainment games, there is optimism that an effectively designed game can balance both enjoyment and education so that learning takes place within the context of fun. This can achieve what Prensky (2001) referred to as “stealth learning,” or the experience of learning as fun so that students do not realize they are learning until after they are finished.

Though it was not possible to determine if stealth learning took place during the experimental design, the result of higher mean scores on the posttest for both groups with the iPad games suggested that it is possible for VGT to achieve an enjoyable experience within the context of learning. Perceptions of students who reported a positive attitude toward gaming in the classroom reflected similar research in the field (Bourgonjon et al., 2010; Fromme, 2003; Vorderer & Bryant, 2006).

In the context of music education, however, much work may need to be done to achieve the popularity currently enjoyed by other gaming genres. Data from the survey reported a low interest in learning more about music through VGT. In addition, games such as *Guitar Hero* and *Rock Band* were not shown as influential in motivating students

to play a real instrument. This conflicts with earlier research, such as Peppler et al.'s (2011) conclusion that *Rock Band* could potentially be a catalyst to build student interest in more formal music instruction.

This and other studies that have used COTS games to determine correlations between music-performance games and student interest (Auerbach, 2010; Biamonte, 2011; Pasinski, 2015) can only provide limited conclusions because, as Arsenault (2008) observed, COTS games do not perfectly simulate any one dimension of music learning since they favor the entertainment quality of the simulation rather than realism. As such, students' perceptions of VGT in education may ultimately depend on the design of the individual game itself rather than generalizing within gaming genres.

Affective Behavior

Observations examining the effectiveness of games that teach musical knowledge and skills to elementary school students in the general music classroom (Research Question #1) included an analysis of affective behavior during game play in instructional settings. This section reviews demonstrations of positive affective behavior, including examples of motivation, engagement, immersion, and the flow state, compared with prior research with VGT in educational environments. Negative aspects of affective behavior, such as aggression, violence, gender stereotypes, and addiction, are addressed in the following section.

Researchers addressing the positive effects of these games in the classroom have cited increased student engagement and motivation as primary aspects of digital game-based learning (Barab et al., 2009; Brown & Cairns, 2004; Douglas & Hargadon, 2000;

Gregory, 2008; Rigby & Ryan, 2011; Ryan et al., 2006), but only through the observation of children playing games in either an informal setting or laboratory environment.

Elements that may have provided empirical evidence that VGT not only promotes motivation but also effectiveness in achieving educational objectives were not present, including a pretest or posttest, randomization of participants, or the use of a control group.

All, Castellar, and Looy (2015) recommended that no less than 30 participants be involved in future studies, with each iPad group approximating the same number of students. The present study aimed to follow these recommendations, but as the number of students in each class was predetermined by the school administration prior to the beginning of the school year, there were some slight variations in each group. These differences were not perceived to affect the nature or results of the study, particularly in the observation of students' affective behavior during the instructional sessions.

Students' motivations for playing the iPad games were analyzed within the context of self-determination theory, as specific links were observed between self-determinism and gaming. Self-determinism is governed by three aspects of emotional needs: the need for competence, autonomy, and mastery (Kapp, 2012; Pink, 2009; Rigby & Ryan, 2011; Ryan et al., 2006). If the participants were not progressing through the games at a pace they considered appropriate, they would express feelings of frustration, which either resulted in quitting or asking for assistance. Students who were achieving high scores were clearly motivated to continue playing and, in some cases, seek out other students who were having difficulty in order to assist them.

Students participating in the control hybrid group could not tell if they were achieving competency without direct feedback from the instructor. This in some cases led to confusion, which required more teacher intervention in describing the conditions for successfully completing the objective. For example, students in the iPad groups (Groups A and C) were required to correctly play a series of written rhythms in various time signatures by playing the game *Rhythm Cat*. The game automatically alerted the players when they were correct by highlighting each note as they tapped the screen. The students then received a rating out of three stars for the entire exercise, based on how many notes they correctly played.

The lecture/discussion group's (the non-technology group) only source of feedback was the instructor listening to each student individually and critiquing their performance. It was also possible for advanced students to listen to their classmates and determine competency, but this could not be effectively used in formal student assessment. The hybrid group received a briefer version of the instruction provided to the non-technology group; thus, they were better prepared for playing the game and showed competency at a faster rate than the iPad group.

These data suggested that one of the essential qualities of effective instruction is the ability to provide immediate and meaningful feedback. In a classroom setting with a large group of students and one instructor, it may be difficult to assess competency fully while simultaneously attending to the needs of each individual student. Effective video games, both commercial and educationally-orientated, directly assess and provide instant feedback as players progress. At all times, players are aware of how they are doing, and

failure serves as an instructional guide for what they did incorrectly and how to do better the next time.

However, based on the data collected by the experimental treatment, video games in and of themselves may not always provide the necessary individual instruction that is given by a qualified teacher. This can be mitigated by the instructor's ability to create and communicate educational objectives that match the developmental needs of their students. Some video games have the ability for students to customize the difficulty level, making the game more challenging or easier, depending on ability. However, the possibility exists that students will intentionally lower the difficulty level so that they are not challenged at all, leading to a total absence of educational growth. The teacher, however, can monitor this by direct observation or choose games that must be completed on a certain difficulty level before customization is available.

The experimental data also suggested that creating the conditions for competency leading to concept mastery may require both teacher-directed instruction and student-directed manipulating of technology. This may depend on ensuring that the video game to be used matches the teacher's instructional goals and provides effective feedback within the game's design that can be reliably used for student assessment. The iPad games that were used during the lesson portion of the study all contained a built-in assessment component, with the exception of *Melody Melody*.

Melody Melody did not quantifiably assess students' ability to use aural perception in detecting differences in pitch variations. Though the objective of the game was to correctly match identical melodies by listening to a series of short melodic phrases and matching two at a time, students were observed simply tapping each box on the

screen until they matched the correct melody by process of elimination. As reported in the field notes, students felt this did not help them effectively practice aural perception, resulting in decreased motivation to play *Melody Melody*, compared to the other games.

Rhythm Cat, *Blob Chorus*, *Staff Wars*, and *Flashnote Derby* all contained the same design constructs of giving negative feedback when students failed to show mastery over the game's challenges. *Rhythm Cat*'s rating construct prevented students from moving on the next level until at least two stars were attained. *Blob Chorus*'s system of promoting mastery through competence consisted of a numerical scoring system that was updated every time a player made a selection. Every correct selection resulted in gaining one point, while an incorrect answer lost one point. At the conclusion of 10 rounds, a final score was displayed, along with an overall percentage of correct answers. Although there was no preventing students from customizing how many pitches they could choose from (anywhere from two to eight), many students would not increase the difficulty until they received a high percentage that they considered tantamount to mastery. In many cases, this meant achieving the highest score in the class or a perfect score of 100%.

Flashnote Derby contained a similar design where players would 'race' against a computer opponent, gaining speed every time they correctly identified the names of various treble clef pitches. Like *Blob Chorus*, the difficulty level could be customized without the need to complete prior levels, but with each successive level, the length of time given to correctly identify a note decreased, resulting in many students practicing at lower levels to increase their competence.

This was also present in *Staff Wars*, but unlike the other selected iPad applications, the game did not end until the player lost all three 'lives.' This is a common

gaming design, in which the game will increase difficulty on its own until it becomes too much for the player to handle. The most popular example of this design in COTS games is the puzzle game *Tetris* (Pajitnov, 1984), where the player must match falling blocks of different shapes together to make them disappear before they reach the top of the screen. In the case of *Staff Wars*, the length of time given to correctly identify pitches decreased every time a student correctly identified ten notes. Pitches would accelerate across the screen more rapidly until the player made three mistakes, ending the game and displaying a final score of correct notes.

In this case, there was no option to customize the difficulty level, as the game automatically increased the difficulty in correlation with player ability. *Staff Wars* provided the most engagement among participants in Groups A and C because it created a sense of emotional urgency and intensity, fueling adrenaline as the game became faster. Since *Staff Wars* did not present an end-game percentage such as *Blob Chorus* and *Flashnote Derby* or the level progression of *Rhythm Cat*, students' perceptions that they had achieved mastery were completely based on teacher feedback and comparisons of scores from their classmates.

Competition among students was not encouraged or discouraged by the instructor. An announcement was made at the beginning of each lesson that no rewards would be given to the student with the highest score. However, a warning was given that the introduction of the competitive element would require appropriate behavior in accordance with the school's code of conduct. There was a significant amount of student motivation to achieve the highest score in the class, and several students asked about scores in other classes, hoping to be the highest scoring student in the entire grade.

Though students openly bragged to and taunted their classmates with their scores, there was no point where comments became hurtful or behaviorally inappropriate. On the contrary, students would actively encourage others, especially those who were having difficulty with any of the iPad games. The only feelings of anger or frustration demonstrated by the participants were when they did not achieve the desired score or were distracted by external stimuli. This aspect of gaming encourages Lazzaro's (2004) concept of 'hard fun.' Though the challenge level of the higher levels of the games was greatly increased, players were observed showing intense emotions from completing these levels, such as exclamations of joy, physical displays such as holding their arms in the air as a sign of victory, and showing their iPads to other students.

An essential requirement of intrinsic motivation as defined by self-determination theory is the ability to work autonomously and progress at an individualistic pace (Pink, 2009). Students in the iPad group received this condition for the entire length of all three lessons, while students in the non-technology group were directed by the instructor and given limited opportunities to work independently. Lessons in the hybrid group were balanced between 20 minutes of teacher-directed instruction and 20 minutes of student-centered individual work.

Although complete autonomy was given to students playing the games in the iPad group, many students required additional assistance from the instructor or other students. The pace of student progression in the iPad group was also determined by the level of competition displayed in a given class dynamic. Students who were more competitively-oriented attempted to finish levels as quickly as possible to be the first who had completed the game. This sometimes resulted in a cursory understanding of the musical

concepts that the games were designed to assess. Students who took their time and were not motivated by external competition were more likely to report a greater sense of competency when asked by the teacher.

The non-technology group was given limited time to work independently or in groups of their own choosing after receiving teacher instruction. This had to be closely monitored as some students would choose team members with whom they could socialize and be distracted from the purpose of the lesson. Those who remained focused demonstrated a greater sense of motivation to complete the assignment, unlike during teacher instructional time. These observations suggested that while autonomous work has the potential to increase intrinsic motivation among students, it must be organized and monitored by a qualified teacher to ensure that educational goals are met. VGT has the ability to allow students to work at an individualized pace, but only when games are selected and supervised effectively.

Further evidence of positive affective behavior can be determined by the observation of student engagement levels with video games as an educational tool. One of the most significant attributes to the success of COTS games is their ability to draw in players and create a suspension of disbelief. This requires players to be so deeply invested in the game that the fictional world presented within the game's construct is believed to be genuine. This has become especially potent with the advent of virtual reality games, whose 3-D worlds controlled by the players' physical movements adds an extra dimension of realism.

The belief in a game's alternate reality forms the basis of what is referred to by researchers as immersion (Brown & Cairns, 2004; Castronova, 2007; Douglas &

Hargadon, 2000; Egenfeldt-Nielsen et al., 2016; Juul, 2005). The primary catalyst for achieving immersion is the ability for players to interact fully with the game's environment. This is vastly different from other forms of media such as television and movies because the user has no control over the events that occur on the screen and is relegated to being a passive observer. Video games cross the threshold of multimedia interactivity because they involve user participation directly on a personal level.

Each decision the player makes affects the narrative, progression, and eventual completion of the entire game. Compared to a classroom based on lecture and teacher-directed activities, the motivational pull of digital game-based learning may be more effective than traditional methods of the past. However, immersion in a particular video game does not guarantee that learning objectives will be met, only that users have invested themselves completely in the game's construct. Because of this, researchers have suggested that educationally-based games currently do not and will not ever achieve the same kind of immersion present in COTS games (Gee, 2013; Klopfer et al., 2009; Olson, 2010; Prensky, 2006).

This may be because educational games largely do not create fictional worlds and instead focus on practicing a desired learning concept. Known as "skill-and-drill" (Prensky, 2006), educational games generally do not contain any narrative, characters, or dynamic environment, which does not create a state of emotional investment among *users*. While the games presented on the iPads during the instructional sessions were considered enjoyable by the participants, and served as an effective tool in helping to teach musical knowledge, they all focused on a skill-and-drill structure that caused a certain amount of boredom after playing the same game for a prolonged length of time.

COTS games, by contrast, are much more complex and can create entire fictional worlds for players to explore (Juul, 2005). Adaptations of these games for educational use have achieved some success—most notably, Mojang’s game *Minecraft* (Persson & Bergensten, 2011) in its application to STEM subjects (Sáez-Lopez et al., 2015). There are no currently known video games, however, that have adapted the use of an open-world construct to teach music. Creating an open-world game devoted to music education may encourage students to reach greater immersion levels, especially when given the capability to interact with other players as featured in MMOs.

Immersion as one of the defining characteristics of the flow state has been observed in both students and adults engaging in musical activities (Cassidy & Paisley, 2013; Cheng, 2014; Csikszentmihalyi, 1975, 1990; Custodero, 1998; Denis & Jouvelot, 2005; Kaylai & Pichlmair, 2008; Linek et al., 2011). Elements of flow, defined by Csikszentmihalyi (1990) as “so involved in an activity that nothing else seems to matter” (p. 4), were also observed during the course of the study with the students who had access to the iPad games. Behaviors such as a clear and intense focus on the game, verbal and physical displays of positive emotion (such as loud outbursts of affirmation and pumping fists into the air), and surprised reactions when informed that the lesson was about to conclude (alteration of the sense of time) were consistent with aspects of the flow state.

This is also supported by Csikszentmihalyi’s (1975b) earlier explanations of flow as inherent in the act of play itself: “The most typical kind of flow experience is play, and games are the most common forms of play activity” (p. 43). Games have a natural ability to create flow in the player through competition, adrenaline, and the possibility of a reward. Though the reward of completing each of the iPad games was simple pride of

completion, students showed a high degree of motivation for not only completing the game, but also achieving the highest score among their classmates.

All of the iPad games, with the exception of *Melody Melody*, used in the instructional sessions possessed the qualities necessary for achieving a flow state, such as clear objectives, immediate feedback, deep concentration, player control, and intrinsic rewards. However, none of them contained the necessary materials to initiate deep immersion within the game universe. This would likely require a more complex design and a greater investment of time to allow students to engage fully and explore what the game has to offer. Based on responses received from the survey and interview data, students would likely be positively motivated to play educational games if they were based on an open-world concept with relatable characters in which to invest emotionally.

Immersion and flow may not be fully necessary to achieve the goal of learning musical concepts and skills, but they may be helpful in motivating students to pursue further musical knowledge, such as playing an instrument or joining an extracurricular ensemble. The process of adapting the open-world structure of popular COTS games to serve an educational purpose may be the next stage of development for VGT in the music classroom. However, debates that highlight the potential negative affective behaviors attributed to video games still cast a stigma on not only the educational possibilities of games, but also the entire digital gaming industry.

Industry Controversies

Video games have always attracted controversy since the development of home-based consumer products dating as early as the 1980s (Funk & Buchman, 1995). Displays

of violence on consoles such as the Atari 2600, released in 1977, had such poor graphical quality that it was difficult to interpret exactly what was happening on the screen. Most examples of violence in these and arcade games were cartoon-based, such as the act of eating ghosts in *Pac-Man* or getting crushed by a truck in *Frogger*.

This sort of violence may not be potentially dangerous to young, developing minds due to the sheer fictional quality of its nature. The realistic implications of children eating ghosts or being intentionally being hit by trucks resulting from excessive video game play may not be plausible even in extreme circumstances. However, as video game technology improved and the first generation of home console users became teenagers and young adults, game developers sought ways to retain their audience by creating material that catered to this emerging demographic (Herz, 1997; Kent, 2001; King, 2002).

Games in the 1980s began a new development in content with the appearance of games centered in violent action. ‘Fighting’ games such as *Karate Champ* (Technōs Japan, 1984), *Street Fighter* (Capcom, 1987), and *Double Dragon* (Technōs Japan, 1987) were all built around the premise that the player controls a human character and must destroy the ‘bad guys’ by using martial arts and weapons. Fighting games became a popular draw for video game consumers in both arcades and on home consoles (Herz, 1997; Kent, 2001).

The inclusion of violent content was augmented with the refinement of the ‘first-person-shooter’ (FPS) genre. Though games designed with first-person perspectives had existed since the early 1970s, games in the early 1990s such as *Wolfenstein 3D* (id Software, 1992) and *Doom* (id Software, 1993) took violence to new levels. Players would use a variety of firearms to destroy enemy characters systematically. As

technology improved over the decade, games began displaying more intense levels of violence, adding elements such as blood, screams, and “gibs,” which were “chunks of meat blasted loose in gory fashion from dying enemies” (Jensen, 2017).

The popularity of violence in games has not abated in the last several decades. The ESA reported that of the top five best-selling games in 2017, three of them were action combat games involving heavy amounts of person-on-person violence (ESA, 2018). Though the creation of the ESRB and other rating systems allows for more consumer awareness of the content of video games, it does not prevent those games from being regulated or purchased by minors. However, the ESA report also stated that 90% of parents are present when their child purchases a video games, with nine out of 10 parents requiring permission from their child before acquiring a game.

Since events such as the congressional hearings of 1993 and the Columbine High School massacre in 1999, many researchers have sought to blame violent video games as a catalyst for aggressive behavior in young people (Anderson & Bushman, 2001; Anderson & Dill, 2000, Carnagey & Anderson, 2005; Gentile, 2009). Video games were again placed in the forefront following the Parkland High School shootings in early 2018. President Donald Trump considered video games as a negative influence on students, stating that “the level of violence on video games is really shaping young people’s thoughts” (Ducharme, 2018).

Researchers have suggested that players’ aggressive thoughts increase while playing violent video games in laboratory settings (Anderson & Dill, 2000; Carnagey & Anderson, 2005; Porter & Starcevic, 2007). However, there does not seem to be any direct correlation between playing violent video games and violent behavior (Kutner &

Olson, 2008). A number of factors, including genetic predisposition, social development, and demographic, are all instrumental in determining what leads individuals to commit violent acts. Yet, these debates still continue to play a large role in the video game industry, with both sides convinced of the merits of their arguments.

Music performance games have been largely immune to criticisms involving violence and aggression. Games such as the *Guitar Hero*, *Rock Band*, *Piano Tiles*, and *Just Dance* series contain no violence and are all rated 'E for Everyone' by the ESRB. However, because these all fall into the general category of video games, it is possible that they have inherited the stigma generated from other gaming genres. As observed in the present study, the only aggressive thoughts influenced by the content of the educational music games on the iPads resulted from frustration at not being able to complete a level and from losing in competition with other students.

The games used in the study had no content that could be considered as violent or aggressive. Two examples, however, are worthy of mention because of the potential to be interpreted as possible violent material. In the game *Blob Chorus*, whenever a player identifies an incorrect pitch, the blob that sang the note explodes into a pile of goo. The effect is supposed to be humorous, but there was a concern that students would intentionally choose the wrong answer just to see the exploding animation. This behavior was not observed as students were more motivated to get the questions correct and achieve a high score.

The other example was in the game *Staff Wars*, where students had to identify a series of pitch names correctly as they traveled across the screen. When a student made a selection, a spaceship located at the bottom of the screen would shoot a laser beam at the

note, destroying it if the answer was correct. When the student made a mistake, the spaceship would get hit with a laser beam itself; after three mistakes, the spaceship would explode and the game would end.

These two examples were not observed to detect any increased levels of aggression during the instructional sessions. Students were motivated primarily by achievement of the game's objectives and competition with other students. Therefore, it is likely to assume that both COTS and educational video games designed for music applications do not require any violent content to be effective teaching tools or sources of entertainment.

During the survey and interview portion of the study, students were asked about their own video gaming preferences in their home usage (Research Question #3). In correlation with the ESA's findings, most participants preferred to play the same COTS genres of action/adventure games, fighting games (including FPS), and sports games. Specific examples were given during the interviews, with games such as *Call of Duty*, *Battlefield 1*, and *Grand Theft Auto* mentioned as popular among students. Since the effect of COTS violent games on student affective behavior was beyond the scope of this study, no follow-up questions were asked on the effect of these games on aggressive thoughts.

Although music performance games were noted as one of the least popular types of games in the survey, many similar factors can be applied to both genres. Forty-three percent of students reported in the survey that challenge was the most influential factor in game design. Music performance games do possess a significant level of challenge which has the ability to be customized. In addition, players have the ability to compete against

each other in person or online. Music performance games also contain soundtracks with popular songs that are relevant and recognizable to most players.

It is possible to consider that music performance games are not as popular as the other genres reported in the surveys and interviews because of its lack of violent content. Students were observed enjoying themselves playing the iPad games, but it is likely that they would choose to play a COTS game if given a choice between the two. Designing educational games for music that are as engaging as current popular genres while leaving out violent content may well be the next challenge for student acceptance.

Addiction to video games has become a definable phenomenon under the categorization of gaming disorder announced by the World Health Organization (WHO, 2018), but as there were only approximately 50 confirmed global cases of gaming addiction at the time of this classification, it is unlikely that these developments will have a major impact on digital game-based learning in the near future. Responses from the surveys regarding participants' video game-playing habits showed that the majority of students play between 1 to 5 hours per week, which does not fit the criteria given by the WHO as addictive behavior.

In Question 5, "How often do you play video games?" only 2% of respondents chose the 'Never' option. The greatest frequency of responses was equally divided between 'Sometimes' and 'All the time' (34% each). Twenty-two percent answered 'Often' and only 8% answered 'Rarely.' Since there was no detailed description defining what 'All the time' entailed, a follow-up question was given on the number of hours per week students played video games. The majority of student responses was another equal division between 1-2 hours per week and 3-5 hours (27% each).

Twenty-eight percent of students reported that they played more than 5 hours per week, with 41% of males and 19% of females classified by sex. While this could be considered an excessive amount of time spent playing video games, it does not satisfy the conditions for gaming disorder set by the WHO. These conditions were defined as “increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities” (WHO, 2018). This includes forgoing all other aspects of an individual’s life, including attendance at school.

No student involved in the study had demonstrated an excessive amount of absences prior to or during the study, suggesting that none of the participants suffered from any outward signs of gaming or any other addictive behavior. Since studies in gaming disorder are limited, it is unknown when this behavior can be diagnosed in children. In addition, because most children’s time playing video games are regulated and monitored by adults, it is possible that symptoms of gaming disorder may not manifest until adolescence.

It is also unclear if there is a predilection toward certain gaming genres when diagnosing gaming disorder. Judging from the ESA’s (2018) report on the most popular-selling games of 2017, music performance games may not be considered a potential risk for encouraging addictive behavior. Once again, however, the negative stigma applied to all video game genres may affect the viability of music games in both COTS and educational environments. Future studies in gaming disorder may assist in providing more information in recognizing symptoms and providing effective treatment.

An additional source of controversy that was examined during the course of the study was sex-based differences and stereotypes that may result from video game culture.

Sources of gender stereotyping in the video game industry were initially caused by the creation of games predominantly oriented toward male consumers, which reflected the gender of most early influential game designers such as Allan Alcorn, Ralph Baer, and Nolan Bushnell (Cassell & Jenkins, 1999).

Many of the games produced throughout the 1970s and 1980s featured male characters attempting to rescue the prototypical ‘damsel in distress,’ such as in *Donkey Kong*, *Dragon’s Lair*, *Super Mario Bros.*, *The Legend of Zelda*, and others. A particularly controversial game named *Custer’s Revenge* (Mystique, 1982) drew condemnation from numerous activist groups because the game play featured a simulated rape of a Native American woman by the player.

A watershed moment in the history of video games occurred in 1986 with the release of the Nintendo game *Metroid*. The player controls the character of Samus Aran, an intergalactic bounty hunter completely clad in armor. When the player has finished the game, it is revealed when the armor is removed that Samus is a woman. This revelation helped to shatter the stereotype that female characters in video games could only be relegated to sex objects or defenseless weaklings.

Over the last several decades, many strong female characters have been created for both male and female audiences, such as Chun-Li from the *Street Fighter* series, Sonya Blade from the *Mortal Kombat* series, Lara Croft from the *Tomb Raider* series, Chell from the *Portal* series, and Terra and Celes from *Final Fantasy VI*, to name a few. Even Princess Peach (*Super Mario Bros.*) and Princess Zelda’s (*The Legend of Zelda*) characters were updated in future sequels in both series as strong, competent, and independent leaders.

The steady inclusion of these kinds of female characters has encouraged a tremendous increase of female gamers, such that adult women now represent a greater portion (33% to 17%) of the video game-playing population than boys under 18 (ESA, 2018). Males still hold a greater average of frequent game purchasers, with 61% male to 39% female, though 45% of gamers in the United States are women (ESA, 2018).

With sex stereotypes in the gaming industry continuing to shift, it was noteworthy to consider gender roles when analyzing data from the test scores, surveys, and interviews. Due to the quasi-random nature of the experimental portion, an equal number of boys to girls was not possible. However, the ratio of students representing opposing genders was very similar, with 86 participating total males to 99 females. A further breakdown of participants by sex in each assigned group was illustrated in Table 7 in Chapter IV.

Results of the pretest/posttest design were calculated using the total number of participants as organized by sex (Table 14). Mean scores between the pretest and posttest showed an increase of 3.05 for males and 3.27 for females. Posttest means compared by sex showed a value of .03 in favor of males. These data showed that even though males achieved higher mean scores on both the pretest and posttest, females achieved a higher amount of growth.

When subjected to further statistical measures, including a paired *t*-test, ANOVA, and ANCOVA, data showed that sex was not a significant factor in determining the effectiveness of VGT as a learning tool in the music classroom. In addition, sex differences by grade level also did not account for a statistical significance in difference of mean scores. This suggested that males and females learn equally well with video

games in education environments, especially when competition between individual students is not factored into the overall assessment.

Feedback from the survey and interviews revealed additional information regarding boys' and girls' video game preferences. Numerical participation in the survey was slightly biased in favor of females when divided by sex, with 42% of respondents identifying as male and 58% as female. Further results from the survey revealed that girls play video games slightly less frequently than boys, both individually and with friends.

Boys and girls did prefer the same types of gaming genres, particularly action/adventure, fighting, and sports games, with challenge being the primary quality of motivation to play. This contradicts earlier research that claimed girls prefer games with more cerebral orientations, such as strategy or puzzle-based games (Cassell & Jenkins, 1999; Olson, 2010; Pepler, Warschauer, & Diazgranados, 2010).

The similarity of preferences by sex was further reinforced in the survey with regards to the correlation between video games and education. An ANOVA showed no statistical significance between sexes on a 95% confidence level for questions that focused on the use of video games in the music classroom. The highest similarity rate between responses categorized by sex was the affirmative statement that video games have the potential to teach more about music (see Question 14, Table 18).

Individual interviews also showed similarities between boys' and girls' preferences for playing video games. Female participants, however, reported more often that playing games is a result of "being bored" and "finding something to do," while boys played for the challenge and socialization aspects. While both boys and girls enjoyed action/adventure games, more boys cited preferences for FPS games with realistic

violence, such as *Call of Duty* and *Battlefield 1*. Girls enjoyed action/adventure games as well, but with more cartoon-based violence such as *Sonic the Hedgehog* and *Super Mario Bros*.

Overall, male and female perceptions of video games in both entertainment and educational settings are becoming more similar over time. These findings suggested that previous research on differences between gender trends is becoming increasingly obsolete due to rapid developments in video game culture. It is likely to assume that gender differences in video game preferences will continue to diminish as more games are released that feature female characters that are equal to male characters.

Controversy surrounding video games may continue to maintain its place as a major aspect of the industry, but it is possible that with the development of video games that do not promote violence or gender stereotyping, stigma will gradually abate. Educational uses for video games can also serve to lessen negative perceptions of the industry, particularly with future research that provides evidence of their positive impacts in the classroom.

Pedagogical Considerations

Though limited research has been conducted on the applications of VGT in music education environments, VGT as implemented in the general education classroom has been increasingly explored over the last decade (Annetta, 2008; Brown, 2008; Dicheva et al., 2015; Gee, 2007; Kapp, 2012; Prensky, 2006; Shaffer, 2006). However, cross-curricular integration of VGT in the performing arts still revolves around the same constructs that are shared by all effective educational designs. This section outlines how

results from the present study can inform future implementation of VGT by designing educational objectives, music curriculum, and the assessment and evaluation of student learning.

It is important to note that video games as a tool for teaching music must not be the first consideration when creating a music curriculum. Any learning activity, whether involving digital game-based technology or not, must be designed around educational objectives that are previously determined prior to its implementation (Lee & Hammer, 2011; Russell, 2016). These objectives are approved by the particular district's Board of Education and normally revolve around the state or national standards of that discipline.

The present study was designed to be an examination of the effectiveness of VGT in the general music classroom to teach music knowledge (Research Question #1). As such, educational objectives from both the New Jersey State Standards and National Standards were chosen before the selection of specific iPad games to use during the instructional settings (displayed in Table 3). Only after the objectives were chosen were the individual iPad applications selected for use in the study.

This was essential due to the need to choose games based on their ability to help teach one or several concepts represented in the standards. Previous research using COTS games did not identify any educational objectives rooted in state or national standards and thus could not effectively evaluate student learning, apart from assessing motivation and engagement levels (Jenson et al., 2016; Paney, 2014; Pasinski, 2015; Richardson & Kim, 2011). For VGT to be considered a viable tool for music education, games must be specifically designed and chosen to match the educational objectives previously

determined and represented by the state or national standards of visual and performing arts.

Each of the iPad games selected for the study addressed one or several standards to be used for student assessment. However, not all of the games selected individually focused on all of the five standards, as illustrated in Table 3. For example, *Melody Melody* used standard musical notation, but did not involve any student performance technique. While focusing completely on aural perception, *Blob Chorus* did not utilize any musical notation and was ineffective in covering any standard that displayed the objective of student demonstration of music knowledge using written notation.

Staff Wars and *Flashnote Derby* both involved written music notation as applied to pitch, but did not include any rhythmic elements nor the application of these elements to performance-based skills. However, the games showed effectiveness in teaching the identification of standard pitch symbols and the ability to differentiate pitch structures in traditional music notation. When compared with the control group in the posttest scores, using these particular games was slightly more effective than non-digital game-based learning methods.

This does not necessarily mean that using video games in the general music classroom is more effective in achieving educational objectives than instruction based on class discussion and performance, as stated in Research Question #2. Instead, it may be concluded based on the experimental data stated in Chapter IV that VGT has the potential to reach objectives effectively based on the individual selection of games to match particular objectives as derived from predetermined standards. A game not designed to meet those particular objectives, such as using *Staff Wars* to teach rhythmic skills or

Rhythm Cat to practice pitch perception, would be contrary to its purpose and potentially unsuccessful.

Student observations from the survey and interview portions of the study were useful in acquiring additional information regarding the ability for video games to reach educational objectives (Research Question #4). The perception that video games can effectively be used to learn received a generally positive response, as did the idea that VGT can be used to teach music (see Table 20). However, there was a less positive response when students were asked if they would enjoy more video games in school or be motivated to use VGT in music class.

The survey data showed that even using COTS games such as *Guitar Hero* and *Rock Band* received a below-average response regarding motivation in playing a real instrument. This suggested that while students believed VGT can be an effective tool for teaching music, it did not mean it should be used exclusively. Responses from the individual interviews explored some of the reasons behind these opinions, particularly when considering the differences between COTS games and edutainment games.

More in-depth answers collected from the interviews analyzed in Chapter IV may suggest that because students are more experienced with COTS games, their perceptions of games used in the classroom may originate from that experience. One participant mentioned that video games are not designed for education or children at all, while another cited games as merely a distraction from boredom. As the majority of video games are designed for entertainment purposes, this may be instrumental in students' opinions that the games they play in their daily lives cannot serve an educational purpose.

The participants also mentioned that while they enjoyed playing the iPad games presented in class, they would not play them voluntarily in their home environments. Both the survey and interview data suggested that competition and fun were the primary motivations for playing video games, not the act of learning musical concepts and skills. However, the interactive ability of video games was highly preferable to more passive avenues of learning, including teacher lecture and question-and-answer methods.

This did not suggest that students preferred the complete absence of a teacher in favor of playing video games by themselves. The combination of playing video games with guidance from a knowledgeable instructor seemed to be the most agreeable learning environment as opposed to one or the other. Results from the posttest supported this opinion, as the group with both teacher and video game instruction demonstrated the highest mean scores and growth from the pretest (Table 12).

Designing and implementing VGT to meet educational objectives in a music curriculum may be successfully achieved, as the evidence provided in the present study has suggested, but many considerations still must be taken into account before introducing VGT into the music classroom. This includes if the game is designed for the purpose of helping students meet specific objectives as predetermined by the teacher and present within the approved music curriculum.

Additionally, the choice of video game must also reflect where in the curriculum it is best suited. Assigning video game play to random elements during the curriculum's timeframe would be as ineffective as any other unrelated musical activity. Finally, while VGT must be primarily designed to achieve educational objectives within the context of the music curriculum, there must be an element of fun, competition, and social

engagement so students can relate the game to COTS games played in their home environments. Otherwise, attaining student engagement and motivation to participate may be difficult. Details on specific qualities necessary to design an effective video game for music education are discussed in the next chapter.

When designing VGT to fit into an existing curriculum, it is also necessary to include how the game will serve to assess and evaluate students' ability levels to complete tasks set forth by the teacher, as defined by the educational objectives. Many games have assessments already built into their basic constructs so that players are aware of their progress throughout the game. In addition, these games normally offer tutorials, sometimes as part of the gameplay itself, to assist the player in learning the rules.

COTS games released in earlier decades would usually contain instructional manuals the player would read before beginning initial gameplay. The manual would present the basic premise of the game; in-game features such as characters, enemies, and items; and the layout of the control patterns ('A' button = jump, 'Start' = pause, etc.). Physical game manuals have been almost entirely eliminated from games after designers found that players preferred to learn by actually playing the game instead of reading the instructions.

Since then, games in both COTS and edutainment genres present instructional information as either part of the gameplay or by giving the player an option to bypass the tutorial entirely. For most COTS games, it is not difficult to determine how the player is being evaluated during the game. Most games have an on-screen indicator notating the player's current state, sometimes called 'health,' which fluctuates depending on how successful they are in navigating the in-game obstacles. For example, in *Guitar Hero*, the

player's health decreases when they press an incorrect button on the controller or at the wrong time during the music. A certain number of mistakes will result in the player losing and the game ending.

The feature of instant feedback in games is one of the most effective ways for students to assess themselves and learn from their mistakes. COTS games accomplish this by giving players multiple attempts, or 'lives,' so that players may recognize what they did wrong and make different decisions on the next attempt. Traditional educational assessments are sometimes ineffective in assessing growth because students do not know how effectively they performed until long after the assessment is over, and they usually do not receive another attempt to correct themselves (Brown, 2008).

The main consideration in determining how effective VGT is in assessing students is the difference between the game's assessment and the teacher's assessment. All of the iPad games involved in the study had built-in assessment measures that informed the participants of their progress and mastery of the game's objective. The games involved a numerical scoring system that was communicated to the students as they were playing and a final score was displayed when the students had either completed the game or lost.

The system of assessment used by *Rhythm Cat* involved each written note changing color whenever players played them correctly. The number of correct notes determined the final score, which was displayed out of a total of three stars. Anything less than two stars would require students to replay the level. The scoring of *Blob Chorus* was based out of a series of 10 questions, each allowing the player to score a certain

amount of points before advancing. At the conclusion of the round, the players' final score would be displayed in numerical form.

Staff Wars and *Flashnote Derby* had similar methods of assessment based on numerical scoring systems. However, while *Staff Wars* awarded one point for every correctly identified pitch, *Flashnote Derby* awarded more points for how quickly the player identified each pitch. *Flashnote Derby* also ended after a certain number of questions (between 10-30, depending on the difficulty level), while *Staff Wars* did not end until the player had committed three mistakes. Therefore, it was possible for *Staff Wars* to continue indefinitely, but the window of time to answer, which decreased after each 10 correct identified pitches, became so short that it eventually became too difficult for even the most accomplished students to proceed past a score of 80.

Melody Melody also provided a numerical scoring system based on how many attempts it took students to match two identical melodic phrases correctly. The more unsuccessful attempts the student made, the more the score decreased. However, this was not an effective way to assess students' aural perception ability, as matching melodies required a majority of guesswork and luck. The lack of assessment based solely on skill may be a reason why *Melody Melody* was not popular among the participants and was not successful in advancing musical knowledge.

Participants' scores on any of the iPad games were not considered in the overall evaluation. The only source of formal assessment for all three groups was the pretest and posttest, particularly because the control group was not assessed with the iPad games. However, in the music classroom environment, it would be possible to use the assessment embedded in games to formally evaluate students' musical knowledge and skills. This

decision would have to be made by the teacher about whether to use the game's assessment, an alternate method, or a combination of the two.

Teacher-assisted instruction may help with evaluating student skills in order to differentiate between individual students' capabilities. Video games provide a very objective method of assessment that may not conform with the subjective nature of musical performance. Aspects of music education such as identifying pitches or using music notation correctly may warrant a more objective evaluation of skills, but video games do not always account for individual considerations such as prior experience or student disabilities, whether in terms of learning, physical, or both.

Using teacher-assisted instruction in evaluation can also help determine not only the students' current skill level, but their potential for building on existing skills. This reinforces Vygotsky's (1978) concept of the zone of proximal development, also referred to by Gee (2007) as a regime of competence, where the game's difficulty slightly exceeds the students' ability level. The gap between the game's objective and the student's competence is then bridged by the guidance of the teacher, something that the student cannot achieve alone and the game cannot provide. The teacher's evaluation of the game's assessment may then take these factors into account and be modified accordingly.

Because no mandatory state or national standardized tests to assess students in the visual and performing arts currently exist, procedures of determining if students reach educational objectives will reside with the individual instructor. Video game assessments may be adequate for providing that evaluation in the perceptions of teachers; future research of this nature could be helpful in teacher assessments of musical skills and knowledge using both digital game-based learning and other forms of instruction.

Educational Barriers

Aside from the stigmas discussed earlier in this chapter regarding potentially negative affective behavior effects that are perceived by some researchers as correlated or even caused by video games, several logistical concerns may prevent educators from accessing and implementing video game technology in their classrooms. Since the present study focused solely on VGT in the elementary general music environment, the following discussion is oriented toward that classroom setting. However, it is possible to apply these barriers to most music education scenarios, such as middle or high school classroom music or even performance classes such as choir, band, or orchestra. Performance-based classrooms, including lessons, chamber groups, or large ensembles, may benefit from the introduction of digital game-based design to improve performance skills on instruments or vocals. COTS games like *Guitar Hero* and *Rock Band* require players to use a modified controller that is specifically designed to interface with the console system. Unfortunately, this setup does not assist players in learning a real instrument, as the design of the controller barely matches the configuration of an actual guitar.

However, some COTS games interface directly with a player's voice or instrument through an audio jack or microphone. *SingStar* (London Studio, 2004) and *Rocksmith* (Ubisoft, 2011) both assess players' performances on guitar, bass guitar, or voice similar to the design of *Guitar Hero*. While all of the available songs that students can play come from the game itself, the potential exists for future versions to include a broader variety of music to match up with learning objectives as decided by a music teacher.

Even rudimentary conducting technique has been applied to VGT, such as in the 2014 Disney Interactive game *Fantasia: Music Evolved* (Disney Interactive, 2014). *Fantasia: Music Evolved* combines the orchestral music presented in the original 1940 film *Fantasia* and its sequel *Fantasia 2000* with popular songs by artists such as Bruno Mars, Elton John, The Police, and others. Players control the game play with their own conducting movements, which are interpreted by a motion-control camera that is installed with the console's hardware. Though *Fantasia: Music Evolved* is not designed as an edutainment or serious game, the potential exists for games such as these to be adapted to suit the needs of aspiring performers.

Achieving these innovations for music education would require several logistical factors to be satisfied. First, the technological resources would need to be available for teacher use on a regular basis, along with continuous updates and professional support for hardware or software issues. Also, training would need to be provided for teachers who are not familiar with the technology so they can be effective in properly implementing it in the classroom. Finally, administrative support would be required to integrate VGT successfully into the district-approved curriculum.

Acquiring the resources necessary to implement VGT fully into the general music classroom may be difficult depending on the size of the school's budget and accessibility to new technologies. In the case of the present study, iPads were not initially available for the entire class and had to be borrowed from the school's iPad cart. The iPad cart was available to all teachers and could be reserved in advance for a class session or series of class sessions.

Since the individual general music classes met once every 6 school days, it was necessary to reserve the iPad cart for 12 separate sessions, which may have inconvenienced other teachers who wanted to use the iPads for their own classes. As it is an unlikely situation that all teachers in one building would each have access to iPads for all of their students, it is still necessary to share and would possibly create scheduling conflicts between teachers.

iPads are not the only technological means of promoting VGT, as most schools have one or more computer labs that can accommodate an entire class. Once again, the issue of scheduling conflicts becomes apparent when considering that many general music teachers have a different set of students in a given week or cycle. In order for all students to receive the same lesson, the computer lab would need to be signed out for multiple consecutive days. In the case of the corresponding school schedule involved in the present study, the computer lab would have needed to be signed out for 6 consecutive days over the course of three cycles. This would no doubt have come into conflict with other teachers' needs, especially if the study had been conducted during the school's standardized testing period.

Using standard COTS gaming consoles such as a PlayStation or X-Box would also be problematic, considering not only the expense, but also the limitation of only up to four students playing at one time. A series of class sessions would be required for all students to have an opportunity to play, which may not be an effective use of class time. Using iPads or laptops may give all students the ability to play simultaneously and possibly interact online if the game has that capability, but it is unrealistic to assume that

iPads or laptops will be available whenever the teacher requires the length of time needed to teach an entire cycle of classes.

The accessibility for a single music teacher to use VGT at his or her convenience may not be possible at the present time. However, alternative options may be available depending on the school's existing resources. Because VGT should not encompass an entire general music curriculum, the use of iPads, laptops, or computers can be confined to sporadic use throughout the school year. In addition, teachers can use software that is compatible with home devices so that students may access them outside of class. Web-based free sites that use VGT may also be available on both computers and on mobile devices.

However, it still may be challenging at this time to acquire the resources necessary to implement VGT, especially if the school does not possess the adequate budget or support to provide teachers with technology. Music teachers may wish to consider alternative means of receiving funds, such as fundraising, grant writing, or donations through community or web-based services. The music program that was used in this study had already possessed six iPads received through online donations at www.donorschoose.com.

Though this number of iPads was not sufficient to provide for every student in the class and additional iPads were required for the specific purposes of the study, the six iPads already available could be used in small groups or shared by multiple students on a rotational basis. While this may not be completely ideal in a regular general music classroom environment as opposed to a one-on-one iPad to student ratio, it may be an effective solution for teachers with partial access to technological hardware.

School districts that may wish to implement VGT are also responsible not only for providing teachers with the necessary materials, but also in the training and technical support for ensuring that it is properly implemented and functioning properly. The largest factor regarding the successful integration of VGT is the teacher's ability to teach the software to students, support them when needed, and use VGT to assess and evaluate their skills in accordance with educational objectives.

This may be relatively easy for teachers who are already familiar with VGT in either a COTS or edutainment capacity, but teachers who possess little to no experience with VGT may be intimidated and unable to adapt. This is especially true in the case of older teachers who did not grow up with VGT or began playing video games when they become available for home consumers. Referred to by Prensky (2001) as "digital immigrants," these individuals may experience more difficulty learning how to use the software and integrate it into an already existing curriculum.

By contrast, teachers who grew up with this technology already available, or "digital natives" (Prensky, 2001), are much more comfortable adapting technology to their needs based on their prior experience. A study conducted by Bensiger (2012) examining the perceptions of 50 preservice teachers revealed a positive attitude toward assisting students with social and academic skills by using VGT. These perceptions also included the identification of several barriers such as cost of purchasing games and hardware, finding appropriate educational games, and obtaining technical assistance in installation and maintenance. Provided with these opportunities, the participants agreed that they would take further steps to integrate VGT within their own classrooms.

An additional survey was administered to full-time K-12 teachers from 26 schools in North Carolina (Ertzberger, 2008). Factors that hindered participants from using video games in their classrooms included lack of time to create and customize video games, relevance to the curriculum, expense of acquiring video games, and lack of professional development and training. A majority of participants reported that computer and video games are effective instructional tools for learning and are easily approachable by the students, but would not implement them in their classroom because of these limitations.

It may be possible that as time passes and the population of administrative personnel transitions from digital immigrants to digital natives, VGT in the classroom will receive more support. This would include allocating more budgetary funds to technology materials, providing more professional development opportunities to find appropriate games that match curriculum objectives, and technical support to install and repair issues with both hardware and software.

With more research providing evidence to the benefits of digital game-based learning, it is likely that support for VGT will increase and solutions will be found to address these issues. Music teachers can help facilitate this transition by creating and implementing games that show positive quantitative results in the teaching and assessment of musical knowledge and skills.

Synthesis of Key Findings

This study explored and analyzed a variety of facets in video game technology and digital game-based learning as applied to music education. Quantitative and qualitative data were collected over a 6-month period using elementary school students in

the natural general music classroom environment. Students were randomly organized into classes prior to the beginning of the study by the school administration and accepted into the study upon reception of both a signed student and parental consent form.

All quantitative results were analyzed using SPSS Statistical Software version 24 (2016); qualitative results were coded using constant comparison (Boeije, 2002) with the assistance of two professional educators not directly affiliated with the study. At the conclusion of the study, all documentation was collected and secured in a locked file drawer or on a password-protected computer. No issues or complications were reported by any of the participants, parents, or school personnel during or after the study was completed.

This section serves to synthesize the key findings discussed earlier in this chapter based on analysis of the quantitative and qualitative results. Findings are categorized according to the study's research questions, which were explored in temporal order. Each subsequent research question served to inform the previous question; data were analyzed according to the sequential nature of the study (Tashakkori & Creswell, 2007).

Research Question #1: Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?

Key Finding #1.1: Data from the experimental treatment suggested that examples of video games whose purpose is to achieve specific educational objectives can be effective in teaching musical concepts and skills to elementary general music classroom students.

Key Finding #1.2: Field note analysis of the experimental treatment suggested that elements of successful video games that have the potential to teach musical

knowledge and skills include the opportunity for students to interact with a virtual environment, customize their playing experience, control the level of difficulty the game presents, and share their experience with others. This has the potential to promote deep engagement, immersion, stealth learning, and the facilitation of the flow state.

Key Finding #1.3: COTS games, though highly motivating and engaging, are not designed to teach musical concepts and skills and are thus ineffective for the general music classroom (Arsenault, 2008; Paney, 2014; Tobias, 2012). This includes music performance games, which have limited capability even to motivate students to pursue more formal music studies.

Key Finding #1.4: Gaming hardware technology such as iPads, laptops, or tablets may be the most effective option for the implementation of VGT in the music classroom due to its lower costs, accessibility, portability, online capability, and ability to download digital gaming applications.

Key Finding #1.5: To implement VGT successfully in the general music classroom, teachers must be motivated and experienced in introducing the technology in their classes, budgetary resources must be allocated toward purchasing materials, support must be given from administrative personnel, and technical assistance must be available for installation and repair purposes (Squire, 2005; Tobias & Fletcher, 2011).

Research Question #2: How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?

Key Finding #2.1: VGT may be no more or less effective in teaching musical knowledge and skills, compared to other teaching methods. This is based on multiple

factors, such as student engagement, teacher experience, the specific games used, and how the games are incorporated into the curriculum to assess and evaluate students.

Key Finding #2.2: As suggested by Gee's (2007) regime of competence, VGT may not be as effective for reaching educational objectives without the guidance of an experienced and motivated teacher. Scores analyzed from the experimental treatment suggested that the combination of an experienced teacher and games designed for learning are the most effective for reaching the potential of digital game-based learning.

Key Finding #2.3: The experimental data also suggested that VGT should not be used exclusively as the only instructional tool in the general music curriculum to achieve educational objectives, but as combined with other methodologies, including those not involving digital technology.

Key Finding #2.4: Sex did not play a role in differentiating ability levels when achieving musical learning objectives when analyzing scores from the experimental treatment. Student opinions of both sexes acquired from the surveys and interviews were also similar in video game practices and preferences.

Research Question #3: What are the perceptions of elementary school students regarding VGT in their personal lives?

Key Finding #3.1: Data from the survey and interview portions of the study suggested that the greatest motivations for students to play video games included having fun, competing and socializing with others, and testing their ability against difficult challenges.

Key Finding #3.2: Due to students' preferences to play games that feature violent content, the games used in the experimental treatment may not yet possess the ability to engage students on the same level as COTS games.

Research Question #4: What are the perceptions of elementary school students regarding VGT in educational environments?

Key Finding #4.1: Because of some inappropriate content in many current COTS games and the controversies surrounding negative effects of video game play, such as addiction and aggressive behavior, educational games do not currently receive the support needed for school integration (Kutner & Olson, 2008).

Key Finding #4.2: Due to the increasing number of studies and resources dedicated to VGT and learning, in addition to positive perceptions by students collected in the survey and interview portions of the present study on the effectiveness of digital game-based learning, it is likely that VGT will become more accepted in the future (Barab et al., 2009; Denis & Jouvelot, 2004).

It is possible for alternative interpretations of these findings to arise based on different experiences and perspectives of future researchers. Efforts were made in the present study to eliminate researcher bias as much as possible in order to present a methodology that could be replicated in most American elementary general music classrooms. This included aligning the educational objectives of the pretest/posttest design with the New Jersey Department of Education (2014) and National Music Standards (NAfME, 2014).

Administration of both the pretest and posttest was given by audio recording; this prevented any variation or personal interference during the course of the exam. Surveys

were conducted online through TC Qualtrics software without guidance or assistance from the instructor. Interviews were conducted using predetermined questions by an approved faculty member not directly affiliated with the study.

Despite efforts to maintain impartiality and objectivity during the course of the study, it is possible for outside parties to develop alternative views of the presented findings. One possible interpretation is that the iPad games used in the study may be outliers in the case that using other video games designed to teach musical knowledge may not be as effective. In addition, using other examinations other than the pretest/posttest used for this study may elicit different results.

It is also incorrect to assume that the views expressed by the students involved in the survey and interview portions of the present study reflect the views of other students that may be solicited in future replications. Schools representing a different demographic mixture, economic situation, or geographical setting may be contrary to the findings presented in this study. As most of the studies of this nature have been conducted with adults in laboratory environments, it will be necessary for future research to be carried out in similar conditions.

Results may also vary depending on the age of the participants. Middle and high school students may contain vastly different perspectives on the nature of VGT in their home and school use. Prior implementation of digital game-based learning in an established music classroom could greatly affect test scores because of students' experience with games in a learning situation. Conducting similar research outside of public schools, such as private and parochial institutions, could also be a factor in reaching alternative findings.

Finally, time itself may serve as a cause for contrary results to these findings. As the video game industry is constantly changing to shifting demographics and consumer demands, new technologies may become available that cater to music educators and be accepted by the educational community at large. For the past several decades, controversy surrounding the use of video games has stunted their growth in educational environments. However, as more digital natives enter the educational field, it is likely that game designers will develop new games specifically designed to promote the positive benefits of VGT in the music classroom.

Summary

This chapter analyzed and discussed the collective data resulting from quantitative and qualitative information gained from the pretest/posttest control design, survey, and interview responses. Findings were categorized according to the design of the conceptual model introduced in Chapter I. This included applying the results to industry products, stakeholder perceptions, affective behavior, industry controversies, pedagogical considerations, and barriers to educational implementation.

Findings were categorized and summarized according to the structure of the research questions. Alternative explanations of these findings were explored from the perspective of researcher bias and the ability to replicate the experiment in schools of various geographical locations and demographics. Future research of this nature was encouraged to provide further evidence of the effectiveness of VGT in the music classroom.

The following chapter summarizes the study and uses the findings presented in Chapter IV to draw conclusions to the research questions introduced in Chapter I. In addition, recommendations for the creation of an effective video game designed to assist in the teaching of music education are outlined, along with potential integration into an existing general music curriculum. Recommendations and limitations for the implementation of further research are also discussed. The chapter concludes with a brief author's reflection sharing personal views and experiences about the present study and the future of VGT in music education.

Chapter VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Overview

Video game technology has rapidly advanced in both technological and aesthetic design since its inception nearly 50 years ago. Its consumer appeal has steadily increased over the past several decades into a multibillion-dollar industry along with the diversity of players ranging from multicultural, age, and gender demographics (ESA, 2018). Video games do not discriminate across racial, cultural, or gender differences; they have proven to be an international phenomenon that continues to grow and thrive.

It is only natural that video games, due to their popularity and relevance in young people's lives, can be created or modified to serve purposes suited for learning. The act of using game-based structures in educational situations has been practiced by educators for decades (Russell, 2016); using video games may be the next stage in game-based learning or simply an additional tool for teachers. However, a major difference between video games and other forms of gaming are the controversies surrounding the video gaming industry, such as perceived correlations linking video games to aggression, addiction, and violence (Kutner & Olson, 2008).

While some researchers have explored the benefits of using COTS games in the classroom (Gee, 2007, 2013; Squire, 2005), games whose sole purpose is to provide

educational assistance have entered the school environment as a way for students to bridge the gap between learning and fun. However, edutainment games have not yet been widely accepted by educators, administrators, or the general community at large due to the stigmas placed upon them through their connection with some COTS games (Bösche & Kattner, 2011).

The present study was designed to ascertain the nature of video games in educational settings. It aimed to test the viability of games designed to teach musical concepts and skills in the elementary general music classroom. In addition, the study examined the perspectives of elementary-aged students representing multiple demographics and backgrounds of their personal feelings about video games in their homes and in school.

The findings revealed from this study contribute additional empirical evidence to the effectiveness of using digital game-based learning in music education. This chapter summarizes the objectives, procedures, and results of the study, along with outlining recommendations for the application of VGT in music learning environments. Recommendations for conducting future research in this field are also discussed, concluding with a reflection on the potential future of VGT in both education and society.

Summary of Study

The purpose of this study was to examine the educational possibilities of video games designed to teach musical knowledge and skills in an elementary general music classroom. Selected games were compared and tested along with non-digital game-based learning methods such as lecture, class discussion, and in-class composition and

performance activities. In addition, students participated in a survey and interviews to explore common themes on the motivational qualities of video games and the potential for their inclusion in music education.

Many definitions of what constitutes a game have been offered by researchers over the last several years (Egenfelt-Nielsen, Smith, & Tosca, 2016; Kapp, 2012; Koster, 2014; McGonigal, 2011). However, for the purposes of this study, the definition of a game as described by Salen and Zimmerman (2004) was applied, such that a game “is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome” (p. 72).

Aspects of VGT in educational environments were presented as an interconnected conceptual model (see Figure 1) involving elements of games in both commercial and learning atmospheres. This included the different categorizations of industry products, which are divided into games solely created for entertainment purposes (commercial-off-the-shelf, or COTS games) and games designed for educational purposes (serious games or edutainment). The present study used serious games involving elements of entertainment such as animated characters, sound effects, and an engaging virtual environment.

Other aspects of VGT that were discussed as influential were stakeholder perceptions of the viability of video games, as a positive force in both society and in the classroom. This included the potential benefits and consequences of video games’ effects on human behavior. Positive behavioral responses that have been correlated with video game play include motivation, immersion, increased creativity, socialization, and individuality (Annetta, 2010; Gee, 2007; Johnson, 2005; Prensky, 2006; Squire, 2005).

Negative effects of video game play as described by some researchers include an increase in aggressive and violent behavior, and the potential to become addicted to video game play to the point that it has become a classified disorder (Anderson & Bushman, 2001; Gentile, 2009; Ravaja et al., 2005; WHO, 2018). Such differences of opinion have created a large-scale debate about the nature of video games and their place in the digital age.

This study focused on the educational applications of VGT in the music classroom, including the ability of VGT to assist with the creation or achievement of learning objectives as defined by state and national standards. In addition, consideration was given to how to integrate VGT into an existing general music curriculum, and how to properly use VGT to assess and evaluate students formally.

Finally, educational barriers were explored for what prevents teachers and administrators from implementing VGT in the classroom. Reasons such as lack of technical resources, support from administrators, and proper training and professional developments were described for why some teachers are hesitant to utilize VGT (Archbell, 2009; Baek, 2008; Bensiger, 2012).

The study was designed as mixed method using quantitative and qualitative measures of data collection (Creswell, 2014; Tashakkori & Creswell, 2007; Wiersma & Jurs, 2009). Participants engaged in a quasi-random experimental pretest/posttest control design (Creswell, 2014), followed by a computerized survey after the experimental portion was completed. Randomly selected students were then asked to participate in a short semi-structured interview session. Data were triangulated and coded by multiple educational professionals using the constant comparison method (Boeije, 2002).

Participants were recruited from the fifth and sixth grade student body of an elementary school located in the northeastern United States in September 2017.

Participants were ages 10-12 and represented a variety of demographics as determined by information provided by the participating school's Department of Education (NJDOE, 2018). Participants were allowed to be recorded into the data collection after signed consent forms from both the participant and the participant's parent or legal guardian were received.

A total of 92 students from fifth and sixth grade, comprised of 39 males and 53 females, completed the consent forms and were factored into the data collection ($n = 92$). Racial information was also taken into account but not factored into the results of the study. The sample taken represented 49.72% of the total population of fifth and sixth graders from the participating school.

Of these 92 students, 82 completed the pretest/posttest control group design due to absences during one or more of the instructional sessions. Classes were categorized into three groups based on the normal schedule of classes predetermined by the school's administration. All three groups took a Musical Skills and Knowledge pretest (Appendix B) based on several of the combined New Jersey Visual and Performance Arts Standards (NJDOE, 2014) and National Association for Music Education Standards (NAfME, 2014).

After completing the pretest, students in each group received three instructional sessions that took place once every 6 school days over a period of 4 weeks. The iPad group was given preselected iPad educational video games designed to teach and practice the standards presented on the pretest. The non-technology group was not given any

video games to play; lessons were comprised of a combination of teacher lectures, class discussion, and compositional/performance activities. The hybrid group received both video game play and teacher instruction equally. Each class session was 40 minutes in length and was completed without interruptions or distractions.

After the three class sessions were completed, all groups took the Music Skills and Knowledge Test again. Administration of the test was given by audio recording; sounds were played by a neutral musical tone. Students were given 40 minutes to complete the test; no student required additional time or did not finish. Results of the pretest and posttest were tabulated and statistically analyzed for comparison of means, ANOVA, and ANCOVA by group, sex, and grade level using SPSS Statistical Software version 24.

After completing the experimental pretest/posttest control group portion of the study, participating students completed an online survey created with TC Qualtrics. Ninety-two students completed the survey ($n = 92$), with a representation of 39 males and 53 females. The survey was a combination of questions collecting information about the participants' personal use of video games at home and 5-point Likert-style questions regarding the participants' personal views of video games as used in education and the music classroom.

After all participants completed the survey, two males and two females were randomly selected to participate in a one-on-one interview with an educational professional not directly affiliated with the study ($n = 12$). The interview was semi-structured and based on questions predetermined by the researcher. Interviews were recorded on an iPhone 6 using the application Voice Record Pro. After all interviews

were completed, coding was completed separately by the researcher, the interviewer, and the school's principal using constant comparison (Boeije, 2002).

All data collection was complete by June of 2018. Materials including test scores, demographic information, survey results, and interview recordings were secured in a file drawer or transferred to a password-protected computer. Results were calculated immediately after all data collection was completed and coincided with the conclusion of the 2017-18 school year.

Confidence intervals for the pretest/posttest control group design were set to 95% for mean scores. The iPad group achieved the highest mean score for the pretest of the three groups, followed by the non-technology group and the hybrid group. However, mean scores for the posttest showed the hybrid group as the highest scoring group, followed by the non-technology group and the iPad group. A comparison of means revealed that the hybrid group achieved the greatest amount of growth between the pretest and posttest, followed by the non-technology group and the iPad group.

ANOVA and ANCOVA analyses revealed no statistical significance when scores were compared by grade level or sex, leaving the iPad group assignment and difference of instructional design as the primary means of comparison between mean scores. Field notes taken during the instructional sessions observed greater enjoyment and engagement from students who had access to the iPad games. However, the iPad group required more assistance due to its lack of teacher instruction, while the hybrid group received teacher guidance along with the use of the games.

Following the conclusion of the posttest, students were informed of the nature of the study. The iPad and hybrid groups expressed interest in playing the games again and

learning new applications, while the non-technology group showed disappointment that they did not have access to the games and asked if they could play the games themselves. Extra time during class was given after the conclusion of the study for the non-technology group to play as a reward for participating.

Survey and interview data also did not note a statistical difference between responses when categorized by grade level or sex. Males, however, played at home and with friends more frequently than females. Mean scores revealed that students played video games at home on an average of 1-5 hours per week, with or without friends. Popular gaming genres among students included action/adventure games, sports games, fighting games, and puzzle games. Music performance games were listed as rarely played.

The greatest preference of gaming design that motivated participants was the level of challenge the game presented, followed by its gameplay, story, graphics, and musical soundtrack. In application to educational situations, a majority of students believed that video games could be used to learn about music, though less participants reported that they would be interested in seeing more musical video games in school. Playing COTS music performance games was not a motivating factor in pursuing more formal music studies, as the primary reason why students play video games is for enjoyment or to occupy their time.

Individual interviews supported these data, as those who did not believe that video games should be used in school claimed that “they’re not for kids” and are also a distraction from higher priorities such as homework and extracurricular activities. Participants mostly agreed that a video game could be designed for music education, but

would need to include the same kind of engagement present in current COTS games. This would involve creating games with relatable characters, an immersive virtual world, the ability to play and compete with friends, a challenging yet fair difficulty, a scoring system that provides instant feedback, and customization for individual ability levels.

Comparison of the triangulation of data suggested that video game technology is favorable among most elementary school students of both sexes. Students played mostly for the quality of fun, specifically when they had the opportunity to play cooperatively and competitively with each other. Educational games were also received favorably, but not nearly as enthusiastically as COTS games.

Student opinions were divided about the use of video games in educational contexts as opposed to more direct teacher instruction. However, students were enthusiastic about the prospect of designing a game used for music education, especially when given the opportunity to use features present in most COTS games. Most students mentioned they would play the iPad games again and expressed an interest in continuing to play after the study was completed.

It was also suggested that video games are a relevant and integral part of most young people's social culture, with some participants playing over 5 hours per week. While males demonstrated a tendency to play more frequently than females, both sexes enjoy playing similar genres of games relatively equally. Enjoying games designed for educational purposes, however, will remain less in comparison with COTS games until more serious games are created with design principles inherent in successful commercial games.

Conclusions

The guiding questions that shaped the design of the present study were derived from a combination of current educational practices involving VGT, benefits and detriments of adapting video game culture to serve educational needs, and perceptions of stakeholders that could potentially inform the future application of VGT in the music classroom. The conclusions drawn from the quantitative and qualitative data collection may assist in greater acceptance and empirical research of VGT, not just in public school elementary music education, but in all forms of educational organizations.

In summary, the four research questions that directed the study were as follows:

Research Question #1: Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?

Research Question #2: How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?

Research Question #3: What are the perceptions of elementary school students regarding VGT in their personal lives?

Research Question #4: What are the perceptions of elementary school students regarding VGT in educational environments?

The following conclusions were based on the primary findings generated from data collected in order to answer these questions adequately. Findings were categorized based on the temporal nature of the study and compared to prior research in the field.

Research Question #1: Are video games designed to teach musical knowledge and skills effective in the elementary general music classroom?

Mean scores collected during the pretest/posttest control group design suggested that VGT is effective in teaching musical skills and knowledge to elementary school general music students. This was done using edutainment, or serious gaming, iPad applications designed to practice certain aspects of musical concepts. Using edutainment games to form this conclusion cannot be generalized to COTS games, as they are designed for entertainment purposes.

Although previous research has been conducted using COTS music performance games (Arrasvuori, 2006; Arsenault, 2008; Auerbach, 2010; Biamonte, 2011; Mercer, 2009; Miller, 2013; Pepler et al., 2011; Smith, 2004; Tobias, 2012), the results of the present study cannot be used to strengthen their arguments. COTS games were not considered for use in this study primarily because the results of these earlier experiments could not draw any correlations between playing commercial video games and learning music.

Studies involving video games specifically created for learning music contained similar results linking the positive affective behavior of gameplay to the acquisition of musical knowledge (Denis & Jouvelot, 2005; Hämäläinen et al., 2004; Jenson et al., 2008; Juslin et al. 2006; Karlsson et al., 2009; Wechselberger, 2016). It is possible to include the present study as grounds for additional evidence towards their conclusions, but there were differences in this study's design, compared to previous attempts.

All of the games used in prior research were created by the researchers themselves and thus not available commercially. As such, replications of experiments using these specific games are not possible and cannot be verified. The present study used games that are available for purchase by any music educator with iPad technology,

and can be verified independently under similar conditions. In addition, all of the studies described earlier were conducted in laboratory settings, which may have potentially affected the results, as opposed to holding the experiment within the context of the natural classroom environment. Though certain limitations existed by using this method, the results may be more applicable to real-world teaching practices.

When VGT is implemented appropriately by a music educator who is knowledgeable of the specific software and taught effectively so students may manipulate them independently, then VGT has the potential to become a successful instructional tool for music education. This is also determined by factors such as the individual games used in instructional sessions, the technology available for use in the classroom, and the response its implementation receives from stakeholders such as students, parents, and administrative officials.

Research Question #2: How do these games compare to instruction based on class discussion and performance in teaching elementary school students musical knowledge and skills?

Research Question #2 focused on the comparison between using specific games to teach musical concepts and skills and instructional methodologies not involving VGT. These methods included teacher lecture, class discussion, and activities such as composing, improvising, and performing individually and in groups. Based on the considerations discussed previously, VGT may or may not be a more effective method of musical instruction than non-digital game-based learning.

While there are many commercially available games for teaching music, none are currently known to possess the same qualities that draw young people to COTS games.

However, the results of this study shows that VGT may have the ability to engage and motivate students to participate in class. Traits that well-designed video games share include user accessibility, appropriate levels of challenge and difficulty customizability, instant feedback, competitive elements with a system of rewards, and the ability to interact with others competitively and cooperatively.

These elements may not be present in traditional methods of music instruction, especially when instructional settings are centered on teacher instruction and not student interaction. Differentiated instruction may also not be applied to classroom activities due to time constraints or inability to attend to individual needs. Effectively designed video games can enhance activities rooted in musical objectives, promote competition and cooperative learning through social interaction, provide instant feedback with real-time scoring systems, and enable students to customize their experience to best suit their abilities.

Nevertheless, several aspects of VGT are inferior to methods not involving digital games. Results from the pretest/posttest control group experiment revealed that students in the group strictly limited to the iPad games without teacher assistance achieved the least amount of growth between the assessments. This was also supported by the perspectives of some of the students involved in the interview sessions, who preferred the involvement of a dedicated teacher rather than learning from an automated source.

Therefore, the most rational answer to Research Question #2 is that the effectiveness of some video games in the music classroom over other methodologies depends entirely on how it is implemented. Like any educational tool, VGT is not as effective when it is employed exclusively and without the guidance of a designated

teacher. This eliminates a crucial aspect in learning beyond a student's capabilities, which is required to fill the gap between acquired knowledge and potential knowledge, as illustrated in Vygotsky's (1978) zone of proximal development or Gee's (2007) regime of competence. Video games may one day possess the ability to serve as a sole instructional resource, but presently the need for a qualified teacher to design, implement, and assess these resources is imperative for effective student learning.

Research Question #3: What are the perceptions of elementary school students regarding VGT in their personal lives?

Research Question #3 sought to gather the perceptions of elementary school students about their use of video games in both the home and school environment. Through both survey and interview research, several findings were determined based on participant responses. It was assumed that the responses were open and honest as participants were aware that the data collection would be completely anonymous and not reflective of their standing in the general music class.

As the students involved were young enough to satisfy Prensky's (2001) criteria of digital natives, students' use of digital media was similar to Prensky's assessment that children who are born with readily available technology will be more knowledgeable of its use and will manipulate it more frequently. Children's gaming preferences were also similar to those found by some examples of earlier research (Blumberg & Alschuler, 2011; Bourgonjon et al., 2010; Fromme, 2003) in that motivation for gaming included a sense of enjoyment, competition, and passing the time when inactive.

Student perspectives of gender differences were one of the largest divergences from prior research. Gaming served as a way for students to socially interact with each

other, though evidence that children preferred playing with members of their own sex was not observed. Specific gaming genres, such as action/adventure, fighting, and sports games, were enjoyed by both sexes, which contrasted with research claiming that girls preferred more puzzle and strategy-oriented games (Olson, 2010; Peppler, Warschauer, & Diazgranados, 2010).

Research Question #4: What are the perceptions of elementary school students regarding VGT in educational environments?

Students' perceptions of VGT in the classroom were similar to prior research in terms of gaming aspects that appeal to students (Blumberg & Alschuler, 2011; Bourgonjon et al., 2010). Such elements included the relevance of the game to the educational objectives, user-friendliness, customizability, and ability for students to interact with other. Most significant, however, was the element of fun, which seemed to be the most essential quality in the success of VGT. As no known studies focusing on students' perceptions of VGT as applied to music education were available, it is plausible that these same elements would be applicable to all academic subjects, including fine and performing arts.

The uniqueness of the present study's design compared with similar aspects of prior research in this field revealed both similarities and differences when analyzing findings. This suggested that while the application of VGT in the music classroom may possess some of the same qualities in applying this to other academic subjects, age groups, and demographics, considerations must be made exclusively for music education.

The following section applies these findings directly to educational practices in the general music classroom. While the study was created specifically for students in an

elementary school environment, these recommendations may also be appropriate for general music or music appreciation classes at higher grade levels. The success of this implementation in various settings will, as always, depend on the individual factors that constitute an effective educational tool.

Recommendations for Educational Practice

Video games, regardless of purpose, have the same basic constructs in that they all possess the qualities inherent to games. This was defined in Chapter I by Salen and Zimmerman (2004) as “a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome” (p. 72). Whether designed for entertainment or educational reasons, the nature of the game must provide some kind of structure in which players have a recognizable objective, a system of rules that provides a clear path to achieving that objective, and immediate feedback that allows players to determine if they are achieving the objective.

The video interface can vary depending on the technological needs and availability of peripheral products. For example, many video game consoles made by companies such as Sony, Microsoft, or Nintendo do not come with visual interfaces, in which the user would be required to connect the system to a television or computer. This has in part been rectified by the development of portable devices, such as the Sony PSP, Nintendo DS, and Nintendo Switch, to name a few, which have small built-in monitors so that an external visual interface is not needed.

In the classroom setting, this may not be ideal considering that only one student has the ability to use the system at a time. For group-oriented lessons, projecting the

console onto a Smart Board or external television may be the only viable option.

However, students and teachers would not be able to use the touch-screen feature of the Smart Board as it would only serve as a projector. Controlling the game would still have to be accomplished by using a controller or keyboard.

This is why using iPad or Tablet products may be the most effective form of technology currently available for digital game-based learning. iPads do not require a separate visual interface, nor do they need separate peripheral controllers or other external accessories such as a keyboard, a mouse, or multiple wire connections. The only wire connection needed is to charge the battery and connect the iPad to a computer, which allows for the back-up of data. Another reason why iPads are preferable to console systems is that consoles normally require the purchase of games as external software packages, whereas iPads can download games directly from the internet.

In addition, most games designed for console systems take up a large amount of memory as games increasingly take a longer time to complete. This can range from anywhere between 2 to over 100 hours of game play. A typical General Music class that meets sporadically would not have the available time to complete even one console-based game. In the case of the present study, students met for class once every 6 school days for a 40-minute period for the duration of the school year. This calculates to approximately 35-40 class sessions per year, or a maximum amount of 27 hours for the entire school year. Most current generation games require much longer than this to complete and would not be suitable for designing an entire curriculum around.

Many current game controllers have over a dozen different command inputs that can easily confuse and alienate users who have limited experience with games. This can

also serve to discourage “digital immigrant” teachers who are not familiar with that specific technology. iPads, however, can accommodate a variety of applications and games that are designed for portability in a simple, user-friendly touch-screen interface. iPads can also be projected onto a Smart Board or computer for larger, whole-class lessons, though Smart Board technology has not yet developed the ability for a touch-screen interface when an iPad is projected and still must be controlled by the iPad itself.

The cost-effectiveness of iPads as opposed to purchasing a console system is more affordable when taking into account budgetary concerns for public school music programs. To allow each individual student to access the games used in the study simultaneously, the school provided an iPad cart as needed. The cart was available to all teachers and could be reserved ahead of time. Installing the specific applications required communication with the school’s information technology department, who was contacted several months before the pretest/posttest experimental phase.

Using a commercial console system for the experimental phase would have required a separate system for each student, a television interface, and controllers. In the case of studies conducted using music performance games such as *Guitar Hero* or *Rock Band* (Auerbach, 2010; Pepler et al., 2011), a specialized controller resembling a guitar would need to be purchased separately at a larger cost. A search on Amazon.com revealed the combined cost of a new PlayStation 4 system, a *Guitar Hero Live* game, and a *Guitar Hero* controller as approximately \$550.00. A new 2017 model iPad viewed on the same site cost \$313.60.

This example illustrates not only the cost-effectiveness of using iPads for digital game-based learning, but accessibility through school resources. The only financial

considerations involved with the present study were purchasing the applications used during the lessons between the pretest and posttest. The combined cost of downloading each of the five games was approximately a total of \$7.00 per iPad (*Rhythm Cat* and *Melody Melody* had free versions available). This amounted to a total cost of approximately \$175.00 for five individual games on 25 iPads.

Due to its cost-effectiveness, accessibility, online capability, portability, and user-friendliness, iPads were the most effective means of teaching musical concepts with video games. Use of iPads as opposed to commercially-based consoles may also serve to reduce the stigmas placed on video games because iPads are becoming an increasingly essential resource for classroom teachers of all subjects. Currently, there is also a greater abundance of games available for iPads that are designed for educational purposes, as opposed to those created for consoles strictly for entertainment purposes. These games, as introduced in Chapter I, are known as commercial-off-the-shelf (COTS) games and are also available on iPads.

COTS games, though reported as extremely popular with students, have limited to no ability to teach musical knowledge. Music performance games in general, reported by previous studies as helpful in attracting students to pursue more formal music studies (Arrasvuori, 2006; Mercer, 2009; Miller, 2013; Pichlmair & Kayali, 2007; Reyher, 2014), are becoming less popular and are not regarded by students as engaging as other game genres. Games that were mentioned as popular with students in both the surveys and interviews included action, especially first-person shooters, adventure, and sports games.

This information was similar to the top five best-selling video games of 2017 as reported by the Entertainment Software Association (ESA, 2018). In the report, the first

three best-selling games were either first-person shooters or action/adventure games where the player uses guns to kill non-player characters (*Call of Duty: Infinite Warfare*, *Battlefield 1*, and *Grand Theft Auto V*). The other two best-selling games were both sports games (*Madden NFL 17* and *NBA 2K17*). Since including violent content would not be considered appropriate in video games designed to teach musical knowledge and skills, it may not be possible to achieve the kind of popularity with an educational game that is reflected by students' current game preferences.

The increasingly realistic depiction of real-world violence in games may have impacted the perspectives of some of the participants to determine that video games are designed for older audiences. Game designers may indeed be marketing products for adult gamers, considering that the age of the average male gamer was 33 and 37 for females in 2017 (ESA, 2018). Since COTS games account for the majority of revenue in the video game industry, COTS games have received the most attention from consumers and society at large. Though music performance games may be a subset of COTS games, they have diminished in popularity and accounted for only 4.1% of video game genres sold (ESA, 2018).

COTS games with the same structure of *Guitar Hero* and *Rock Band* are available for iPads, most notably *Magic Piano* and *Piano Tiles*. Several interview participants mentioned these games as enjoyable to play, but only as recreation and not to learn any musical skills. The games also did not seem to encourage students in receiving a more formal music education, such as taking piano lessons or learning music notation. Studies using iPad COTS games to determine whether musical concepts can be taught through

digital game-based technology have yet to be conducted, but it is likely that they will draw the same conclusions as studies using console-based COTS games.

Assuming that extraneous factors such as individual student access to technology, support from administrative officials, and proper professional development training are satisfied, the success of incorporating VGT into the music classroom rests mostly on the quality of games used and their relevance to the music curriculum. As mentioned earlier, regardless of their general inability to teach or assist in instruction, using COTS games is not practical due to their cost and requirement to interface with a dedicated console.

This would entail purchasing a system such as an X-Box, PlayStation, Nintendo, or other gaming console. Some games can be played using a personal computer or laptop, but most COTS games available for this system take up an enormous amount of memory and require a more rapid processing speed than computers that are not designed for gaming can maintain. In addition, educators may wish to focus on games that can be completed within the confines of one or multiple class sessions, particularly games that can be played multiple times in order to practice and improve musical skills.

This section details recommendations for well-designed video games in music education and how they can be integrated into a new or existing curriculum. Many aspects of well-designed educational games can be drawn from previous research using games outside of music education. These suggestions can also be combined with results from the previous study, including students' perceptions gathered from the survey and interview data.

Choosing a video game or series of video games to use in the classroom, regardless of subject, lies primarily in the juxtaposition of balancing educational

objectives with the sense of enjoyment. As McGonigal (2011) described, the initial difficulty is that part of what contributes to a game is that it must include voluntary participation. Being assigned to play a video game as part of a classroom evaluation or grade may lower the amount of student motivation to engage fully.

A possible solution to this is to accentuate the aspect of fun of playing the game rather than explain the educational purposes first. If successful, students will be so entirely focused on enjoying the game itself that learning will occur naturally. This mirrors Prensky's (2001) concept of stealth learning, but Prensky himself acknowledged that edutainment may never reach the same level of motivation currently achieved by COTS games. This does not necessarily mean that students cannot gain the same type of enjoyable experience using video games to learn music, as long as the game's design aspects possess features that are contained in successful COTS games.

Based on results from the survey, the most engaging characteristic of video games was the level of challenge presented in the game's design. This also reinforced the sense of competition that created a sense of intrinsic motivation within participants during the instructional sessions. The challenge of a game can be created by a design involving a player vs. system structure, which was present in the iPad games during the pretest/posttest control group phase. It can also involve a player vs. player or players vs. players structure, which would increase the amount of student interactivity and social interaction, allowing students to work together or against each other in an environment based on rules and procedures.

For this to occur, an online connection would need to be available and maintained through the school's technology department. To achieve the type of student interaction

necessary to promote motivation through challenge and competition, the game would need to function much like a massively multiplayer online role-playing game (MMORPG) similar to *World of Warcraft* or *Lord of the Rings Online*. These games are played through a connection to an online server, which normally requires a paid subscription on a monthly or annual basis.

The subscription allows users to purchase a certain amount of licenses for students to have unlimited access to the game both in school and at home at their convenience or as part of a structured lesson. A potential disadvantage to this method may be the overall cost, since general music teachers normally teach every student in the school over the school year and would require individual licenses for each one.

A solution for this would be to choose games that are free for student use, a practice already implemented by the online game *Prodigy* (Prodigy Team, 2015). *Prodigy* uses a Pokémon-style player vs. player and player vs. computer battle system that requires students to answer math questions correctly in order to win. Winning a battle earns access to rewards that can be used to upgrade the player's character, which can be used in subsequent battles. This occurs in a virtual fictional world where players can roam around and interact with other players in a social MMORPG environment.

Adapting a game such as *Prodigy* to serve a music educational objective may be possible, but currently no known online games exist with that purpose. The iPad games used during the present study did not contain any fictional worlds for students to explore; thus, the creation of a MMO music education game may achieve more success than current music edutainment games.

The creation of a virtual universe may also increase immersion, as players may experience a suspension of disbelief that can progress into a flow state. This could be accomplished by combining an engaging and intricate world design with a customizable level of challenge and social interaction. Another appealing aspect of gaming is the opportunity for players to create new identities by immersing themselves in fantasy. This has been considered a major aspect of development and a central tenet of game-based learning (Caillois, 1958; Huizinga, 1950; Piaget, 1962).

Other aspects inherent in a game's design includes a scoring mechanism that provides instant and unambiguous feedback that can be interpreted clearly by both the student and the instructor. Teachers should be able to use the feedback provided by the game to assess and evaluate students based on specific educational objectives designed by the teacher and tested by the game. However, failure to achieve these objectives should be followed by the opportunity to reattempt that specific goal, allowing for the player to accept failure as a part of the learning process and be motivated to try again.

In summary, intrinsic design concepts that educators should look for in a well-designed game are the following:

- ability to practice specific educational objectives with the assistance of an instructor;
- encouragement of active learning by promoting simple, user-friendly gameplay;
- allowing students to progress at their own pace and customize difficulty levels;
- adequate challenges by competing with the system or other players;

- a scoring system that provides instant and clear feedback; and
- engagement of learners by including elements of fun such as characters and a storyline.

Games that possess these elements have the potential to be effective tools for education in any subject. Specific aspects of music education, such as rhythm, pitch, aural perception, history, theory, composition, and other areas, can be adapted into a game-based format and used in any general music curriculum that has access to the appropriate technology and support from administrative officials.

The success or failure of incorporating VGT into a music curriculum depends largely on the support of its implementation by all affected parties. Acceptance or ‘buy-in’ to a curriculum involving the use of digital game-based learning must be offered by three distinct groups. These groups include the faculty and administrative staff who will teach and supervise instruction of the curriculum, in addition to choosing specific software and its application to musical objectives. In addition, the community, represented by a Board of Education, must approve all changes to curriculum and instruction, especially when considering budgeting for new technological materials.

Bensiger (2012) provided evidence that video games are generally popular among preservice teachers. Considering the amount of time that has elapsed since then, it is likely to assume that as more individuals enter the teaching field, VGT will also become more present in teacher training programs. The implementation of techniques and teaching strategies through digital game-based learning can be included in any music education technology department, which many certification programs currently offer. VGT in music education can be included into any music technology course or developed

as a standalone course or set of courses. Given the increasing amount of research highlighting the effectiveness of digital game-based learning, it would not be surprising to see an increase of teacher education programs that incorporate VGT into their curriculum.

Members of the community can also be influenced by the perception of video games in larger society, particularly its perceived negative aspects as reported in mass media. Finally, the students themselves must be engaged by the proper application of VGT and its potential to teach, rather than simply playing video games that are solely meant for entertainment and are not designed to meet educational objectives. If all three groups are in agreement on the positive benefits of VGT in music education, there is a strong likelihood that incorporating VGT into the curriculum may be successfully integrated. Figure 11 illustrates the interconnected nature of these stakeholders and their individual contributions.

Though the perceptions of VGT in the music classroom of teachers, parents, and members of the community was beyond the scope of the present study, there is evidence based on prior research that VGT will become more accepted in the future. The most significant examples of this are the growing trend toward digital natives entering the educational field (Prensky, 2001). The preservice teachers that Bensiger (2012) interviewed were the most enthusiastic about implementing VGT in their classrooms and would likely be active, more experienced teachers at the present time.

A report by the ESA (2018) reported the average gamer at 34 years old, with the 18-35 age demographic as representing the greatest portion in both males and females. As many of these teachers continue their careers in school administration, it is likely that

support for VGT will increase as well. However, support for VGT will depend largely on not only the demonstrated success of games to achieve educational goals, but also the public's perception of video games as related to both positive and negative aspects of behavioral implications.

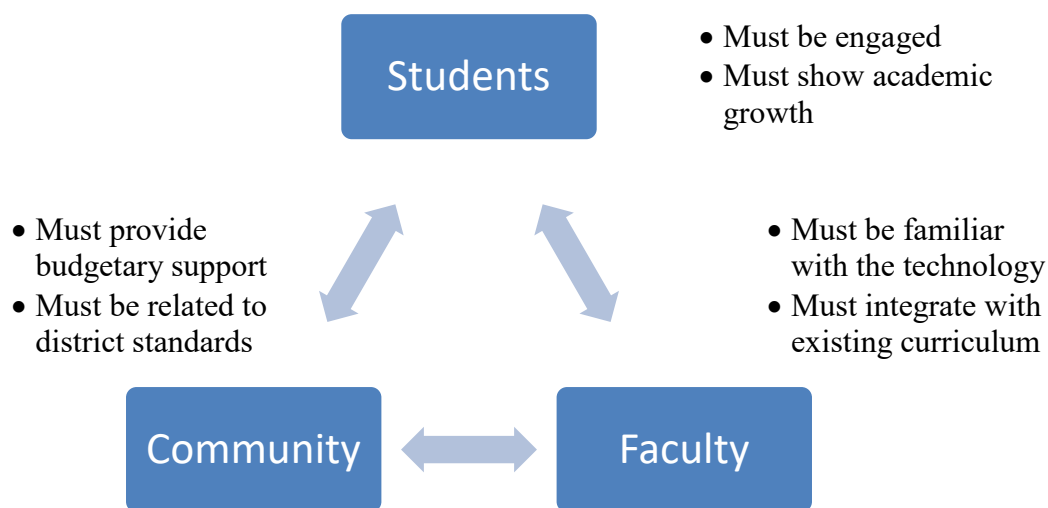


Figure 11. Diagram of educational stakeholders

Implementation of VGT into a new or existing curriculum will depend mostly on the state or national music standards accepted by the school's department of education. For the purposes of this study, a combination of the New Jersey Visual and Performing Arts Standards (NJDOE, 2014) and the National Association for Music Education Standards (NAfME, 2014) was used to test the ability of VGT to achieve selected educational objectives.

The video games chosen for inclusion in the study had to satisfy the requirements of achieving those standards before any other considerations. In addition, they had to provide a way for students to demonstrate the desired skills so they could be evaluated

for how effectively they had reached those standards. Recalling that VGT is ultimately another tool for teaching music, in addition to other materials as shown to be effective in individual classrooms, the choice of a video game or whether to use a game at all to teach a certain musical concept will always depend on what is the most effective method selected by the teacher.

Most current educational video games focus on a single concept or standard, such as the games selected for use in the present study. This requires the game to fit into the objectives of an existing curriculum by inserting it into the timeline of a single unit or multiple units. If the game is designed to practice several music standards, then the instructor has more opportunities to use the game more often during class. This may give students more opportunities to gain proficiency and assess their growth within an objective or group of objectives.

The selection of a video game to use in the music curriculum must be connected to the educational objectives provided by the state or national standards of that particular district. How and when VGT should be applied within the curriculum will depend on the teacher's preferences and experience. Taking all of these facets into account when deciding to implement VGT in the music classroom will be the decisive factor for its success or failure in achieving educational goals.

Recommendations for Future Research

The viability of VGT in both the music classroom and all academic areas can only be reinforced with the continued application of empirical study and research to the educational potential of video games. Claims stating that video games are responsible for

negative consequences have implied causality when they can only be correlated as a possible influence on affective behavior (Anderson & Bushman, 2001; Anderson & Dill, 2000; Bösche & Kattner, 2011; Buchman & Funk, 1996; Carnagey & Anderson, 2005; Funk & Buchman, 1995; Gentile, 2009). Because of this and other stakeholder perceptions, more evidence-based research is required to further rational arguments focusing on VGT and learning.

To contribute further valid evidence to the effectiveness of VGT, more studies must be conducted outside of a laboratory environment and inside the classroom. Additionally, participants representing a variety of ages younger than university students should be used to provide a wide range of data. This extends to gathering information from both public and private schools containing diverse demographic backgrounds, including race, gender, and economic strata.

Longitudinal studies may also be beneficial to ascertain students' perceptions of VGT over time, in addition to how VGT is being used in the music classroom at different grade levels. Since the video game industry is continuing to progress at a rapid rate, new technologies will likely be available as students progress through school. Examining virtual reality games, social media games, and online co-op games are just a few examples of how future studies can branch out from the general subject of VGT.

Future studies may also wish to compare the impact of COTS games as compared with the learning possibilities of edutainment games. This would also merit the use of a similar pretest/posttest control group design and survey/interview data. As VGT studies in music education are still relatively in their infancy, there are many opportunities to contribute empirical evidence to the digital game-based learning field.

Limitations that arise from conducting similar studies include the need to reduce or eliminate researcher bias. The present study took several measures to ensure impartiality, but the results may be interpreted differently by others as the participants were the researcher's own students. Future studies may benefit from a more random selection, but this may be difficult if the study is to mirror the environment of the natural classroom, particularly in possible longitudinal studies. Teachers who wish to contribute to this field of knowledge in the future can engage in their own action research using games they are familiar with, or conduct experiments with either a laboratory or natural classroom environment.

In addition, access to materials may depend on the availability and access of technology as determined by the school's administration. The present study acquired access to an iPad cart which facilitated the number of students involved, but only because it was reserved several weeks in advance. Future studies will need to consider the availability of the necessary technology, including hardware, specific games to be used, and technical assistance, should the need arise.

When working with minors, parental consent will be mandatory. This may limit the number of participants who may enter into the data collection. Smaller samples which have been used in prior research (Denis & Jouvelot, 2005; Hämäläinen et al., 2004; Pepler et al., 2011) cannot give compelling evidence, compared to using a larger sample. Although 185 students were enrolled into the fifth and sixth grades at the time of the study, only 92 were factored into the data collection due to lack of the submission of the parental consent form. Parental and community support may need to be measured before undertaking future studies of this nature.

With proper planning and attention to ethical procedures, future research involving minors may be successfully conducted. Studies of this nature may also benefit from involving multiple researchers to assist in the coding and triangulation of data. The present study included a professional music teacher and school administrator employed within the district but not directly affiliated with the study to assist in the coding of interview data. Multiple researchers may eliminate the need for outside personnel and allow for a greater range of data collection.

Finally, future studies must ensure that subsequent researchers can attempt the replication of specific research. It was the intention of this researcher that the methods used could be applied to most general music programs with different demographics and geographical locations. Given access to the necessary technology and support from district stakeholders, future experiments of this nature may be attempted with success. As such, another objective of this study was to encourage future music educators to carry out their own research in VGT to add their own empirical evidence to this emerging field. With the undertaking of new and innovative research into digital game-based learning in the music classroom, new questions will arise about the nature of VGT and how its continued development will influence students and the educational process as a whole.

Summary

This chapter reviewed the purpose, methodology, and findings of the present study. Conclusions based on the guiding research questions were discussed in comparison with results determined from previous research. This research was not confined to music

or arts education alone, but spanned across multiple academic subject areas and found common threads linking both positive and negative aspects of VGT in the classroom.

Recommendations for the practical and theoretical application of VGT inside the general music curriculum were offered, in addition to thoughts regarding the design of an effective video game designed specifically for music education. Recommendations for the implementation of future research were also encouraged, specifically in context to its focus, logistics, ethics, and limitations. This chapter concludes with a brief reflection sharing some of the author's thoughts during the process of this study.

Video game research has much further to travel before any conclusions regarding its merits in music education can be seriously considered. It is encouraging to witness an increasing number of studies devoted to digital game-based learning, many of which apply directly to music learning. The continued development of VGT will no doubt be instrumental in directing future research as well as its influence over students, teachers, and the educational community at large.

Author's Reflection

Prior to the beginning of this study, I contacted several prominent members of the video game research community for their recommendations on how to proceed. I began an e-mail correspondence with Kurt Squire and James Paul Gee, whose writings helped to inform the direction of my research. I also had a lengthy phone conversation with Mark Prensky, who was kind enough to share his time and opinions as I formulated the plan for what eventually became this study.

While these individuals were extremely helpful in providing me with the direction in which I wanted to proceed, the application of digital game-based learning had not been so explored to the degree that these dedicated researchers had yet explored. Thus, it was exciting and a bit intimidating to diverge from the mainstream research of VGT as applied to general education in order to focus more on how it could be applied to arts education.

I am not saying that this research is in any way groundbreaking or revolutionary in nature. Simply, I hope this provides encouragement to future researchers who would like to open the door further. I personally was encouraged by my professors, my friends, and especially my family, whom I would like to thank again for all their unwavering support during this journey. Though this may be the conclusion of this particular journey, the quest for knowledge will never be 'game over,' especially when there is always so much more to play.

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Appendix A

Parental Consent Form—Introductory Letter

September, 2017

Dear Parents/Guardians:

I would like to ask your permission in involving your student as part of my doctoral research at Teachers College, Columbia University. I am studying the effects of educational video games on learning music skills, and I will be designing lessons to test student knowledge using various iPad applications. I will also be conducting surveys and interviews to collect information on student perspectives regarding video game use, preferences, and its ability to teach in educational environments.

This research will be conducted as part of the normal General Music curriculum lesson structure, and will in no way interfere with students' other classes. In addition, no personal information will be circulated; all data will be collected anonymously and records will be destroyed at the conclusion of the study.

It is my intention to use the data collected from this study to increase awareness of digital media in educational practices. If you require more information or have any questions/concerns, please contact me at the phone number above or by e-mail at alessler@burlington-nj.net. Thank you in advance for your assistance, and I look forward to receiving your favorable response.

Best regards,



Andrew Lesser, M.M.
Director of Vocal/General Music

- Please fill out completely -

Name of Student _____

Grade _____

I authorize my student to participate in the above research study. I understand that any information gained from participation in this study will be confidential and will not be released to the general public. I give Mr. Lesser permission to conduct lessons, surveys, and interviews with my student at selected times during the 2017-18 school year.

Signature of Parent or Guardian _____ Date _____

Appendix B

Pre-Post Test

Name _____

Part 1: Rhythm*Directions: Listen to the three examples of rhythms and choose the correct one by circling the letter.*

1. 

2. 

3. 

Part 2 - Melody*Directions: Listen to the three melodies and choose which one is the correct one played on the piano.*

4. 

5. 

6. 






Part 3 - Pitch

Directions: Listen to the three notes and choose which note is the same one as the match note.






- | | | | |
|-----|--------|--------|--------|
| 7. | Note 1 | Note 2 | Note 3 |
| 8. | Note 1 | Note 2 | Note 3 |
| 9. | Note 1 | Note 2 | Note 3 |
| 10. | Note 1 | Note 2 | Note 3 |

Part 4 - Music Notation

Directions: Identify the letter name of the notes in the blank space below:

11.	12.	13.	14.	15.
				
_____	_____	_____	_____	_____

Directions: Identify the correct rhythm of the notes by circling the correct answer:

16.	17.	18.	19.	20.
				
A. Whole note B. Half note C. Quarter note D. Eighth note E. Sixteenth note	A. Whole note B. Half note C. Quarter note D. Eighth note E. Sixteenth note	A. Whole note B. Half note C. Quarter note D. Eighth note E. Sixteenth note	A. Whole note B. Half note C. Quarter note D. Eighth note E. Sixteenth note	A. Whole note B. Half note C. Quarter note D. Eighth note E. Sixteenth note

**When you are finished, put your pencil down and raise your hand so I can collect your paper.
Please do not call out or make noise so others still taking the test are not disturbed.**

Appendix C

Survey Questions

1. Please indicate group letter:

A

B

C

2. What is your grade level?

Fifth grade

Sixth grade

3. Are you male or female?

Male

Female

4. Please indicate your racial identification:

White

African-American

Latino

Asian

Native American

Other

5. How often do you play video games?

Never

Rarely

Sometimes

Often

Always

6. How much time per week do you play?

Never

Less than 1 hour

1-2 hours

3-5 hours

More than 5 hours

7. How often do you play games with friends?

Never

Rarely

Sometimes

Often

Always

8. How often do you play these types of games at home?

Never

Rarely

Sometimes

Often

Always

Action/Adventure

Educational

Fighting

Music

Puzzle

Shooter

Simulation

Sports

Strategy

9. How many people play video games in your household?

One

Two

Three

More than three

10. What is the most important part of a game to you?

Gameplay Sound/Music Graphics Story Challenge

11. Do you play online multiplayer games? Yes No

12. How often do you play music video games (like Guitar Hero and Rock Band)?

Never Rarely Sometimes Often Always

Strongly Disagree **Disagree** **Neutral** **Agree** **Strongly Agree**
1 **2** **3** **4** **5**

13. I think video games can be used to learn things.

1 **2** **3** **4** **5**

14. I think video games can help teach me about music.

1 **2** **3** **4** **5**

15. I only play video games when I am bored and need something to do.

1 **2** **3** **4** **5**

16. I think educational video games can be fun and enjoyable.

1 **2** **3** **4** **5**

17. Playing music video games make me angry.

1 **2** **3** **4** **5**

18. I want to see more educational video games in school.

1 **2** **3** **4** **5**

19. Playing video games makes me want to learn more about music.

1 **2** **3** **4** **5**

20. Playing games like Guitar Hero makes me want to try a real instrument.

1 **2** **3** **4** **5**

Appendix D

Interview Questions

1. Do you play video games?
- 2a. (If yes to #1): Why do you play video games?
- 2b. (If no to #1): Why don't you play video games?
- 3a. (If yes to #1): Do you play with friends? How often?
- 3b. (If no to #1): Would you play more video games if your friends played?
- 4a. (If yes to #1): What kinds of games do you like to play?
- 4b. (If no to #1): Do you think you would be interested in playing video games in the future?
5. Have you ever played any music games outside of class? If so, which ones?
6. Do you like playing the music games on the iPads during class? Why/why not?
7. What are the most important qualities that you feel should be in a game?
8. Do you think video games should be used in education? Why/why not?
9. If you were designing a game to teach music, what would you have in it?
10. Would you rather learn music from playing video games or other activities? Why/why not?