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Not Created Equal: The Effectiveness of Two Types of Educational Computer Games

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NOT CREATED EQUAL: THE EFFECTIVENESS OF TWO TYPES OF EDUCATIONAL COMPUTER GAMES

by

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ABSTRACT

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The purpose of the study is to compare two types of educational video games based on Malone's (1984) theory of *challenge, curiosity,* and *fantasy.* The participants were 136 students from a community college in the southeastern United States. The study used a quantitative approach with participants randomly divided into two groups, one playing each of the two games. Participants were given a brief introduction to a list of French phrases and words, took a pre-test, played the selected game, and then took a post-test to assess content knowledge gain. Brockmyer et al.'s (2009) Game Engagement Questionnaire was used to assess game engagement, a demographic questionnaire to address whether gender, minority status, or socio-economic status affected content knowledge or engagement, and an open-ended question to allow for any additional responses.

MANCOVA and follow-up ANCOVA found no significant differences in content knowledge gain or engagement between participants playing the two games, regardless of gender, minority status, or socio-economic status. Additionally, there were no significant differences between pre-test and post-test scores, indicating that neither game proved effective for teaching the material. Although not effective as a teaching tool, the games could be a tool for study and practice to reinforce material that had already been introduced. Additionally, the difficulty of the games may have frustrated the participants,

causing them to learn less and eliminating any differences in engagement.

Implications for educators include the importance of providing ample practice time to learn the mechanics of learning games, providing sufficient time or repeated exposure to learning games for them to be effective, reserving drill-and-practice games for reinforcement rather than teaching, and ensuring that games' difficulties are in line with student expectations and abilities. Further research could be conducted comparing two short casual games played repeatedly over the course of a semester comparing multiple class sections, testing a multi-platform mobile game for effectiveness and participants' willingness to play outside of class time, comparing two longer-playing, user-directed games of the sort championed by Gee (2005) and Harel and Papert (1991), or comparing shorter, casual learning games to longer, in-depth learning games.

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DEDICATION

I would like to thank and dedicate this dissertation to my amazing daughter, Kaitlyn, who was born during the process, and to my equally wonderful wife, Katherine, who has encouraged me even when I did not want to be encouraged. I want to thank my parents, as well, for encouraging my education from childhood.

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CHAPTER I

INTRODUCTION

This chapter discusses the widespread penetration of digital gaming into American culture in general and in American education specifically. Some dominant theories of educational game design are also explained in this chapter to help establish a theoretical base for examination. The chapter explores a gap in the research, namely the experimental comparison of different educational digital games with regard to engagement and content knowledge gain. This study also investigates the gap in research by exploring relationships between different games, gender, minority status, and socio-economic status with regard to content knowledge gain and engagement.

Experimental research not only forms the basis of a body of knowledge that can not only help educators choose and construct digital game-based learning products but also help refine and expand upon existing theory. Through experimental comparison of two educational digital games, only one of which conforms to Malone's (1984) theories of engaging design, the researcher attempts to determine whether differences exist in content knowledge and engagement, and whether those differences are related to the gender, socio-economic status, and minority status of the participants. Through the use of open-ended responses, the researcher attempts to explain the reasons behind the quantitative results and any additional concerns or thoughts the participants may have.

This dissertation study focuses on short, simple games that can easily be integrated into existing classroom scheduling structures through the use of centers or rotating computer time. These games can be freely and legally downloaded by students who desire further practice outside of the bounds of the classroom.

This chapter first addresses the background of educational gaming and related theoretical principles that lead toward explaining the research problem and purpose. Research questions and hypothesis are then provided and used to help guide the methods of this research study. The chapter concludes by defining important terms, clarifying the study's delimitations and assumptions, and reiterating the practical and theoretical justifications for the study as a whole.

Background

The digital gaming industry is a ubiquitous part of the American cultural landscape; four out of five households in the United States have a device that can play digital gamers (Entertainment Software Association, 2015), and 97% of American teenagers play video and computer games (Lenhart, et al., 2008). There has likewise been great growth in the area of educational video and computer games aimed toward the home market. Leapfrog is one example. Founded in 1995, its products are currently sold in over 45 nations worldwide and used in many classrooms (PR Newswire, 2011). Although some may assume that students and young people are most strongly concerned with the gameplay and graphics of learning games, Iten and Petko (2016) found no correlation between anticipated enjoyment and willingness to play a serious learning game, but a significant correlation between the students' perception of the educational value of the game and their willingness to play it. In short, the students wanted to know what the learning game could teach them, not whether it could compete in terms of entertainment value.

There has been a long popular perception of video games as largely being the purview of young males. Game covers, promotional materials, and the contents of some

games carry sexist, alienating messages. As Burgess, Stermer, and Burgess (2007) discovered, women were absent on the majority of video game covers and significantly more likely to take passive roles as characters. Also, they have both exaggerated sexual characteristics and revealing clothing than male characters. These findings held true when the researchers removed from their analysis those games that would not reasonably expect female characters to participate such as those set in the National Football League or World War II battlefields.

Despite lingering stereotypes and sexist depictions, women and girls do play video games. According to game industry statistics, not only were 40% of game players female, but "women age 18 or older represent a significantly greater portion of the game-playing population (33%) than boys age 18 or younger (15%)" (Entertainment Software Association, 2015, p. 3). Casual and social games were the most popular online games, with a 30% share of online game play, and the most popular mobile games, with a 46% share of mobile game play (Entertainment Software Association, 2014, p. 5). Further, the majority of players of casual games are women (Casual Games Association, 2010).

Research has found that female students do engage with video and computer games, so long as the content is inviting to them. As Riemer and Schrader (2015) discovered, female students anticipated both more positive outcomes and more difficulties in using and adapting to serious learning games, but were as willing to engage with learning games as male students. Furthermore, male students will not disengage themselves from female-friendly games (Andrews, 2008; Annetta, Mangrum, Holmes, Collazo, & Cheng, 2009). One such example is *Phoenix Quest*, a mathematics and language game that features a female protagonist and focused on problem-solving and

communication, without any violent component. Although boys and girls approached the game differently, students of both genders had overall favorable opinions of the program (De Jean, Upitis, Koch, & Young, 1999).

Female players often play different games than their male counterparts. Andrews (2008) found that female high school students favored casual games more often than male students, supporting the data from the Casual Games Association (2010). Female players also played alone more often than male students, who often played online or at their friends' houses (Andrews, 2008; Lenhart, 2015).

Although people of all races and ethnicity play video games, a recent Pew Research Study discovered few areas of difference in video game play between American teenagers of different races. While Hispanic and African-American teenagers were more likely to play video games alone than Caucasian teens, and were less likely to be involved in online groups such as Massively Multiplayer Online Game guilds, 97% of teens of all races played video games frequently, with many playing every day (Lenhart et al., 2008).

Students of all socio-economic statuses (SES) play video and computer games, but they do not necessarily play the same games in identical ways. According to a South African study of students of English as a Second Language, high-SES students preferred strategy games such as adventure role-playing games and logic puzzles, while low-SES students preferred twitch games such as arcade or combat games (Herselman, 1999). Andrews (2008) found similar differences between American students at two high schools: one high-SES and one low-SES. Low-SES students preferred console games and actively disliked non-casual computer games, citing complicated controls. Likewise, low-SES students were less likely to play online, but more likely to use portable game

consoles. Low-SES students of both genders expressed a strong preference for sports games, while high-SES students did not have a single genre that dominated their interests. Elliott (2014), however, found low-SES students willing to engage with *Minecraft*, a longer, more complex game, within the context of class instruction. The class's *Minecraft* assignments included planning and building a town, and were presented in a collaborative and non-linear format befitting the game's open-world nature.

Educational video games are an undeniable part of the cultural landscape, and as such, have become a part of the educational landscape. The question is not whether video and computer games are used for educational purposes, but how to maximize the benefits of their use. As Papert (1998) notes, not all educational video games are created equal, and in order to be a good educational video game the game in question must first be a good video game. The difficulty of mastering a video game is part of its appeal, and games that are too easy often fail to engage their target audience.

Students of several different ages in several countries have demonstrated increases in student engagement with learning. They also have equal or greater content knowledge gain when using computer and video game-based learning methods as opposed to using traditional methods of instruction. Chang and Chen (2009) studied 115 third-grade students in Singapore, 57 of whom played a computer game and 58 of whom used text-based computer-aided instruction. The researchers found both increased engagement and content knowledge gain in students that played the computer game. Hwang, Chiu, and Chen (2015) found similar results with 87 Taiwanese sixth grade students, with significant gains in learning, motivation, and satisfaction among students learning through gameplay. Rosas et al.'s (2003) study of first and second grade students

in Chile showed significant gains in time on task and significant reductions in disciplinary problems when using video games. However, there were no significant changes in content knowledge outcome when video games were played in lieu of traditional instruction during regular classroom hours. Ku, Chen, Wu, Lao, and Chan (2014) however, found significant differences in confidence and mathematical ability gains between game-playing fourth-grade students and those undertaking traditional instruction, and found these differences to be most pronounced among students with the lowest starting ability levels.

Similarly, Ebner and Holzinger (2007) found similar results among 121 master's level engineering students at the University of Graz in Austria. Students that played the game had similar educational gains and a greater degree of engagement with the material. Vogel et al. (2006) conducted a meta-analysis of research studies testing the effectiveness of digital games and simulations. The researchers discovered that the body of literature showed overwhelming evidence that digital games and simulations led to cognitive and motivational gains.

Though these researchers and others have investigated how video game-based learning compares to traditional instruction, there has been little research in comparing the differences in engagement and content knowledge gain between participants playing different types of educational computer and video games. Likewise, little is to be found that takes into account players' minority status and socio-economic background when comparing content knowledge gains and video game engagement. The purpose of this study is to explore differences between computer games of different types with regard to

both engagement and change in content knowledge, while taking into account players' gender, minority status, and socio-economic status.

Theoretical Foundation

Mihaly Csikszentmihalyi (1997) wrote extensively on the subject of engagement, which he called flow, a state in which the person is completely immersed in a task or activity to the point that difficulty and distractions effectively vanish. Csikszentmihalyi noted that clear goals and motivations, such as the rules and objectives of a well-designed game, helped generate a flow state. Tasks that are difficult, but still possible, and stretch a person to learn new skills or expand on existing ones are likewise effective in bringing on the flow state. Tasks must be meaningful in order to create flow, but a person can create meaning in his or her own actions.

Reaching a flow state during leisure time is more difficult than when working. Passive entertainment such as television viewing very rarely serves to engage watchers. Active leisure, including games, sports, and hobbies, can be more effective at generating flow, but this requires working through a learning period in which flow is relatively unlikely because of unfamiliarity and frustration (Csikszentmihalyi, 1997).

Theories of educational game design generally seek to create games that activate engagement or flow in the player, often by addressing Csikszentmihalyi's (1997) theories directly. Kiili (2005), for example, specifically developed a theory of good game design based on flow, a theory that denigrated simple, linear digital games in favor of complex, player-driven simulations. Many of Gee's (2005) conditions of good learning environments align with Csikszentmihalyi's concepts.

Similarly, Seymour Papert (1998) deals with issues of flow and engagement. Papert complains that educational video and computer games are often Shavian reversals that combine poor game design with the worst aspects of Behaviorist pedagogy such as repetitive drills and problems with only one correct response. Good games, according to Papert, are difficult but fun and give the player a level of control and autonomy, thus engaging them through their difficulty and not in spite of it.

Not all theorists reject simple games, even those games that take a Behaviorist pedagogical approach. In 1984, Malone published the results of an experimental research into the traits possessed by educational digital games that created intrinsic motivation in players. Originally presented in 1982, a year when the most popular games included *Tron, Pac Man,* and *Dig Dug* (The Internet Movie Database, 2011), Malone's (1984) study involved short, simple games with a Behaviorist drill and practice pedagogical approach. Malone found games that stimulated the players' curiosity, games that provided an interesting fantasy, and games that challenged the players led to higher levels of intrinsic motivation.

Gee (2005) identified thirteen traits of good learning systems design. These were specifically aimed at educational digital games and divided them into three major categories: (1) empowering learners, in which the learners had freedom to choose different learning approaches, customizing them to their own personalities and preferences; (2) problem solving, in which well-ordered challenges kept the difficulty at a level that was challenging but possible, and in which the skills to be learned were integral to the progress of the game; and (3) understanding, in which the players learn skills and materials not in isolated, decontextualized pieces, but as functional systems.

Although a short, simple game may not be able to fulfill Gee's (2005) and Papert's (1998) expectations of player choice, customizability, and broadly systemic integration of knowledge, the simple and casual digital games may still have a place within a larger educational learning environment. A single educational video game or commercial video game used for educational purposes need not include all of these choices and characteristics inherently but can be a single part of a larger learning environment consisting of a variety of games, media, reflections, and other authentic activities (Lacasa, Mendez, & Martinez, 2008; Price et al., 2016). The use of shorter, casual games may help overcome the extensive obstacles to classroom integration of educational digital games that researchers Baek (2008) and Tsekleves, Cosmas, and Aggoun (2016) discovered.

Statement of the Problem

Digital games, whether played via computer, console, or portable device, have become a major part of society in industrialized nations, and to no surprise, have found their way into educational contexts. A study sponsored by the Joan Ganz Cooney Center revealed that "Nearly three-quarters (74%) of K-8 teachers report using digital games for instruction," with 80% of game-using teachers primarily using dedicated educational video games (Takeuchi & Vaala, 2014, p. 5). Educational video games are available for mobile devices, as browser games and as installed software for personal computers, in areas including math (Feeney, 2014), finance (Page, 2014), history (Brennan, 2014), and literature (Farber, 2015).

A great deal of research has established the effectiveness of digital game-based learning in generating gains in both content knowledge and motivation (Annetta,

Minogue, Holmes, & Cheng, 2009; Ebner & Holzinger, 2007; Hwang et al., 2015; Ke, 2008a; Ku et al., 2014; Price et al., 2016; Rosas et al., 2003; Squire, DeVane, & Durga, 2008). Vogel et al.'s (2006) meta-analysis found significant cognitive and motivational gains with educational video games, with fail-safe numbers of 1,465 and 117, respectively. Surprisingly, little research has been done comparing the effectiveness and engagement of different types of digital games. Malone started from a basic learning activity and added elements one at a time, recording participants' reactions, to create his theory of *curiosity, challenge,* and *fantasy* (1984). Dedeaux and Hartsell (2011) compared two games within the Buensoft Spanish suite, but lacked a sufficient sample size to detect significant differences. Ke's (2008a) study found that participants preferred games with an endogenous fantasy, which integrated educational content into the gameplay, to games with exogenous fantasy, in which the educational content interrupted the narrative of the game. Further, existing theories such as Papert's (1998) theory of constructionism, Killi's (2005) flow-based theory of educational game design, and Gee's (2005) components of good educational digital game creation primarily examine in-depth, long-playing adventure games and simulations, ignoring or even condemning shorter, casual games that can be easily integrated into existing teaching environments.

Although there has been significant experimental testing of the overall effectiveness of educational digital games as compared to traditional teaching methods, the experimental comparison of games as compared to each other, specifically with regard to educational game theory, remains largely untested. Theories of effective digital game design must be tested experimentally so that educators and game designers can be guided by proven principles in selecting and designing educational games. Without

experimental testing of existing theories and refining and expanding those theories to include a role of increasingly popular casual digital games, the use of and design of educational video games will remain speculative and largely unguided by evidence.

Purpose of the Study

Instructors and learners can choose from a wide variety of different types of educational digital games. While many academics have proposed theories, based on several fields and previous theorists, as to what makes an effective educational game, those theories tend to focus on long, open-ended simulations and adventure games of the sort that is very difficult to integrate into primary and secondary-level classrooms without significant structural changes (Baek, 2008). These long, open-ended games often require more advanced hardware and faster internet connections, creating technical and financial difficulties to integration, and always require a great deal of time, which can create curricular and educational obstacles to adoption unless the games are tailor-made to the particular state, school, and course's curriculum (Tsekleves et al., 2016).

Overall, the focus of the theories of educational digital game design focuses on concepts of intrinsic motivation, wherein the learner seeks to continue with the learning activity regardless of any extrinsic factors such as grades, disciplinary factors, or other rewards or punishments. Kiili (2005) approaches intrinsic motivation by way of Csiksentmihalyi's (1997) concept of *flow*. Papert (1998) points out that difficulty and mastery of complex skills is a selling point of commercial digital games and seeks to explain how that can apply to learning. Malone (1984) draws three conditions for intrinsic motivation from his research with simple digital games, finding *fantasy*, *challenge*, and *curiosity* that, when taken together, can create an intrinsic desire to

continue playing. The theories largely take as a given that greater engagement and intrinsic motivation can lead to greater learning.

Extensive quantitative and qualitative studies have investigated whether or not educational video games are effective and engaging compared to non-game-based teaching methods, and both quantitative and qualitative studies have investigated students' preferences with regard to genres of digital games. But, researchers have not compared different video games to one another as much with regard to engagement and content knowledge gain. While Malone (1984) has tested his theory with regard to engagement, no studies show whether his principles of *fantasy*, *curiosity*, and *challenge* lead to a greater content knowledge gain.

This study compares the levels of content knowledge gain and engagement between participants playing the different digital games. Further, the study determines whether such differences vary by gender, minority status, or socio-economic status. The results of this study can serve to help educators better choose between existing educational digital games, and help game designers develop more effective, engaging educational digital games. This study may form the basis of a body of knowledge that will test and refine existing theories, and perhaps generate new theories about good digital game-based learning design, both in the context of in-depth simulations and short, casual digital games.

Research Questions

Based upon the problem identified concerning games and their influence upon engagement and learning of content, the following research questions are presented in

this study. The research questions look closely at user demographics and motivation, and whether they influence the effectiveness of using educational games in instruction.

1. Are different levels of content knowledge gain (as measured by pre- and post-test scores) and engagement generated by educational digital video games that meet all of Malone's (1984) three conditions of intrinsic motivation (*challenge*, *curiosity*, and *fantasy*) as opposed to games that do not meet Malone's (1984) conditions?
2. If such different levels of content knowledge gain and engagement exist, do they vary based on participants' gender, minority status, or socio-economic status?
3. What common themes arise from participants' post-participation comments?

Research Hypotheses

The above research questions help the researcher lay the foundation of examining different areas pertaining to the use of educational games. Based upon elements of the research questions, the following hypotheses are created:

- Research hypothesis 1: Participants who play games that meet Malone's (1984) three conditions will have different levels of content gain (as measured by pre- and post-test scores) than participants who play games that do not.
- Research hypothesis 2: Participants who play games that meet Malone's (1984) three conditions will have different levels of engagement than participants who play games that do not.
- Research hypothesis 3: Gender and game type played, either separately or in combination, make a difference in engagement and content knowledge gain (as measured by pre- and post-test scores), in that students of different genders

playing the different digital games, will have different levels of engagement and content knowledge gains.

- Research hypothesis 4: Minority status and game type played, either separately or in combination, make a difference in engagement and content knowledge gain (as measured by pre- and post-test scores).
- Research hypothesis 5: Socio-economic status and game type played, either separately or in combination, make a difference in engagement and content knowledge gain (as measured by pre- and post-test scores).

Definitions

To understand the context of this study and what variables are being investigated, certain terms need to be defined. The following are definitions that the researcher has used when conducting this study.

Casual Games – games designed to be family-friendly, easily learned, and playable in relatively short amount of time (Casual Games Association, 2010).

Computer Games – games played via computer, whether desktop, laptop, or mobile computing device such as a tablet or smart phone. The distinction between computer games and console or video games is largely a business term, used by Entertainment Software Association (2015) to differentiate sales numbers. In practice, many games are released across multiple platforms, and some games can be played in online multiplayer mode even with some players participating via console and some by computer.

Console Games – games played via dedicated gaming console, whether portable, such as a PlayStation Portable, or stationary, such as an Xbox 360. These are a subset of Video Games.

Digital Games – all computer-based games, regardless of the hardware upon which they are designed to run. This includes all games within the categories of Video Games, Console Games, and Computer Games, and includes both casual and enthusiast games of all genres and types.

Engagement – the player's attention to and involvement in a digital game (Brockmyer et al., 2009).

Enthusiast Games – long, complex games that require a large time commitment to play and often contain mature content (Casual Games Association, 2010).

Minigame – a shorter game embedded within a longer game or virtual world. Minigames are often, essentially, casual games embedded within longer, enthusiast games or virtual worlds.

Motivation – the desire and willingness of the participant to engage in a behavior; in this case, playing an educational digital game.

Video Games – games played via dedicated gaming console or coin-operated arcade cabinet, including portable consoles such as the PlayStation Portable and stationary consoles such as the Xbox 360.

Delimitations

This study is delimited to undergraduate students at a public community college in the southeastern United States. Within the literature reviewed, the researchers most often delimited studies to a single school or small group of schools to help increase

internal validity at the cost of generalizability. Differences that arise between participants from different schools, cities, states, or communities could introduce confounding variables or variables not relevant to the study. The content topic of French language learning, chosen because naive participants are available, may further reduce generalizability. The study is also delimited to volunteers with have varying degrees of experience with game and prior language learning experience.

This study is also delimited to the inclusion of two educational digital games, both of the casual type with drill-and-practice pedagogical frameworks involved, but differing in their relationship to Malone's (1984) theory of engaging game design in terms of *challenge, fantasy,* and *curiosity*. Games used in the study do not address the subject of in-depth, long-playing adventure games and simulations, despite their prevalence in the theory. The games used in this study, *Scramble 'Em* and *Shoot 'Em*, are simple enough to run on older computers and short enough to be easily integrated into the classroom schedule. Future research may explore other types of digital games such as simulations, or compare different types of digital games with each other.

Assumptions

The researcher assumes that participants will actively play the educational digital games for the time allotted, do their best to answer the questions on the pre-tests and post-tests correctly, provide accurate demographic information, and answer the questions on the engagement questionnaire truthfully, to the best of their ability. A further assumption would be that the participants have little or no knowledge of the French language; this assumption will be tested through analysis of the pre-test data for outliers.

Justification

Digital games are unlikely to vanish from the educational environment, having been shown to lead to both cognitive and motivational gains (Hwang et al., 2015; Ku et al., 2014; Price et al., 2016; Vogel et al., 2006). As Prensky (2005) noted, current primary and secondary-level students live their lives engaged with media, and rebel against essentially nineteenth-century teaching methods that do not offer them the opportunity to engage deeply with the subject matter. As educators seek to engage and reach their students, educational uses of digital games will continue to increase over time. As such, further research must be completed to determine experimentally what types of digital games are most effective at generating cognitive and motivational gains among different populations of students. As current research stands, while significant research studies have proved learning effectiveness of educational digital games at the time of data collection, only one study has been found that compared relative effectiveness of two or more educational video games, and this study has not yielded conclusive results (Dedeaux & Hartsell, 2011). Likewise, although research has explored differences in video game preferences and play habits among people of different genders, minority status, and socio-economic status, differences in engagement and content gain have not been studied experimentally. Thus, although many authors have proposed theories, those theories remain largely untested. Except theories, there is no body of evidence as to which types of games are most effective; only theories. This study is meant to investigate that gap in the research.

This study also provides an important first step by comparing two casual digital games. *Shoot 'Em* that meets all three of Malone's (1984) conditions of intrinsic

motivation of *fantasy*, *curiosity*, and *challenge*, and *Scramble 'Em* that meets none of them. Both games are simple and short enough to be practically integrated into a classroom environment through the use of in-class individual learning centers, laptops, or computer laboratories. Malone's theory has been chosen because it specifically addresses short, simple digital games rather than complex simulations or overall learning environments. As such, the theory is most applicable to games that can be easily integrated into existing classroom structures.

Although some theorists prefer long, in-depth adventure games and simulations (Papert, 1998), such games can prove nearly impossible to integrate into existing curriculum that must work within the confines of state or district mandated pacing guides (Baek, 2008; Tsekleves et al., 2016). As Squire et al. (2008) noted, students may require as many as 15 hours of practice with complex simulations such as *Civilizations III* before they reach the level of proficiency with the game that is necessary to become fully engaged with the content at hand. Casual games such as *Scramble 'Em* and *Shoot 'Em* can be played immediately and multiple times within a relatively short class period or center time.

Summary

Digital games are a fundamental part of modern society and their appeal is not limited to a single gender or age group. Although some differences have been found as to digital game preference, people of all ages play digital games (Entertainment Software Association, 2015). Digital games have penetrated deeply into the educational system, both through use in school and through educational games such as Leapfrog being used at home. Their effectiveness for generating content gain and engagement has been well-

established through research (Hwang et al., 2015; Ku et al., 2014; Price et al., 2016; Vogel et al., 2006).

Several theories have been offered as to what makes a good educational digital game, largely focusing on long adventure games and simulations, but those theories largely remain untested. While the effectiveness of educational digital games has been extensively tested through research (Hwang et al., 2015; Ku et al., 2014; Price et al., 2016; Vogel et al., 2006), the comparison of different types of educational video games has largely remained untouched, thus the theories of digital game-based learning remain largely unsubstantiated by experimental data.

The purpose of this study is to address that lack of data and to test, refine, and expand existing theories of digital game-based learning. The study focuses on short, casual games that can easily be integrated into existing classrooms, relying most heavily upon Malone's (1984) theory. Further, the study seeks to determine whether differences in engagement and content knowledge gain between students playing games with different designs exist, and whether or not those differences are related to the participants' gender, socio-economic status, and minority status.

The next chapter, the critical review of literature, explores several theories of good educational digital game design, as well as existing research concerning the effectiveness of educational digital games, their integration into the classroom, and difference in digital game preference among different demographic groups.

CHAPTER II

CRITICAL LITERATURE REVIEW

The review of literature first addresses the characteristics of effective digital games, addressing the major theories by Gee (2005), Papert (1998), Kiili (2005), Malone (1984), and others to help explain the theoretical background of the study. The next section addresses existing research as to the practical applications of educational digital games, looking first at factors affecting students' acceptance of and preferences among educational digital games, then moving onto specific cases of successful integration of digital games into the educational environment. This includes explicitly educational games, games that are covertly educational, and commercial off-the-shelf games. Special attention is given to the obstacles of integrating digital games into the educational environment and how those obstacles are overcome.

Characteristics of Effective Educational Video Games

Theorists of educational digital gaming do not all agree on the best approach to creating and applying serious learning games. This section will first address those theorists who favor complex, long-playing games with a great degree of player autonomy and then continue to address those who favor shorter games with high degrees of replayability.

Theories in Favor of Complex Games

Seymour Papert (1998) argues for incorporating difficulty and depth into video gaming, noting that successful commercial video games are hard and that difficulty is a large part of their appeal, as long as the material is also interesting. The learning that takes place within a video game is unified and directly relatable to the goal of mastering

the game, unlike the fragmented, decontextualized, and boring learning that often takes place in schools. Learning, according to Papert, is inherently difficult and video game developers have learned to leverage that difficulty into creating motivation, rather than fighting to make learning easier, even at the expense of imagination, relevance, and interest.

Furthermore, Papert (1998) notes that children who play video games often have very sophisticated understandings of the process of learning, including the ability to help others to learn. Much like Gee (2005), Papert credits much of this sophistication to the degree of choice and ownership of learning involved in playing complex video games. Indeed, Papert holds that learning to learn, as opposed to learning content, is the highest and best educational use of video games.

Blumberg, Rosenthal, and Randall's (2007) observation of adults found that frequent gamers quickly generated more strategies and ideas for getting around obstacles as compared to infrequent gamers when playing a game that was new to both groups. These results support Papert's (1998) theories that the real benefit of video games is not learning new content, but the skill of learning itself.

Harel and Papert (1991) present a definition of constructionism that is an offshoot of Constructivism. They propose that knowledge and understanding constructed by the learners, rather than transmitted from the instructor to learner, are constructed most easily and effectively through the creation of authentic, concrete products. Harel and Papert discuss experiences with the latter's ongoing Logo project, in which students use mathematical principles to create computer graphics and build programmable objects using a combination of Lego blocks and small actuators and motors.

Harel and Papert (1991) note that the use of computers, even computer games, in education does not necessarily increase learner agency and involvement. Computer-aided instruction and educational games can embrace many different pedagogical foundations, some of which actually serve to increase the rigid, authoritarian nature of primary and secondary education. Papert (1998) is especially critical of drill and practice games with what Ke (2008a) would refer to as exogenous fantasy or no fantasy at all, which serve only as an attempt to control learners by co-opting a popular activity: video games (Papert, 1998).

Kiili's (2005) flow-based theory of educational video game design is similarly critical of drill and practice games, noting that trial and error without reflection does not increase learning. As a whole, Killi agrees with Papert (1998) and Gee (2005) that educational video games should provide opportunities for player choice, exploration, and reflection (Kiili, 2005).

The Learning Environment

In contrast to Kiili (2005) and Papert's (1998) ideals of deeply simulative and learner-driven video games, Lacasa et al. (2008) envisioned a digital environment in which a number of learning options are available to the learners through the use of a wide variety of more narrowly-construed digital products used within a unifying pedagogical framework. Indeed, Labus, Despotović-Zrakić, Radenković, Bogdanović, and Redenkovićt (2015) created the beginnings of just such a complex and multi-component learning environment when they combined an educational Facebook game with a Moodle-based Learning Management System, creating an integrated learning environment with components existing in different forms and platforms, rather than

within a single game. Students at the University of Belgrade in Serbia using the game had better test results than the control group and had high satisfaction with the game. Although Labus et al. did not do so at the time of publication, the combination of dedicated learning management systems and games hosted in Facebook or elsewhere could create a learning environment of the sort Lacasa et al. (2008) envisioned if multiple games were presented as options.

Lacasa et al. (2008) also suggested that specifically educational games make use of adaptive difficulty, making the game harder or easier based on the player's performance. This would allow novice players to experience success without discouragement and prevent advanced gamers from getting bored if the game is too easy for them, ensuring that the game remains *pleasantly frustrating* (Gee, 2005) for all players, regardless of skill level. Adaptive difficulty contrasts with the way many commercial games are packaged, with user-chosen difficulty levels. On the other hand, beating a popular new game on its hardest setting can be a badge of honor among gamers, Papert (1998) notes, as the challenge of mastering a difficult game can be a motivating factor.

Debriefing and post-game reflection were both vital parts of the learning process in Lacasa et al.'s (2008) study. The games, multimedia, and lessons themselves are only part of the learning experience and must be preceded by preparations and followed by reflection to be maximally effective. The addition of preparation and reflection outside of the individual game addresses Kiili's (2005) concern that video games may lack the necessary reflection to move the player's search for the correct solution beyond mere trial and error to genuine learning.

Kebritchi and Hirumi (2008) contacted the authors of fifty-five journal articles on the subject of educational video games and discussed the pedagogical foundations of their work. Ultimately, Kebritchi and Hirumi developed five major categories of pedagogical foundations: (1) direct instruction, (2) experiential learning, (3) discover learning, (4) situated cognition, and (5) constructivist learning. They also discovered research that did not address the games' pedagogical foundations and research whose pedagogical foundation did not establish any theoretical foundations.

Direct instruction describes drill and practice games based on Behaviorist pedagogy, with concepts presented and practice problems given in an almost purely instructional way. Students are provided with feedback and assistance in order to get the questions correct, but there is little immersion or fantasy involved (Kebritchi & Hirumi, 2008).

Experiential learning involves presenting an authentic problem within a simulated virtual environment that is as authentic and realistic as possible, while providing opportunities for instruction, internalization of experiences, and reflection (Kebritchi & Hirumi, 2008). Based on the theory of situated learning, discovery learning is similar to experiential learning, albeit with a greater degree of learner freedom. Learners are expected to discover the important concepts through their interactions with the virtual environment, rather than through instructional materials. Discovery learning requires a higher degree of prerequisite skills and knowledge from the learners but can be used to develop substantial proficiency (Kebritchi & Hirumi, 2008).

Situated cognition is based upon the concept that perception and action precede the formation of concepts, and should therefore, be the subject of greater attention in

learning. Games based upon situated cognition focus on the effects of what the players do and show them, sometimes through trial and error, the kinds of skills and actions that produce desired results (Kebritchi & Hirumi, 2008).

Constructivist learning, based upon the theory of Constructivism, holds that learners create, or construct, their own understanding, rather than having information imparted by an instructor, curriculum, or media (Kebritchi & Hirumi, 2008). Within this category, some educational games base their pedagogical foundations on Papert's (1998) constructionism subset of constructivism, which uses the creation of authentic products as a means to the construction of meaning and understanding.

Components of Good Educational Digital Game Creation

Gee (2005) addresses the question of how to create effective learning environments, with a focus on digital game-based learning. Gee notes that commercial video game developers motivate their players to learn complex, difficult games that may take tens or hundreds of hours to complete. He states that good game designers have mastered motivational learning and then goes on to describe thirteen principles of good learning design, dividing them into three categories: (1) empowered learners, (2) problem-solving, and (3) understanding.

Within the empowered learners category, Gee (2005) describes four principles: (1) *co-design*, or involving the learner as an active participant in the learning process, rather than a passive consumer, a principle in line with constructivist thought in general; (2) *customize*, or allowing learners to use their own favored learning styles, rather than prescribed, one-size-fits-all processes; (3) *identity*, in which learners take on new roles that feel authentic and interesting enough to trigger deep, long-term investment; and (4)

manipulation and distributed knowledge, which involves the use of smart tools that allow learners to extend their reach beyond themselves and confidently grasp new areas of knowledge.

Within the problem-solving category, Gee (2005) describes seven principles. These include: (1) *well-ordered problems*, wherein the order of the problems presented to learners is designed to guide them to discover solutions that will be applicable throughout, preventing learners from losing their way or being overcome by the breadth of possibilities; (2) *pleasantly frustrating*, meaning that the tasks and challenges should be difficult, but doable, and allow ample room for experimentation and multiple attempts; (3) *cycles of expertise*, which means that learners should master and internalize a certain set of skills, then find those skills challenged, so that they have to reach beyond the mastered skills to use them in new ways or add new skills; (4) *information 'on demand' and 'just in time,'* meaning that learners receive verbal information only when their practical application experience has made them ready for it, allowing for internalization and transfer of knowledge; (5) *fish tanks*, or simplified simulations that illustrate important variables and concepts while preventing learners from being overwhelmed by the complexity of the system as a whole such as tutorial missions in a video game; (6) *skills as strategies*, which means that skills should not be practiced out of context, but as strategies toward accomplishing relevant and satisfying goals such as mastering a game's control scheme in order to defeat a level or challenge; and (7) *sandboxes*, which provide learners with a realistic environment that has little or no risk, allowing them to experiment and play without fear of failure or other consequences.

Within the understanding category, Gee (2005) describes two principles. These two are (1) *system thinking*, in which learners understand the entire system in which they are operating, rather than smaller parts in isolation, and (2) *meaning as action image*, in which the learners are given concrete imagery and experiences through which to visualize and understand concepts, events, and processes.

Most relevant to this dissertation study are Gee's (2005) principles *pleasantly frustrating*, addressing the challenge level of the games in question, and *sandboxes*, as the digital games in question serve as safe environments for learning and reinforcing skills; students suffer no adverse consequences from poor performance on the game and are able to immediately play again. Gee's theory is still applicable to the use of short, casual games in education if one thinks of those games as part of a larger learning environment.

Bourgonjon, Valcke, Soetaert, and Schellens' (2009) study's findings provide experimental data to support Gee's (2005) characteristics of good learning design, while also addressing Papert's (1998) theories. Bourgonjon et al.'s (2009) ease of use variable relates to Gee's Problem Solving category's escalating difficulty (*well-ordered problems*) and Gee's use of early tutorials to allow players to begin playing with a gentle learning curve (e.g., *fishtanks*). Bourgonjon et al.'s (2009) learning opportunities and usefulness variables relate to Papert's statement that students are most engaged with educational video games when they know learning will occur and what they are to learn. This allows them to become active participants in their own learning, a concept that connects well with Gee's co-design characteristic.

Gee's (2005) principle of *well-ordered problems* can hold true even in games in which players are given the ability to control order and progressions, as Kim and Schute

(2015) discovered. Kim and Schute found that when given nonlinear control of their progress through a game that was essentially linear by nature, with distinct levels and ordering, students rarely took advantage of that control, skipping ahead only when stuck on an earlier level and returning to previous levels only to improve scores and achievement badges.

Malone (1984) provides a framework for creating engaging video games that do not require the long, involved simulations preferred by Papert (1998) and Kiili (2005). Malone's theory focuses on three major aspects of engagement that can be present in even simple video games: *challenge*, *curiosity*, and *fantasy*.

Like Gee's (2005) *pleasantly frustrating* and *well-ordered problems* traits, Malone's (1984) challenge aspect involves consistently putting the players in situations that force them to try new strategies and struggle to progress, but which are not so difficult to stymie them. Curiosity, much like Gee's *information 'on demand'* and *'just in time,'* keeps the players interested by giving them information at a complexity level that they are most ready for (Malone, 1984). *Fantasy* allows the player to identify with the situation and immerse themselves into it, much like Gee's identity trait and Ke's (2008a) stress on the importance of endogenous fantasy. Malone found that if the players enjoy a game's fantasy, they are more engaged with a game featuring an endogenous fantasy. Likewise, if they dislike the fantasy being presented, an endogenous fantasy leads to greater disengagement, once again pointing to the importance of careful design.

Although the bulk of Gee's (2005) theory is aimed at larger learning environments such as those found in long adventure games or simulations, his *pleasantly frustrating* and *well-ordered problems* apply to short, casual games. Such games can,

themselves, be a like a *sandbox* as they serve as risk-free opportunities to practice and learn.

However, Gee's (2005) other traits of good learning environment design can apply to the sort of learning environments envisioned by Lacasa et al. (2008), which consist of a variety of specific digital products. This includes commercial off-the-shelf games and casual educational games, within a unified pedagogical framework.

Casual games, because of their brevity, often fall into what Kebritchi and Hirumi's (2008) direct instruction category, which includes drill and practice games with Behaviorist pedagogy. While Papert (1998) dismissed such games out of hand, they can have a place within a broader learning environment, and Malone (1984) detailed three conditions for engagement, building his theory on research on the short, casual games that were available in the early 1980's.

Malone's (1984) three conditions, *fantasy*, *challenge*, and *curiosity*, served to distinguish the two casual games used in this study's experiments: *Shoot 'Em*, which meets all three conditions, and Scramble *'Em*, which meets none of them.

Educational Video Games in Practice

When integrating educational digital games into learning environments, educators must consider a number of factors. Educators must evaluate the suitability of the game's content to the learning objectives, and this remains true whether they use a commercial off-the-shelf game in an educational manner or whether they use a game designed to teach a specific topic. Additionally, commercial off-the-shelf games must also be scrutinized for violent or sexist content that may alienate students and detract from the learning environment. Finally, the students' characteristics must be considered as male

and female students and students from different socio-economic statuses tend to have different gaming preferences.

Gender and Digital Gaming

Despite lingering stereotypes of gamers as adolescent boys, both genders play digital games. According to the Entertainment Software Association (2015), 56% of gamers are male, 44% are female, and "Women age 18 or older represent a significantly greater portion of the game-playing population (33%) than boys age 18 or younger (15%)" (p. 3). However, gaming habits of male and female gamers are not identical.

Andrews (2008) found significant differences in gaming habits and preferences between male and female among American high school students of differing socio-economic statuses (SES). The author divided games into four categories: (1) casual games, (2) non-casual computer games, (3) fantasy games, and (4) sports games. Andrews also asked questions about the preference between computer and console-based games. Female students were more likely to play casual games, while male students were more likely to play every other category. Female students also played games alone more often than male students, who often played with others, either in person on online.

These differences, however, are not insurmountable, especially within the field of educational gaming. Nietfeld, Shores, and Hoffmann's (2014) study of *Crystal Island – Outbreak,* an educational game designed to teach eighth grade microbiology, revealed that gender differences in the early stages of game play instruction disappeared as more time was spent playing *Crystal Island – Outbreak,* so that ultimately there was no difference between content mastery and engagement between male and female students.

Riemer and Schrader's (2015) study supports Nietfeld et al. (2014). Riemer and Schrader's female participants had a more positive attitude toward learning through games and experienced higher expectations of both positive and negative affect. That is, female participants anticipated more fun and engagement and more stress and difficulty. Riemer and Schrader found no gender-based difference in preference between quizzes, simulations, and adventure games, specifically when addressing educational digital games.

An estimated 200 million people, the majority of which are women, play casual video games. The Casual Games Association (2010), which compares casual games to older arcade games like *Space Invaders* and classic puzzle games like *Tetris,* defines casual games as family friendly, easy to learn, generally of short duration, and high replay value. The association also contrasts them with enthusiast games such as the typical console or computer games, which are longer, more complex, often darker in content, and require more processing power.

Wohn (2011) found that casual games featured more positive and less sexualized portrayals of women than enthusiast games. In an analysis of 200 casual games, Wohn found that 77.1% of games with a single human main character had females as main characters, contrasted with Williams, Martins, Consalvo, and Ivory's (2009) study's finding that only 10.45% of main characters in enthusiast games were female. Additionally, the authors found that casual games differed from enthusiast games in their depiction of female characters. None of the casual games examined presented female characters in a sexualized manner, in stark contrast to Downs and Smith's (2010) finding that, in 60 top-rated enthusiast games, 41% of female characters were portrayed in

revealing clothing, 43% were portrayed with partial or total nudity, and 25% were portrayed with unrealistic body proportions.

Casual games' more frequent representation and positive portrayals of female characters may be part of the reason why, according to The NPD Group (2014), the majority of casual game purchasers are female. The lack of objectionable content and stereotypical gender messages also means that casual games are more suitable for children than many enthusiast games. Further, the relatively short time commitments required to play casual games may make them more practical to integrate into limited classroom time than longer enthusiast games, even those with no objectionable content.

Socio-Economic Status and Digital Gaming

Socio-economic status has been found to affect digital game preferences as well as general educational characteristics. Andrews (2008) found that high-SES students were evenly divided as to which types of games they preferred, whether they played both console and computer games extensively, and if they frequently played online. Low-SES students showed a stronger preference for sports games, and preferred to play on video game consoles such as the Xbox 360 and PlayStation 3 and portable game systems such as the PlayStation Portable and Nintendo DS. Some reasons given by low-SES participants for their general dislike of non-casual computer games included the complexity of the control systems and the view that computers were tools for work, not play. If video games are to be used in the education of low-SES students, more research is needed in the area of sports games and console games, as opposed to complex, computer-based simulations.

Herselman's (1999) study of resource-advantaged and resource-disadvantaged South African sixth grade students returned similar results. The resource-advantaged students had electricity in their homes and had played video games before, while the resource-disadvantaged students generally lacked access to utilities and did not have video games in the home, although some had played coin-operated arcade games.

Herselman (1999) defined two types of games: (1) strategy games, defined by their complexity and the higher-level thinking skills required for their completion; and (2) twitch games, defined by their relative simplicity and the fast reactions necessary to complete them successfully. Strategy games include fantasy role-playing games and logic-based games. The specific examples used in the study were *Word Fit* and *Cheers*. Examples of twitch games include arcade and combat-based games. The specific examples used in the study were *Sniper, Cover up,* and *Librarian.*

Resource-advantaged students preferred in-depth strategy games and often considered the drill and practice of twitch games boring. Resource disadvantaged preferred drill and practice-based twitch games to the strategy games, which they found overly complex, difficult, and even intimidating. This distinction suggests that shorter, simpler games have a place in the educational system, especially among students of lower socio-economic status (Herselman, 1999).

In contrast to Herselman (1999), Elliott (2014) found that students of lower socio-economic status could and would engage deeply with in-depth, non-violent games. Elliott integrated the open-world building game *Minecraft* into the curriculum of a secondary school in Melbourne, Australia, with a large population of students of lower socio-economic status. Many of the students had difficulties with reading and writing, and

many had behavioral issues as well. *Minecraft* served as a learning environment and the basis for more traditional assignments, such as planning a town, or writing letters and other documents. The assignments were provided in a non-linear manner with opportunities for collaboration so as to preserve the open-world, collaborative nature of *Minecraft.* Students who had previously been the most disengaged from their schoolwork became highly engaged in the *Minecraft* curriculum. It should be noted that Elliott's study required a large amount of dedicated study time, a locally-hosted *Minecraft* world server, and significant technical expertise, requiring significant administrative buy-in to overcome the financial and technical obstacles noted by Tsekleves, et al. (2016). Additionally, the *Minecraft* world was customized to specifically match the course's curriculum, overcoming the educational obstacles to adoption, but exacerbating the aforementioned financial and technical obstacles (Elliott, 2014).

Acceptance of and Preferences for Educational Video Games

Addressing the topic of student acceptance of video games, Bourgonjon et al. (2009) studied over 800 Flemish secondary school students to determine whether gender, experience in playing video games, and opinion of specific video games were related with the acceptance of and preference for educational video games. They found that students' acceptance of educational video games depended not only upon experience in playing video games, but also upon their perceptions of the games' usefulness, their perceptions of the learning opportunities the games presented, and the perceived ease of use of the games. If the potential benefit of playing a game was clear and the game was accessible and easy to use, though not necessarily easy to win, students were more

predisposed to accept it. Students with more experience playing video games in general were more accepting of educational video games in particular.

Reflecting the theories of Gee (2005) and Malone (1984), Przybylski, Ryan, and Rigby (2009) found, in a series of six quantitative studies, including four experimental studies, that there were no correlations between player engagement and violent content in video games for male or female players. Participants with high trait aggression did express greater desire to replay violent video games, but actual engagement when playing was unrelated to violent video games, even among players with high trait aggression. Engagement correlated with participants' perception of both competence and autonomy within the video game, suggesting that those traits and not violence itself were the deciding factors. Przybylski et al.'s results held constant when measured across games with (a) no violence and different degrees of violence, such as the fantasy violence found in platform games such as *Super Mario Brothers*, (b) impersonal violence found in large-scale strategy games, and (c) graphic violence found in many first-person shooting games.

Buttressing Przybylski et al.'s (2009) results, Amory, Naicker, Vincent, and Adams (1999) found that their participants, a group of twenty university students, preferred *Zork: Nemesis*, an adventure game, and *Red Alert*, a real-time strategy game, over *Duke Nukem 3D*, a first-person shooter, and *SimIsle*, a simulation. Participants found that *Zork: Nemesis* and *Red Alert* required a greater degree of problem-solving and had more compelling narratives, meeting Malone's (1984) concepts of *curiosity* and *fantasy*. Additionally, some of the students found *Duke Nukem 3D's* content objectionable, particularly its violence, crude sexuality, and stereotypes, which further coincided with

Malone's (1984) findings that people who dislike a game's endogenous fantasy would dislike the game as a whole. This also supported Przybylski et al.'s findings that violence within video games did not increase engagement. Participants' dislike of *SimIsle* stemmed from a poor user interface and insufficient feedback (Amory et al., 1999), an outcome that supported Gee (2005) and Malone (1984).

Although acceptance of educational video games by students may sometimes be taken for granted, Ke (2008a) undertook an in-field observation and think-aloud reflection in a study of fifteen students in the fourth and fifth grades and found that such acceptance depended greatly upon specific characteristics of the video games and students in question. In findings that were essentially compatible with Gee's (2005) thirteen characteristics, Ke found that acceptance of educational video games was higher for those participants with prior experience with video games, for games with an accessible, yet challenging difficulty level, and for games in which the learning was endogenous to the game's fantasy.

In a much larger, later study than Ke's (2008a), Riemer and Schrader (2015) developed and tested an instrument to evaluate participants' opinions of three different serious learning games: quizzes, simulations, and adventures. Participants had positive attitudes toward learning with serious games of all types, high expectations of positive outcomes, and low expectations of difficulties and drawbacks. This reveals students' interest in learning from the games, not simply playing them.

Following Riemer and Schrader (2015), Iten and Petko's (2016) study of seventy-four primary school revealed no correlation between anticipated enjoyment and willingness to use a learning game. They did reveal correlations between willingness to

use a game and perceived ease of use of that game, and the participants' perception of how effective the game would be in helping them to learn. In short, Iten and Petko's participants valued the potential to learn from the game far more than they valued its entertainment value. While this does not invalidate Ke's (2008a) findings about the characteristics of educational games that participants found most inviting, it does show a different side to students' motivations, which is the motivation to learn.

Ke's (2008a) focus on endogenous versus exogenous fantasy is particularly important. An example of a game with an endogenous fantasy was *Treasure Hunt*, in which players had to use x and y coordinates in order to locate treasure on a map. The skills being learned were directly integrated into the game's fantasy. Though the students knew they were learning about coordinates, this learning did not interrupt the flow of the game. A game with an exogenous fantasy was *Up, Up, and Away*, in which the balloon ride mechanic was interrupted by math problems that had to be answered before the player could continue controlling the balloon.

The importance of increasing learner engagement in educational digital games is not limited to Ke (2008a). In a study of American high school students learning physics and undergraduate engineering students, Hamari et al. (2016) explored the relationship between engagement, immersion, and content gain in a dual study. In both cases, they found that perceived challenge and engagement were correlated with greater learning, although immersion was not. To that end, Ke's (2008a) emphasis on endogenous fantasy should be seen as a means to an end, rather than an end unto itself.

Ke's (2008a) emphasis on the importance of situating the educational content within the gameplay agrees with Gee's (2005) Identity and Meaning as Action Image

characteristics. Ke's endogenous fantasy does not necessarily conflict with Papert's (1998) insistence on honesty with learners, as part of their active participation in learning. The learners can know that they are learning while playing a game that makes that learning integral to the gameplay and game narrative, which was the case in Ke's study. There is a danger when playing games with endogenous fantasy, as De Jean et al. (1999) note, namely that the students will not realize, understand, and reflect upon the material they are learning. Therefore, preparing and debriefing the students prior is important to ensure their understanding and reflection.

Commercial Off-the-Shelf Digital Games in the Classroom

Educators have used a wide variety of digital games, including purpose-built educational games and commercial off-the-shelf games designed for entertainment purposes. Squire et al.'s (2008) year-long case study of twelve lower-income students in fifth and sixth grades found that students using *Civilization III* as part of a learning environment guided by skilled instructors developed greater historical knowledge, developed game skills and thinking skills, and even came to identify with ancient civilizations. Students met ten times during the summer, for a total of twenty-five hours, and once per week for two hours after school during the school year. During this time the instructors played alongside the students and provided additional materials such as maps and vocabulary. Participants also used *Civilizations III's* multiplayer mode, which led them to discuss the value of historical strategies, events, and innovations. These students had expressed dislike of history prior to the course of study. Yet, they engaged themselves deeply with the material in *Civilizations III*, going beyond the minimum requirements.

Shorter, more casual commercial off-the-shelf digital games also have educational value, as Sun, Ye, and Wang (2015) discovered in a study of common mobile casual games to teach physics concepts to eighty-three ninth grade physics students in Taiwan. The group playing *Angry Birds Space* and *Cut the Rope* showed greater gains in knowledge as measured by concept maps than those students learning via lecture-based methods, though the two groups' multiple-choice scores were equivalent.

Similarly, Cherney (2008) found that students playing one of two relatively short, casual games increased their rotational recognition ability significantly more than students who did not, and that female participants showed even greater gains than male participants. Participants playing the three-dimensional game *Antz Extreme Racing* had greater gains than participants playing the two-dimensional game *Tetrus*, a variant of the console game *Tetris*. Although neither game was explicitly educational, both served to significantly aid players in mastering spatial rotational skills that Cherney describes as vital to several areas of the physical sciences, including architecture and medicine.

Simulation games can aid students in exploring different life situations, as Lacasa et al. (2008)'s study showed. Lacasa et al. compared video games to Bakhtin's theories of the carnival, which provided freedom, unusual, even grotesque imagery that created uncertainty and the opportunity to change into the existing social equilibrium. In this case, *The Sims* allowed players to immerse themselves into and create empathetic connections with family structures very different than their own, allowing them to experience what Kebritchi and Hirumi (2008) called experiential learning through the combination of game play, discussion, and writing about the experience.

Gerber, Abrams, Onwuegbuzie, and Benge (2014) similarly made use of several commercial off-the-shelf games as the basis for writing assignments, culminating in an assignment in which the each student created a hypothetical video game, critiqued other students' games, revise their games, and then wrote proposals to hypothetical game companies. Their twenty-six Hispanic and one African-American urban high school students showed a high degree of engagement and satisfaction throughout the process, despite beginning the process far behind their grade level in their English studies.

Purpose-Built Educational Digital Games in the Classroom

In addition to integrating commercial off-the-shelf video games into the learning process, researchers and educators have used and created purpose-built educational video games, that is, games that have been designed specifically for educational purposes. Rosas et al. (2003) conducted a study of 1,274 economically disadvantaged Chilean students in the first and second grades. The researchers provided participants with portable video game systems with four games that the researchers specifically designed to teach core competencies of the first and second year of school, namely mathematics and reading. Researchers divided the participants into experimental groups, internal control groups at the same schools as the experimental groups, and external control groups consisting of students at demographically similar schools. The experimental group played their video games during class time, in lieu of, rather than in addition to, instructional time.

The researchers found that both the experimental group and the internal control scored higher on their post-tests than the external control, and attributed the internal control's higher score to a motivation not to be outdone by the experimental group.

However, the external control possibly was not a good match to the school that contained the internal control and experimental groups. There was no difference between the internal control and experimental groups with regard to test scores, but interviews with teachers revealed that the students in the experimental group displayed greater motivation, greater time on task, and improved behavior with fewer class disruptions (Rosas et al., 2003).

The researchers made no effort to compare the effectiveness of the four different games the students in the experimental group played, and in fact, they did not keep track of how much time the students spent playing each game. They instead allowed the participants to play whichever games they wanted, whenever they were in class playing the video games. Participants played for approximately thirty hours over the course of three months (Rosas et al., 2003).

In addition to designing the four video games to meet the predetermined school curriculum, Rosas et al. (2003) ensured the games included what Ke (2008a) called endogenous fantasy, meaning that the learning activities would occur as part of the flow of the game, rather than interrupting it. The games themselves could best be described as console or arcade style drill and practice games, as opposed to simulations. The games' interfaces were created to be similar to commercial hand-held video games, featuring elements such as jumping, shooting, throwing, and moving. The four games in the study had both a progressive level of difficulty as the game progressed and an adaptive difficulty that matched the particular player's performance (Rosas et al., 2003). The researchers' design choices matched well with Gee's (2005) Well-ordered Problems and

Pleasantly Frustrating traits, respectively, as well as Lacasa et al.'s (2008) arguments for the use of adaptive difficulty.

Similarly, Ke's (2008a) case study of fifteen American fourth and fifth grade students found no relationship between game playing and increased mathematics skills, but did reveal greater engagement and a more positive attitude toward mathematics among the participants after participating in the game-based learning program. A separate study, exploring interactions between classroom styles and the effectiveness of the same ASTRA EAGLE educational video games found, similarly, that the games correlated with more favorable attitudes and equivalent cognitive and metacognitive scores (Ke, 2008b).

Ke (2008a) did not attempt to determine which of the games were more effective at teaching content knowledge, but did determine through observation and conversation that participants preferred those games with an endogenous fantasy, in which the educational content was seamlessly integrated into the gameplay. Several students specifically complained to the researcher about games with exogenous fantasies such as *Tic Tac Toe* or *Up, Up, and Away*, in which educational content such as equations or math problems interrupted the narrative of the game, jarringly breaking their sense of immersion. In *Up, Up, and Away*, the player controlled the progress of a balloon, a process that was interrupted by multiple-choice math questions that had to be answered in order to continue.

Consistent with Gee's (2005) Pleasantly Frustrating concept, Ke's (2008a) participants often guessed answers to problems they considered too complex or difficult for their ability levels. This guessing behavior, with its inherent disengagement and

avoidance of difficult thinking, emerged primarily in those games with exogenous fantasies.

Ko's (2002) study of eighty-eight elementary students found no difference in achievement between participants who played the computer and physical board game versions of *Find the Flamingo*, a memory-like game of interpreting clues and determining location by process of elimination. *Find the Flamingo* lacked any fantasy and was only a computer game in the loosest sense in that it was a game played through a computer. The game was not, however, one that could not be played without a computer in the way that *ASTRA EAGLE* or *Space Invaders* are. Unsurprisingly, a game that simply uses a computer to deliver identical instructional content is no more or less effective than a physical version of the same game.

Continuing the trend of equivalent content knowledge gain and increased motivation and engagement among those playing educational video games, Ebner & Holzinger (2007) studied 121 Austrian engineering graduate students within a single course and found that the pre-test and post-test scores between the experimental and the control groups were equivalent. Once again, engagement was greater among those students who played the video game.

In reference to Malone's (1984) three characteristics of games, Ebner and Holzinger (2007) noted that challenge and curiosity were central to *Internal Force Master*, the online computer game designed for the research. They argued that fantasy applied only to adventure games and would be a drawback in a game designed to teach civil engineering. Calculating the internal forces upon an object is fundamental to all civil engineering and requires a high degree of precision and accuracy because the stability,

and thus safety, of structures such as bridges and buildings depend upon these calculations. Similarly, Papert's (1998) and Gee's (2005) arguments for learner choice are inapplicable; the process must be learned by all students who choose to study civil engineering, and such students made the choice to learn these calculations when they choose to study civil engineering.

Ebner and Holzinger's (2007) use of challenge and curiosity corresponds to Gee's (2005) Pleasantly Frustrating, Well-ordered Problems, and Information 'On Demand' and 'Just in Time' traits. Although Ebner and Holzinger did not make use of a fantasy in designing *Internal Force Master,* they demanded that the game's background be something the players would be able to relate to and identify with, in order to increase motivation and prevent disengagement.

Ebner and Holzinger (2007) had three additional demands for *Internal Force Master*: (1) High Score and Time Limits, which raised stress levels and encouraged replay of completed scenarios by comparing the players' high scores using an online leader board for both the best scores of the month and the best scores overall; (2) Simplicity and Clarity, which required an intuitive interface that could be learned by doing; and (3) Ease of Use, which included adjustable, but not adaptive, difficulty levels to keep the game at what Gee (2005) called Pleasantly Frustrating levels of difficulty.

According to Ebner and Holzinger (2007), the game's interface should be so simple that no instructions, tutorials, help menus, or manuals are needed. This is especially important in a relatively short game such as *Internal Forces Master,* in which individual levels or the entire game is to be replayed multiple times. Others, such as Papert (1998) and Gee (2005) would note that more complex simulations may indeed

require a more complicated interface, and Gee's Fish Tanks and Sand Boxes traits provide specific advice on how to introduce players to more complicated games. *Internal Force Master*, with its relatively short play time, targeted skill, lack of open-ended play, and dependence upon replay for reinforcement, is what Squire (2008) called a Targeted Game, much like *Shoot 'Em* and *Scramble 'Em*.

Consistent with Ke (2008a), Ebner and Holzinger (2007), and Rosas et al. (2003), Annetta, Minogue, et al.'s (2009) study of 129 high school students found no significant difference in the content knowledge scores between participants in the control group and those playing a multiplayer educational gaming application (MEGA). Instead they found students in the experimental group had much higher engagement scores than those in the control group. The MEGA was based around using genetic information to solve a mystery, involving Malone's (1984) *challenge*, *curiosity*, and *fantasy* components and Ke's (2008a) emphasis upon the importance of endogenous fantasy.

While many researchers found no difference in content gain, Chang and Chen's (2009) study of 108 Taiwanese third grade students found that students playing *Fire Department 2: Fire Captain*, a commercial educational video game, had both greater content gain and greater engagement than the control group that used text-based computer instruction. *Fire Department 2: Fire Captain* was created using Keller's (1999) ARCS motivational theory.

Similarly to Chang and Chen (2009), Woo's (2014) study of Taiwanese university students playing the online game *Operating a Small Factory in Computer-Aided Manufacturing* also used Keller's (1999) ARCS theory, and concluded that maximizing motivation and cognitive load lead to maximum learning effectiveness, while leaving

relevance, satisfaction, and confidence undiminished. Woo concluded that the small decreases in attention that occurred had minimal effects.

Consistent with Chang and Chen (2009) and Woo (2014), Cheng, Su, Huang, and Chen's (2014) study of 132 Taiwanese middle-school students studying immunology found that students learning through the *Humunology* game scored significantly higher on both knowledge and satisfaction than students in the control group, who learned through web-based instruction.

Likewise, Hwang et al.'s (2015) study of 48 sixth grade students in an elementary school in Taiwan playing a roleplaying game designed to teach financial management found significantly greater learning, motivation, satisfaction, and flow among game-playing students than among a 39-student control group taught by the same social studies instructor.

Although lacking a control group for comparisons, Lui, Rosenblum, Horton, and Kang's (2014) study aligned closely with Chang and Chen (2009), Cheng et al. (2014), Hwang et al. (2015), and Woo (2014). Lui et al. studied *Alien Rescue*, a group game-based learning scenario for teaching astronomy, aligned with National Science Standards and Texas Essential Knowledge and Skills. In *Alien Rescue,* students plan the rescue of stranded extraterrestrials. The game provided a wide range of choices for the players at any given time and provided in-game notebooks and resources players could reference at their own pace. Two groups of Texas sixth grade students played *Alien Rescue* for fifteen 50-minute sessions. The first group consisted of two hundred twenty students, and the second group consisted of four hundred seventy-eight students. Neither study included a

control group. In both studies, student reactions were highly favorable and both male and female students showed significant increases in knowledge from pre-test to post-test.

Expanding upon Cherney (2008), but specifically with educational games, Lamb's (2016) study of 551 eleventh and twelfth grade students compared three-dimensional serious learning games to two-dimensional laboratory simulations with a traditional instruction control group. Lamb found that the three-dimensional games led to greater content learning gains.

The *Crystal Island* educational digital games provide further evidence of the effectiveness of three-dimensional, long-playing games for education, aligning with Cherney (2008) and Lamb (2016). Lester et al. (2014) and Nietfeld et al. (2014) studied *Crystal Island*, a highly customizable three-dimensional educational learning environment, designed for immersive and inquiry-based learning, and based on Valve's Software Source Engine, which was the basis of the commercial game *Half-Life 2* (Nietfeld et al., 2014).

Lester et al. (2014) developed *Crystal Island: Uncharted Discovery,* a long-playing action-adventure game designed to teach landforms maps and models, including landform types, scale, and navigation. Over the course of 13 hours of play time, the teacher could customize students' access to parts of the in-game world and provide feedback. In a study of eight hundred fifth grade students in eight schools, participants showed significant gains in both content knowledge and problem-solving skills after four weeks of play.

Crystal Island – Outbreak, a version of *Crystal Island* designed to teach eighth grade microbiology, is structured as a mystery game in which players learn about disease

and immunology by diagnosing and curing an outbreak on the island. Players won the game if they could "complete and submit a correct diagnosis with information about the source, disease and treatment" (Nietfeld et al., 2014, p. 963). The mystery structure led to a more focused, experience than the more open-world *Crystal Island: Uncharted Discovery* game, although they both allowed a wide range of player choice and initiative. Players of both genders had significant gains in microbiology knowledge from pre-test to post-test, and post-test scores correlated closely to in-game scores in *Crystal Island – Outbreak* (Nietfeld et al., 2014).

Likewise, Tuzun, Yilmaz-Soylu, Karakus, Inal, and Kizilkaya's (2009) study of thirteen fourth and fifth grade private school students in Turkey found significantly greater intrinsic motivation and significantly lower extrinsic motivation among participants in an after-school program learning through *Quest Atlantis*. This game was a multi-user virtual environment designed for Constructivist education and customized by the researchers to teach geography through the endogenous fantasy of seeking to return lost children to their home countries. The researchers did not use a control group with an equal amount of after-school instruction to compare content knowledge gains, but they did find significant gains in content knowledge between the participants' pre-tests and post-tests.

Annetta, Mangrum et al. (2009) found similar results. They studied seventy-four American fifth grade students, using a Multiplayer Educational Gaming Application, or MEGA, called *Dr. Friction* to teach the construction and physics of simple machines. The researchers found high levels of engagement and significant gains in post-test scores for both male and female students, although like Tuzun et al. (2009), they did not include

a control group against which to compare their participants' gains (Annetta, Mangrum et al., 2009).

Hsiao, Chang, Lin, and Hu (2014) also studied an educational game in which construction played a major role, specifically with the goal of using digital game-based learning to increase creativity among Taiwanese elementary students. A single instructor taught both the control group and experimental group, which played an adventure building came called *ToES,* in which a player's avatar travels back in time and must collect components they needed from different eras to build an electric vehicle, as well as connecting electrical generation facilities with homes and neighborhoods. The experimental group showed increases in creativity measures between pre-tests and post-tests, while the control group did not.

Similarly, Papastergiou's (2009) study of Greek high school students found that the game-based learning approach led to significantly higher levels of content gain and engagement for both male and female students in the area of computer science. The study compared two purpose-designed learning units with the same learning objective: computer memory properties, hierarchy, and organization. Eighty-eight participants composed of forty-six male and forty-two female high school students were randomly assigned into two groups, one of which learned by playing *LearnMem1,* an educational video game created specifically to teach the curricular content, and the other of which used *LearnMem2,* a computer-based learning module without gaming content.

In discussing the design of *LearnMem1*, Papastergiou (2009) specifically mentioned Malone's (1984) and Prensky's (2005) design principles, including a focus on clarity with regard to rules and goals, challenge, fantasy, progressively increasing

difficulty levels as the game progressed, immediate feedback, uncertainty of success, and a high degree of student control. Though not mentioned in the text, many of these design goals aligned with Gee's (2005) traits of successful learning systems.

Papastergiou (2009) chose to make the game relatively simple so that it would run on the older computers present in schools. Further, the game was relatively short so that students could play it to completion within their weekly two-hour computer science course. These practical concerns echo those of Rosas et al. (2003) and Ebner and Holzinger (2007); often long simulations are not practical in primary and secondary education, even if they are superior as Papert (1998) asserts. *LearnMem1* requires players to maneuver their avatars through a maze and avoid obstacles until they reach points that trigger multiple choice or true-false questions. The players then answer the questions and proceed to the next level once enough correct answers have been given (Papastergiou, 2009).

In contrast, Ke (2008a) found that students preferred games with an endogenous fantasy in which the educational material did not interrupt the game experience, but was interwoven into it, as was the case in Price et al.'s (2016) study of 242 children aged 7-12 learning about human biological systems. All participants visited a museum exhibit relating to human biology and were given a pre-test there. Participants then played an online casual educational game and afterward took a post-test. Eighty-one students played *Code Fred: Survival Mode*, which addressed the topic of human biological systems, while 45 played *Simple Machines*, which was chosen as the control because it did not address the topic of human biological systems. The experimental group had significantly greater post-test scores than control group.

Among students with little prior access to technology, the presence of endogenous fantasy may not be as necessary. Bottino, Ferlino, Ott, and Tavella's (2007) longitudinal study of economically disadvantaged students in Genova, none of which had computers in their homes, found widespread engagement. In addition, the experimental classes scored significantly higher on standardized tests in mathematics as opposed to demographically equivalent classes that did not play educational video games.

Similarly, Ku et al. (2014) found that time-constraint and variable difficulty could ensure higher engagement, even with a wholly exogenous fantasy and with students who have easy and ongoing access to technology and media. They compared the learning outcomes of students of high and low previous mathematical ability among 51 fourth-grade students in Taiwan. The group engaged in digital game-based learning playing two short, educational minigames showed significant gains in confidence among students of both ability levels, while the students in the lower ability group of the control group actually had reduced confidence from pre-test to post-test. Both ability levels within the game-based learning group showed significantly greater gains in computational ability than students in the control group.

Ciavarro, Dobson, and Goodman (2008) took the concept of endogenous fantasy further than Ke (2008a) suggested, moving into the realm of implicit learning. Although Papert (1998) questioned both the ethics and the efficacy of lying to students about whether or not they were involved in educational activities, Ciavarro et al. nonetheless created *Alert Hockey*, a sports game in the style of EA Sports' *NHL 95*, designed to implicitly teach on-field behavior. *Alert Hockey* tracked both aggressive behaviors such as hitting unnecessarily and negligent behaviors such as leaving injured players in the

game instead of benching them. Three versions of *Alert Hockey* were created, all with the same interface, but with slightly different lessons embedded. The first penalized players for playing aggressively or negligently; the second neither penalized nor rewarded aggressive and negligent play; and the third rewarded aggressive and negligent play.

Like Rosas et al. (2003), Ebner and Holzinger (2007), and Ke (2008a), Ciavarro et al. (2008) created a relatively short game that would be played multiple times, making repetition itself a part of the learning process. *Alert Hockey* includes basic tutorial levels, aligning with Gee's (2005) *fish tanks* trait. Seventy-four hockey players aged ten to fourteen years played the three versions of *Alert Hockey*. Each participant played three one-hour sessions, each of which comprised five *Alert Hockey* matches, for a total of fifteen repetitions. Researchers found that implicit learning was successful even in a short time. Students in the group that penalized aggressive and negligent actions played less aggressively and negligently the longer they played *Alert Hockey*, but those students in the other groups experienced no significant change in behavior. Most of the players played very aggressively and negligently at the beginning of the course, and it was unlikely that they could play significantly more aggressively even if the game rewarded such play (Ciavarro et al., 2008).

Digital Games and Foreign Language Learning

Researchers and educators have used both commercial-off-the-shelf and purpose-built educational digital games to teach and reinforce foreign language learning. deHaan's (2005) conducted a case study of a single intermediate-level student of the Japanese language who sought to enhance his understanding of the language through playing a Japanese baseball game, *Jiikyoo Pawafuru Puro Yakkyu 6*, on the Nintendo 64

console. Like Rosas et al. (2003), Ebner and Holzinger (2007), Ke (2008a), and Ciavarro et al. (2008), deHaan (2005) found that repetition enhanced both ability to play the game and understanding of the spoken and written Japanese in the game. The user's sense of control and the fantasy role of controlling a baseball team align with Gee's (2005) traits *customize* and *identity*, respectively. deHaan (2005) also found that the game's use of on-screen captions, presenting both the Japanese audio and the Japanese text simultaneously, also helped the player learn. The participant improved over time becoming accustomed to not only the game's control and play style but also to the Japanese phrases and words the game used to communicate.

Following a similar line of study as Lester et al. (2014) and Nietfeld et al. (2014), though using a commercial-off-the-shelf game, Chen and Yang (2013) used the Telltale Games' multi-hour adventure game *Bone* to teach English as a second language to Taiwanese college freshmen. They used a commercially-available game because they found no suitable purpose-built educational game for their purposes, and did not believe that individual educators in the field would find it practical to create their own purpose-built educational games. Chen and Yang divided their participants into two groups; one that was allowed to take notes during the game and one was not. They found that both groups had gains in English language knowledge, and that there was no significant difference in knowledge gains between the group that took notes and the group that did not, indicating that the game itself served as an effective learning tool.

Other researchers have created their own virtual worlds and games for foreign language learning, as De Jean et al. (1999) did for mathematics and language skills. One complex and in-depth example is Doe's (2014) *Lost in the Middle Kingdom.* Doe created

a three-dimensional virtual world set in China's middle kingdom, complete with tasked-based learning, an inventory screen, minigames, and puzzles all drawn together by an overarching quest spanning multiple levels of Chinese language comprehension. *Lost in the Middle Kingdom* is completely immersive in that there are no English-language instructions or guidelines, and everything must be done in Chinese or figured out through visual context. Doe's participants showed major gains in translation and comprehension after playing the game and had generally positive responses to the game experience.

Like Doe (2014), Berns, Gonzalez-Pardo, and Camacho (2013) also created a virtual world with minigames inside it, combining the exploration of a virtual world with the accessibility, challenge, and straightforward nature of more casual games while teaching the German language to Spanish college students. Berns et al. created an "amusement arcade" (p. 215) with slot machines requiring the players to match audio recordings, images, and text, and a final game level in which the players had to complete a virtual shopping trip using only the German language. Pre- and post-tests showed significant improvement in German language knowledge among participants.

Although Butler, Someya, and Fukuhara's (2014) minigames were not contained within a larger game environment, they still bear similarities to Doe (2014) and Berns et al. (2013). Butler et al. (2014) studied nearly 4,000 Japanese students aged 4-12 studying for the *Jido-Eiken*, a nationally normed English-language proficiency test. The *Jido-Eiken* preparation materials contain several simple minigames aimed at the students' ages and proficiency levels. Though the individual games do not provide the player with a wide range of choice, they do collectively, because the student can choose which game or games to play and how often to play them. Butler et al. examined students' reactions to

these *Jido-Eiken* games and found challenge, control, and mystery, which they also called curiosity, following Malone (1984) to be important.

Integration of Digital Games into the Classroom

An increase of cognitive gains and motivation when using digital game-based learning, as shown in Bottino et al. (2007), Chang and Chen (2009), Ciavarro et al. (2008), Hwang et al. (2015), Ku et al. (2014), Papastergiou (2009), Price et al. (2016), and Tuzun et al. (2009) appears to be the rule, rather than the exception. Vogel et al.'s (2006) meta-analysis of studies of computer game and simulation based instruction found that both cognitive and motivational gains were significant across the majority of studies, with fail-safe numbers of 1,465 and 117, respectively.

However, not all educators embrace educational digital games, as Bourgonjon et al. (2013) discovered. Their survey of 505 secondary school teachers' adoption of and acceptance of game-based learning found that a teacher's own experience with video games and a teacher's perception of the usefulness and learning opportunities provided by the games were major factors in that teacher's acceptance of game-based learning, as was the perceived complexity of using the games in the classes. As Baek (2008) and Tsekleves et al. (2016) note, the complexity and obstacles to integrating games into existing class structures can be significant.

Obstacles to Integrating Digital Games into the Classroom

Digital games are easiest to integrate into the classroom when they are used as components of other assignments such as Lacasa et al.'s (2008) use of *The Sims*. As Baek (2008) discovered after undertaking a mixed-method study of 444 Korean teachers, the primary obstacle to integrating video games into the classroom was the difficulty of

finding games that matched perfectly with inflexible, predetermined curriculum units. Rarely possible is for an end-user, such as an instructor, to alter the content of an educational video game; meaning that unless one can be found that matches the existing curriculum closely, educational video games may be impractical in the face of district or government-issued curriculum and pacing guides.

Expanding upon Baek (2008), Tsekleves et al.'s (2016) proposed guidelines for the adoption of educational games categorizes obstacles to the adoption of serious learning games into two main types: Technical & Financial and Educational (p. 169). Technical & Financial obstacles include the technical skills personnel will require to implement the games, maintenance costs and difficulties, platform issues such as older classroom computers or operating system incompatibility, and associated costs. Educational difficulties include concerns of the transference of knowledge, assessment, student willingness to engage with the game, and the difficulty of aligning game content with school curricula. They discovered no solutions that teachers can unilaterally implement, but instead call for policy and funding changes at all levels and from all stakeholders, including classroom teachers, governmental agencies, and the game industry itself.

Webb, Bunch, and Wallace's (2015) case study of four teachers implementing a serious agriscience game, *Virtual Walking the Pens*, supports Baek's (2008) and Tsekleves et al.'s (2016) findings. Webb et al. found that “Teachers’ implementation of the digital game was constrained primarily by inappropriate and inadequate technologies, and time” (p. 891). Some teachers had only outdated computers and slow internet connections, which caused the game to lag and perform poorly, frustrating the students.

Others had to reserve the school's computer lab in order to use the game, and found that limited the times and frequency their students could play. All of the teachers reported good student engagement with the game, when it was working.

Advantages of Casual Educational Digital Games

The difficulties inherent in working within a preplanned curriculum hinder the creation of a student-driven learning environment. This makes existing time constraints even more pressing. The use of shorter, focused video games that serve to reinforce basic skills and content within the curriculum without demanding dozens of hours of dedicated class time is efficient (Baek, 2008). Baek's (2008) findings echo the experiences of Ciavarro et al. (2008), Ebner and Holzinger (2007), Ke (2008a), Papastergiou (2009), Price et al. (2016), and Rosas et al. (2003), who used or created shorter games with high replay value in order to meet their respective practical and pedagogical needs.

Casual digital games are extremely popular, being played by an estimated 200 million people (Casual Games Association, 2010), with mobile and casual game revenues projected to exceed revenues of console games in 2015 (Gaudiosi, 2015). But, despite the widespread acceptance of digital games in society, their acceptance by learners is not guaranteed. Acceptance of such games is predicated upon not only the characteristics of the learners but upon their opinions of the usefulness of the games, learning opportunities the games present, and the ease of use of the games, though not necessarily their ease of completion (Bourgonjon et al., 2009). Ke (2008a) found that students were quicker to accept and more engaged with games that had a difficulty level that allowed them to easily begin playing, but continued to challenge them. They also preferred games which

an endogenous fantasy, conditions that align closely with Malone's (1984) three conditions of *challenge, fantasy*, and *curiosity.*

Research has revealed demographic differences in digital game preference, both in the context of commercial, non-educational digital games (Andrews, 2008) and educational digital games used for computer aided language learning (Herselman, 1999). In both cases, the differences were especially apparent across participants of different socio-economic statuses; lower-SES participants preferred games with simpler controls and reflex-based components.

While extensive research has shown that digital game-based learning is highly effective for both content knowledge gain and engagement (Vogel et al., 2006), significant obstacles remain to its integration into existing educational structures, especially the difficulty of finding games that match predetermined curriculum units and pacing guides (Baek, 2008). Shorter games that reinforce skills within the existing curriculum may prove to be easier to integrate into the classroom.

Similarly, Rosas et al. (2003), Ebner and Holzinger (2007), Ke (2008a), Ciavarro et al. (2008), Papastergiou (2009), and Price et al. (2016) all used short games with high replay value in their research, which not only allowed smoother integration into existing educational structures but also provided a greater opportunity for focused practice, due to the learners having the opportunity and motivation to replay the games multiple times. Studies such as these serve an important role in examining which types of these games are most effective and testing and establishing a theoretical framework for short, casual educational digital games.

Summary

While some theorists, such as Papert (1998) dismissed casual games out of hand, other theorists allowed for their use, and Malone (1984) specifically created a theory about short, simple educational digital games. Ke's (2008a) research elaborated upon Malone's (1984) concept of fantasy, emphasizing the importance of endogenous fantasy (Ke, 2008a).

Existing literature on the effectiveness of digital game-based learning shows that commercial, off-the-shelf digital games can be integrated into an educational environment (Gerber et al., 2014; Lacasa et al., 2008). Educational digital games, including those that are explicitly educational and those that are implicit and attempt to hide the fact that the games are educational from the participants (Ciavarro et al., 2008), are highly effective for both content knowledge gain and engagement (Vogel et al., 2006).

Additionally, significant research addresses not only the effectiveness of digital game-based learning but the process of integration. This includes examining student acceptance (Bourgonjon et al., 2009; Bourgonjon et al., 2013), digital game preferences across socio-economic groups (Herselmann, 1999; Andrews, 2008) and across genders (Andrews, 2008; The NPD Group, 2014; Williams et al., 2009; Wohn, 2011), and obstacles to the integration of digital game-based learning into existing educational environments (Baek, 2008; Tsekleves et al., 2016), including observations as to how to overcome obstacles and maximize stakeholder acceptance. Within this framework, short, casual games that are explicitly educational and maximize Malone's (1984) three

conditions of *fantasy*, *challenge*, and *curiosity* are not only easily integrated into the classroom, but likely accepted by students and other stakeholders.

The following chapter details the study's methodology and procedures. Discussion includes the instruments used to conduct the study, participant characteristics, research design, and methods of analysis. Methodology is an important area to help explain the collection and analysis of data and formulating any type of conclusions.

CHAPTER III

METHOD

This chapter explores the study's research design, beginning with Dedeaux and Hartsell's (2011) pilot study, then continuing to the preliminary study done to clarify the degree to which the chosen games adhere to Malone's (1984) three conditions of engaging video game design. The chapter then continues with an explanation of the research setting, including the participants and data collection location. Other areas such as the nature of the intervention, instruments used for data collection, procedures, and methods of data analysis are discussed.

Research Design

The purpose of the current study is to compare the effectiveness of different types of short, casual digital games and how they might affect content knowledge gain and engagement. The study also examines the influence of gender, socio-economic status (SES), and minority status upon participants' performance and acceptance of digital games for foreign language learning. Because the focus was on distinguishing types of games that might lead to better learning, an experimental quantitative approach is most appropriate. According to the National Center for Technology Innovation (n.d.), "An experimental study is a type of evaluation that seeks to determine whether a program or intervention had the intended causal effect on program participants" (para. 1). Generally, an experimental study includes (1) pre- and post-tests, (2) a treatment group and control group, and (3) random assignment of participants. Although this study did not include a treatment and a control group, two groups of participants were involved as they played different video games. A quantitative method provided the possibility of testing

hypotheses for statistically significant differences in knowledge gain and engagement between the two educational digital games, and for generalizing any differences found to a larger population.

Descriptive methods are also used because the researcher is interested in the self-reported reasons, reflections, and comments of the participants. The use of open-ended questions and content analysis are employed in this study to obtain the descriptive data to support the pre-tests and post-tests findings. However, methods are still primarily quantitative because of the experimental design.

Pilot Study

Before this research began a small pilot study was conducted in 2011 to evaluate possible methods and procedures. The researcher, under the direction of Dr. Taralynn Hartsell, undertook a small-scale pilot study with the goal in mind of piloting similar procedures related to the dissertation, including the use of pre-tests, post-tests, and engagement questionnaires. Buensoft Spanish was chosen because the software contained several different games that all addressed the same vocabulary lists. Spanish was chosen as the content knowledge to be studied in part because of the availability of a suite like Buensoft Spanish and because Spanish is a subject of which adult students may still be inexperienced with.

In undertaking the pilot study, three major problems arose, all of which have been addressed in the dissertation design. First, the pilot study used Spanish vocabulary that created a problem because all of the participants encountered some of the vocabulary terms before, either through prior education or general cultural assimilation. This led the researcher to change the language to French. Second, the engagement questionnaire used

in the pilot study was written by the researcher and not subjected to a rigorous test of validity. To correct this failing, the dissertation study used Brockmyer et al.'s (2009) Game Engagement Questionnaire, which had been extensively tested for validity. Third, the researcher failed to recruit enough participants in the limited time allowed to obtain statistically valid results in the pilot. The dissertation process was not under such tight time restrictions, and the researcher could take the time needed acquiring sufficient participants.

With limited numbers of participants in the pilot, the focus of the study turned to the participants' specific written comments and oral responses. Although the research hypotheses could not be addressed, enough information was gathered to create a publishable article from the pilot study and to establish a basis for this dissertation research (Dedeaux & Hartsell, 2011).

Preliminary Study

In order to document that *Shoot 'Em* meets Malone's (1984) three conditions and *Match 'Em* does not, the researcher conducted a small preliminary study. In the preliminary study, participants spent approximately fifteen minutes playing *Shoot 'Em, Match 'Em, Scramble 'Em* and *Snake 'Em*, all of which are included in the Buensoft French suite. Each preliminary participant played all four of the games, and rated each game on a scale of one to ten based on Fantasy, Curiosity, and Challenge, Malone's (1984) three conditions. *Scramble 'Em* and *Snake 'Em* were included in the preliminary study both for comparison and as possible backup games in case the preliminary testing shows that either *Shoot 'Em* or *Match 'Em* were unsuitable for the larger study.

The results of the preliminary study indicated that *Shoot 'Em* did match Malone's three conditions well. Using a five point scale, preliminary participants gave it an average score of 3.1 in Fantasy, 4.4 in Challenge, and 3.6 in Curiosity, for an overall average score of 3.7, the highest of the four games. *Match 'Em* and *Scramble 'Em* both scored among the lowest, with overall average scores of 2.9. Preliminary participants gave *Match 'Em* an average score of 2.3 in Fantasy, 3.3 in Challenge, and 3.3 in Curiosity, for an overall average score of 2.9. Preliminary participants gave *Scramble 'Em* an average score of 2.0 in Fantasy, 3.7 in Challenge, and 3.1 in Curiosity, for an overall score of 2.9. Preliminary Participant comments revealed that all three games except *Match 'Em* dealt primarily with spelling and secondarily with content, while *Match 'Em* dealt only with content. For this reason, *Scramble 'Em* was selected to replace *Match 'Em* in the study.

As a result of the preliminary study, the researcher modified the pre-test and post-test to address spelling as well as content knowledge, incorporating distractor responses into questions eleven through twenty that were incorrect because they were misspelled. The new pre-test and post-test were validated by Amy Linden, an experienced instructor of French. The pre-test and post-test are included in the Appendices. The Game Engagement Questionnaire did not change, but the researcher added three new demographic questions, addressing the participants' age, degree of experience with digital games, and types of games most frequently played.

Research Setting for Current Study

The research took place at an open-admissions community college in the southeastern United States. The college's student body is 63% female and 37% male, 28% African-American, 1% Asian, 2% Hispanic, 67% white. The data collection

occurred in a Windows-based desktop computer lab. All but three of the computers had been converted to Windows 7 Thin, which did not support the Visual Basic libraries necessary to run Buensoft French. The researcher brought in two laptops, one running Windows 7 Home and the other running Windows Vista, to bring the number of computers capable of running Buensoft French to five. Buensoft French was installed on each of the five computers' hard drives, with an icon placed on the desktop. The researcher started the program and selected the same vocabulary list for each participant. The researcher conducted all research sessions himself, and stayed on hand to address technical questions or issues and administer pre-tests, post-tests, and questionnaires at the appropriate time. Participants did not have to provide anything to participate, but were allowed to use their own pens and headphones if they preferred.

Participants for Current Study

Participants included students from a public community college in the southeastern United States. Community college students were appropriate participants because of the prevalence of college-level language classes. The researcher recruited participants by going to various class meetings with the instructors' permission and through word of mouth. At the class meetings, the researcher asked interested students to sign up for appointment times to participate, and offered a small cash incentive to all who participated in this experimental study of game design and content knowledge gain and engagement. Participants who were eliminated because they scored too high on the pre-test for French language (90%) knowledge still received their cash incentives. During the course of the experimental study sessions, no participants who began the study

discontinued participation. In total, 195 participants were recruited and 59 were eliminated, leaving 136 valid participants.

Each participant was randomly assigned a unique identifying number that was not linked to his or her identity in any way. The participant number determined which group the participant was assigned based upon whether the identification number was even or odd. Participants with even numbers played *Shoot 'Em*, while participants with odd numbers played *Scramble 'Em.*

The French language was chosen because the content is reasonable to find participants who are inexperienced to the language, and thus, easy to measure prior knowledge acquired. Prior to beginning the session, the researcher asked that any potential participants who were not eighteen years of age or older leave. None did, though the researcher later discovered that three participants were under eighteen at the time of the experimental study, based on the demographic section of the Game Engagement Questionnaire. These participant's' results were excluded from the final analysis of data in Chapter IV.

Intervention

Two educational digital games, *Scramble 'Em* and *Shoot 'Em*, were chosen for this study because of the games' general availability, ability to share the same vocabulary lists, and stark differences in relation to each other and the study's theoretical foundations. Following Baek (2008), these games are short enough to integrate easily into existing class structures and focused enough to allow repeated practice in a limited amount of time, which has been shown to be beneficial for long-term retention (Ebner & Holzinger, 2007).

Shoot 'Em, an educational modification of the best-selling 1978 videogame *Space Invaders*, exemplifies all three of Malone's (1984) conditions of intrinsically motivating digital games, *curiosity*, *challenge*, and *fantasy*. *Shoot 'Em* challenges its players, who must balance the task of shooting the letters of the French phrase in order, guided by the English-language translation shown at the bottom of the screen, with avoiding the attacks unleashed by those letters (which take the place of the invading aliens in *Space Invaders*). Further, the player's time is limited in that if the letters reach the bottom of the screen, the player loses the game. *Shoot 'Em* immerses the player in the fantasy of defending against an alien invasion, and while this may be a simple fantasy, it is supported by a variety of sound effects, backgrounds, and animations, all of which also serve to generate sensory curiosity (Malone, 1984).

Scramble 'Em, based on a traditional word unscramble, fulfills none of Malone's (1984) conditions. As a word game, *Scramble 'Em* does not involve the player in a fantasy. Though the potential to fail does exist for an individual phrase, there is no way to lose the game. Failing to unscramble some or all of the phrases only results in a low final score. This does not create a sense of challenge, as the preliminary tests show. *Scramble 'Em* features four sound effects whose timing is completely consistent and predictable: a popping sound when a letter is placed, a dinging bell when the player correctly spells a word or phrase, a short buzzer when the player incorrectly spells a word or phrase, and a sharp series of beeps when the time allotted to complete a phrase runs out. *Scramble 'Em's* only animation consists of the outline of tiles following the mouse cursor when the player drags a letter toward a blank. The player hears an audio recording of the pronunciation of the word or phrase in French only after unscrambling it correctly in the

allotted time. Without variety, the effects cannot surprise the player, even in combination, and so contribute little to the player's sensory curiosity (Malone, 1984).

Salen and Zimmerman (2004) define a game as "a system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome" (p. 80). All of these factors are important: player decision, rules limiting the course of action, and quantifiable feedback such as win, loss, or a score of some sort. Both *Shoot' Em* and *Scramble 'Em* meet these qualifications. In *Shoot 'Em,* the conflict is clear, as is the feedback; the player either wins or loses and attains a score in either case. Player decision is apparent not only in the choice of which letters to shoot in what order but also whether to play aggressively or hide behind the shields and whether to attempt to shoot additional targets such as the spaceship that crosses the top of the screen or the asterisks that accompany the letters. In *Scramble 'Em,* the conflict is essentially against oneself, seeking to unscramble the French phrases in the least amount of time, thus achieving a high score. Player choice is limited to which letters can be placed in which blanks. Within this limited array of choices, the player can choose to focus on remembering the phrase or quickly and semi-randomly arranging and rearranging the tiles.

Experimental sessions were held in an on-campus computer lab from the mid to late morning or early to mid-afternoon. Participants were randomly assigned a number, which served as their identifier on the pre-test, post-test, and Game Engagement Questionnaire. Participants assigned an even number would play *Shoot 'Em*, and participants assigned an odd number played Scramble *'Em*. All participants interacted with the same vocabulary list, Buensoft French's 'Basic Phrases 2,' which includes not only words, but short phrases.

Each experimental session lasted for approximately thirty minutes to one hour and began with a brief introduction to the vocabulary list, followed by a pre-test, fifteen minutes of gaming, a post-test, and the completion of Brockmyer et al.'s (2009) digital game engagement instrument, which has had extensive validity testing. The questionnaire also asked the participants basic demographic questions such as class level classification, gender, minority status, and socio-economic status.

Instruments of Data Collection

Data collection instruments included an engagement questionnaire, a pre-test, and a post-test. The researcher used Brockmyer et al.'s (2009) Game Engagement Questionnaire (GEQ), which consists of nineteen statements such as "I lose track of time" to which participants respond "no," "sort of," or "yes" (Brockmyer et al.). The questions are not divided into separate sections or categories. The researcher chose the GEQ because it specifically measures participant engagement in digital games, and because the instrument has been extensively tested for validity and reliability (see Appendices B and C). The GEQ's reliability testing yielded a Cronbach's alpha of .85, a Rasch estimate of person reliability of .83, and a Rasch estimate of item reliability of .96. Rasch validation showed that "the modeled data accounted for 69.2% of the variability in the responses" (Brockmyer et al., p 628-629). The research questionnaire additionally included demographic questions regarding race, gender, and socio-economic status, and finally asked for further opinions, reflections, and comments through the use of an open-ended question the researcher added.

The pre-test and post-test both are of the multiple-choice format, with content-level questions concerning the French phrases composing the first page and spelling

questions concerning the French phrases composing the second page. Each test asks two questions about each French phrase: (1) one asks for the meaning of the phrase as written in French, and (2) one requests participants to select the correct French phrase when presented with the comparable English phrase. The second question about each phrase tests spelling knowledge, presenting four possible answers: (1) one correct in both spelling and meaning, (2) one correct in meaning, but incorrect in spelling, (3) one correctly spelled but incorrect phrase, and (4) one phrase that is both incorrect in meaning and incorrect in meaning (see Appendices D, E, F, and G). The pre-test and post-test contain the same questions, with both the order of the questions themselves and the order of the possible responses rearranged. The researcher developed both tests based upon a vocabulary list developed by Buensoft specifically for its French language program. The pre-test and post-tests' validity were established through consultation with an experienced French instructor who determined that the instruments were correct in content and age-appropriate to the participants in the study.

Procedures

The researcher filed all appropriate forms with the university's Institutional Review Board (IRB). The researcher obtained permission from instructors at the community college to recruit their students for the study. The recruitment took approximately five minutes per session, during which the researcher briefly described the study, the general idea of dissertation research, and the incentive offered. Participants were given a consent letter with the instructor and dissertation chair's contact information, information about risks, benefits, and confidentiality. Because the

participants' responses were anonymous, the consent letters were not signed but were kept by the participants.

Research sessions took place within an on-campus computer lab. Participants were given identification numbers at random. These numbers were written on their pre-tests, post-tests, and Game Engagement Questionnaires, and served both to protect their identities and to divide them into two experimental groups; participants with even numbers played *Shoot 'Em,* and those with odd numbers played *Scramble 'Em*. The participants were first given the basic information about the sessions, including the consent letters and the requirement that they be eighteen years of age or older and enrolled as students at the community college. The participants were then given one minute to study the French phrases using Buensoft's *Flash 'Em*, virtual flashcards from the same software suite as *Shoot 'Em* and *Scramble 'Em*. The flash cards included both the French and English phrases and the pronunciation of the French phrases. Immediately following the instruction, the participants were given a pre-test on the material to establish a base score for later comparison.

The participants then played their respective digital games for fifteen minutes. The researcher provided headphones to any participants who did not bring them, allowing them to experience the games' sounds without distractions from other players. The researcher provided assistance to any participants who experienced technical difficulties, such as accidentally closing the game. No major technical difficulties, such as power outages or computer crashes, occurred during the course of this study. Following game play, the researcher gave the participants a post-test and an engagement questionnaire, the latter of which included demographic questions. Pre-tests, post-tests, and engagement

questionnaires were printed on paper and not delivered electronically to the participants, and were marked with the participants' identification numbers, not their names, in order to ensure anonymity. Participants received their incentives immediately upon completing the study, and were dismissed at that time. Other than thanking them, the researcher did not share any additional information after the session, although participant questions were addressed whenever asked. The researcher began collecting data in the Fall of 2013 and concluded in the Fall of 2014.

Initially, participants were allowed five minutes to familiarize themselves with the vocabulary list using *Flash 'Em,* but a problem quickly arose. Far too many of the initial twenty-six respondents (21, or 80.8%) scored 90% or higher on their pre-tests, disqualifying their results from consideration. After consultation with the committee chair, the researcher shortened the participants' *Flash 'Em* time to one minute. The initial twenty-six participants' results were excluded from the analysis. In the end 136 participants' results were included in the analysis. Pre-tests, post-tests, and Game Engagement Questionnaires were graded and recorded on the same day they were completed.

Analysis

The quantitative portion of the results was analyzed using SPSS. Demographic information was analyzed using SPSS's descriptive analysis to determine frequencies of gender, race, and socio-economic status, and to ensure that all cell sizes were appropriate. In the case of the race variable, the cell sizes differed too sharply in size, with fewer than five participants indicating "Hispanic," indicating "Another Race," or indicating a multi-racial identity by marking multiple races on the questionnaire. Thus, the researcher

recoded the race variable into minority status, coding white participants as non-minority, and all other participants as minority. The open-response section of the questionnaire was analyzed using content analysis, or coding the written responses to look for recurring themes and common concerns.

A series of Multiple Analyses of Covariance (MANCOVA) were used, with each followed by multiple univariate Analyses of Covariance (ANCOVA). MANCOVA were appropriate because they could identify connections between the dependent variables while minimizing the chance of Type I error. Within the context of this study, relationships between participant engagement and content knowledge gain were of great interest.

The first MANCOVA used the video game played and socio-economic status as independent variables, with engagement and post-test scores as dependent variables and minority status, gender, and pre-test scores as covariates. The inclusion of post-test scores as dependent variables and pre-test scores as covariates addressed content knowledge gain, rather than final content knowledge, by accounting for prior knowledge as represented by pre-test scores.

The second MANCOVA used the video game played and minority status as independent variables, with engagement and post-test scores as dependent variables and socio-economic status, gender, and pre-test scores as covariates. The third and final MANCOVA used the video game played and gender as independent variables, with engagement and post-test scores as dependent variables and minority status, socio-economic status, and pre-test scores as covariates.

Summary

In summary, the researcher studied students at a public community college in the southeastern United States in terms of how they perceived, interacted, and learned the French language from playing two different types of digital games. The researcher took an experimental, quantitative approach. In comparing levels of content gain and engagement between participants playing two different educational digital games, the quantitative testing methods were most appropriate. Power analysis revealed that a minimum sample size of one hundred twenty-eight was necessary to detect a medium effect size 95% of the time in the follow-up ANCOVA with the given variables, assuming an alpha of .05. The game engagement questionnaire additionally included open-ended questions to give participants the opportunity to reflect upon and explain their experiences.

Participants were drawn from a public community college, without regard for major or program of study. The intervention consisted of a brief lesson on the French language vocabulary, a pre-test, fifteen minutes of digital game-based practice, a post-test, and an engagement questionnaire with demographic items and an open-ended response. Each participant took part in only one intervention, which lasted no more than one hour.

Participants were randomly divided into two groups, each playing one of the two digital games, *Shoot 'Em* and *Scramble 'Em,* short, casual games that could easily be integrated into existing class environments. *Shoot 'Em* was chosen because it fulfilled all three of Malone's (1984) conditions for engagement, and *Scramble 'Em* was chosen because it fulfilled none of them. Participants were given a brief introduction to the

material, took a pre-test, played their respective games, and then took a post-test and engagement survey, consisting of Brockmyer et al.'s (2009) engagement scale, demographic questions, and an open-ended response question.

Quantitative data generated by the pre-tests, post-tests, and engagement questionnaires were analyzed through multiple MANCOVA with follow-up ANCOVA, using SPSS. Descriptive data generated through the open-ended item were analyzed through content analysis to look for common themes or concerns. The experimental design was most appropriate for comparing the effectiveness of two interventions, and in this case, two different educational digital games. Quantitative analysis allowed for the detection of correlations and differences between experimental groups. An open-ended question allowed additional information, additional comments, and context that may not have been anticipated. Responses to the open-ended question were analyzed through content analysis.

Results of these analyses are explored in the next chapter. Final participants are discussed first to indicate the demographics, followed by the quantitative and descriptive results organized by the research question and hypothesis.

CHAPTER IV

RESULTS

This chapter reveals the results of the study, beginning with a description of the participants and variables. Each research question and research hypothesis is examined next with the quantitative Multiple Analyses of Covariance and follow-up Analyses of Covariance. The chapter concludes with content analysis of the themes arising from the participants' open-ended responses.

Description of the Sample

One hundred thirty-six of the 195 total participants had a sufficiently complete set of data, were eighteen years or older, and did not score 90% or greater on the pre-test. Only thirty-six of the participants completed the open-ended questions. Participants missing demographic data key to the study or missing more than 25% of their Game Engagement Questionnaire responses were excluded from the analysis. Game Engagement Questionnaire data was averaged to gain a single score, which was then used in the analysis. Of these 136 participants, sixty-seven played *Scramble 'Em* and sixty-nine played *Shoot 'Em*. Demographic data is as follows: fifty-one were female, and eighty-five were male. Ninety-nine were of lower socio-economic status, as indicated by receiving Pell Grants, while thirty-seven were not. Ninety-one were racial minorities, while forty-five were white (see Figure 1). The majority of the participants in the Minority category were African Americans, with eighty-six of the ninety-one Minority participants (see Figure 2). All 136 participants were students attending a southeastern community college.

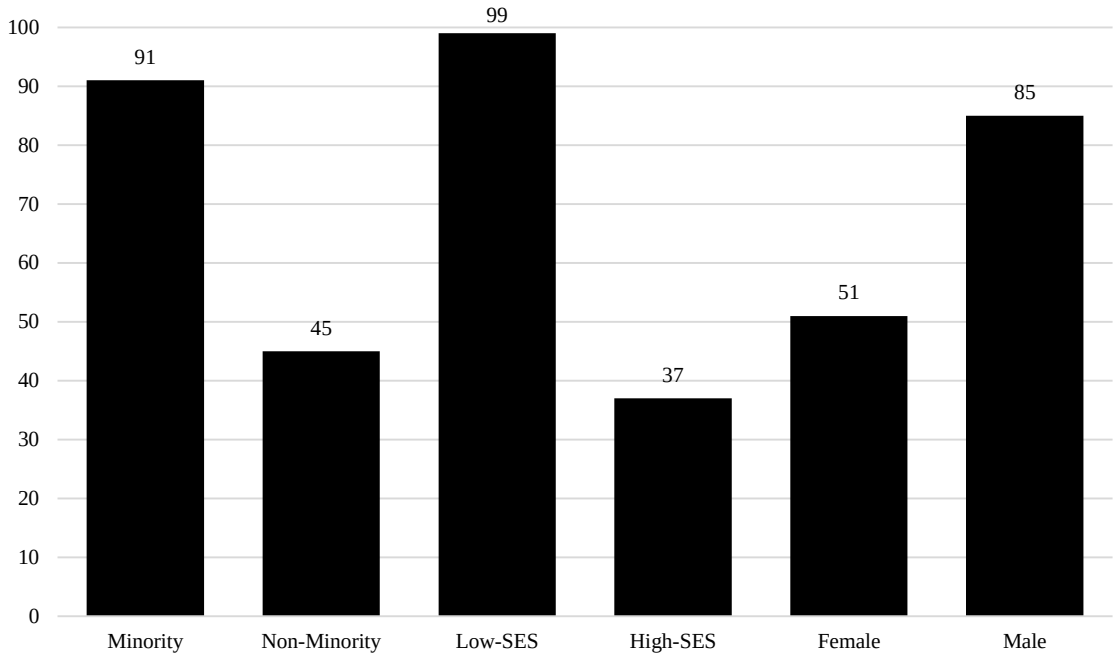

Figure 1. A count of participants in each demographic category.

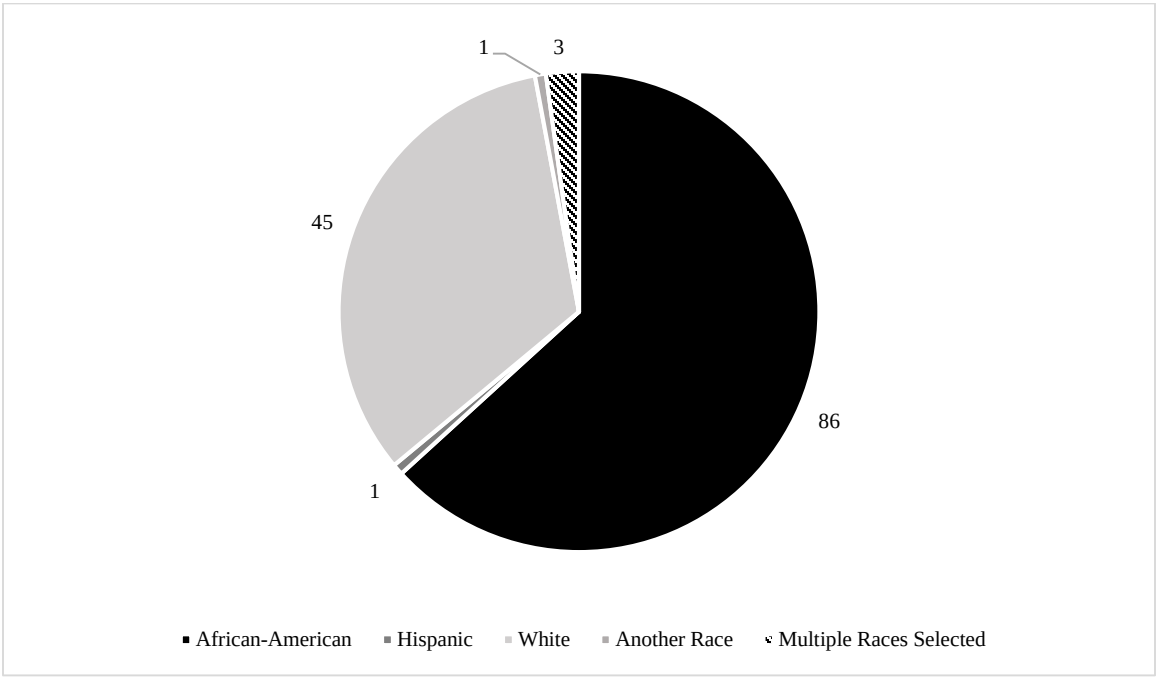

Figure 2. A count of participants by race.

Participants varied in their experience with digital games, both in terms of frequency of game play and types of games played. Twenty-eight of the one hundred thirty-six reported having very little or no experience with digital games, fifty-three participants reported having moderate experience with digital games, fifty-two participants reported gaming frequently or very frequently, and three did not answer (see Figure 3).

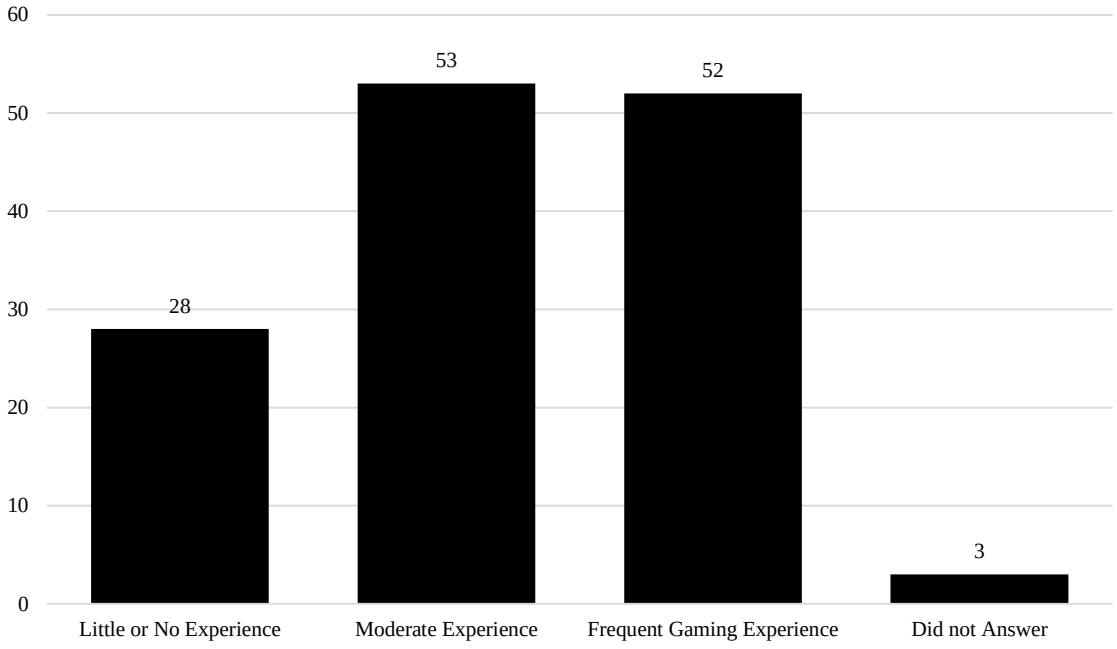

Figure 3. A count of participants by gaming experience.

Fourteen participants reported that they most often played casual and classic games with reflex elements such as *Pac-Man*, *Space Invaders*, and *Tetris*, twenty-one reported that they most frequently played casual and classic games without reflex elements, such as *Angry Birds*, *Farmville,* and *Bejeweled*, thirty-six reported that they most frequently played in-depth action games like *Call of Duty*, *Arkham City,* and *Left 4 Dead,* twelve reported that they most frequently played in-depth strategy and role-playing

games like *Skyrim, Final Fantasy*, and *Starcraft*, thirty-one reported they most frequently played several kinds of games, and twenty-two reported that they did not play video games or very rarely did so.

In the course of data analysis, the researcher examined the meaning-based questions and spelling-based questions separately. Because each test had only ten spelling and ten phrase or meaning questions, the researcher excluded only those individuals who scored 100% on one of the two tests. Some participants who had been excluded from the pre-test versus post-test analysis were included in the spelling-only or meaning-only analysis, and some participants who had been included in the pre-test versus post-test analysis were excluded in one or both of the spelling-only and meaning-only analyses. One hundred twenty-eight participants were retained for analysis of spelling and content, a large enough number for the analyses to have sufficient power.

Description of the Variables

The pre-test and post-test consisted of twenty multiple-choice question each, with each correct question representing one point, yielding a twenty-point scale with a theoretical minimum of zero. Both tests' results were normally distributed. The pre-test had skewness of -.317 and kurtosis of -.803, and the post-test had skewness of -.274 and kurtosis of -.230, both well within acceptable bounds (for a frequency of each score, see Table 1).

Table 1

Pre-Test and Post-Test Scores

	Score	Pre-Test Frequency	Post-Test Frequency	Pre-Test Percent	Post-Test Percent
Valid	0	0	0	0	0
	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	2	0	1.5
	5	0	1	0	.7
	6	0	1	0	.7
	7	1	4	.7	2.9
	8	7	1	5.1	.7
	9	7	8	5.1	5.9
	10	6	11	4.4	8.1
	11	17	12	12.5	8.8
	12	16	13	11.8	9.6
	13	15	9	11.0	6.6
	14	17	21	12.5	15.4
	15	18	11	13.2	8.1
	16	14	13	10.3	9.6
	17	18	10	13.2	7.4
	18	0*	8	0	5.9
	19	0*	5	0	3.7
	20	0*	6	0	4.4
	Total	136	136	100.0	100.0

*Participants with pre-test scores of 18 or higher were excluded from the analysis

The word and phrase meaning and spelling components of the pre-test and post-test each consisted of ten multiple-choice questions, each worth one point, yielding a ten-point scale with a minimum score of zero. All results were normally distributed. The word and phrase meanings pre-test had a skewness of -.357 and kurtosis of -.509, and its post-test had a skewness of -.319 and a kurtosis of -.754, all within acceptable bounds

(see Table 2). The spelling-only pre-test had a skewness of -1.074 and kurtosis of 1.031, and its post-test had a skewness of -.886 and a kurtosis of 1.133, all within acceptable bounds (see Table 3).

Table 2

Pre-Test and Post-Test Scores for Word and Phrase Meaning

	Score	Pre-Test Frequency	Post-Test Frequency	Pre-Test Percent	Post-Test Percent
Valid	0	0	0	0	0
	1	0	0	0	0
	2	2	2	1.6	1.6
	3	5	8	3.9	6.3
	4	10	3	7.8	2.3
	5	17	21	13.3	16.4
	6	22	21	17.2	16.4
	7	28	19	21.9	14.8
	8	20	15	15.6	11.7
	9	24	23	18.8	18.0
	10	0*	16	0	12.5
	Total	128	128	100.0	100.0

*Participants with pre-test scores of 10 were excluded from the analysis

Table 3

Pre-Test and Post-Test Scores for Spelling

	Score	Pre-Test Frequency	Post-Test Frequency	Pre-Test Percent	Post-Test Percent
Valid	0	0	0	0	0
	1	0	0	0	0
	2	0	1	0	.8
	3	3	2	2.3	1.6
	4	0	2	0	1.6
	5	9	6	7.0	4.7
	6	16	12	12.5	9.4

Table 3 (continued).

	Score	Pre-Test Frequency	Post-Test Frequency	Pre-Test Percent	Post-Test Percent
Valid	7	24	29	18.8	22.7
	8	41	31	32.0	24.2
	9	35	29	27.3	22.7
	10	0*	16	0	12.5
	Total	128	128	100.0	100.0

*Participants with pre-test scores of 10 were excluded from the analysis

Brockmyer et al.'s (2009) Game Engagement Questionnaire (GEQ) consists of nineteen questions with three possible values each: *yes, sort of,* and *no*. To create a composite score, *yes* was scored as 3, *sort of* as 2, and *no* as 1, and the scores of all nineteen questions were totaled, creating a scale of nineteen to fifty-seven. GEQ results were normally distributed, with a skewness of .060 and kurtosis of -.810 (see Table 4).

Table 4

Game Engagement Questionnaire Results

Question	No	Sort of	Yes
I lose track of time	63	41	32
Things seem to happen automatically	46	42	47
I feel different	79	18	38
I feel scared	128	4	3
The game feels real	71	28	37
If someone talks to me, I don't hear them	88	23	25
I get wound up	66	28	40
Time seems to kind of stand still or stop	77	22	37
I feel spaced out	88	20	28
I don't answer when someone talks to me	90	19	27
I can't tell that I'm getting tired	81	17	37
Playing seems automatic	40	29	67

Table 4 (continued).

Question	No	Sort of	Yes
My thoughts go fast	35	28	73
I lose track of where I am	99	19	18
I play without thinking how to play	46	24	66
Playing makes me feel calm	40	41	55
I play longer than I meant to	68	20	48
I really get into the game	23	29	84
I feel like I just can't stop playing	66	32	37

Exploration of Research Questions

The researcher explored three research questions and five research hypotheses. The first two research questions were quantitative in nature, dealing with differences in knowledge gain, as measured by post-test scores, and engagement, as measured by the Game Engagement Questionnaire. The last research question examined the themes arising from the participants' open-ended responses.

Research Question One: Differences in Content Knowledge Gain

In regard to this area of examination, the researcher asked the following question concerning the level of content gained:

Are different levels of content knowledge gain (as measured by pre- and post-test scores) and engagement generated by educational digital video games that meet all of Malone’s (1984) three conditions of intrinsic motivation (*challenge*, *curiosity*, and *fantasy*) as opposed to those games that meet none of them?

Hypothesis 1 predicted participants who played games that met Malone's (1984) three conditions would have different levels of content gain (as measured by pre- and post-test scores) than participants who played games that did not.

As a result of the analysis concerning this area, significant differences were not found in terms of content knowledge or engagement in any of the statistical tests run. A MANCOVA with post-test score and engagement as dependent variables, game played as the sole independent variable, and pre-test score as the sole covariate found no significant differences, $F(2, 132) = 2.045$, $p = .133$.

An ANCOVA with game played as the independent variable, pre-test score as the covariate, and post-test score as the dependent variable barely approached significance: $F(1,133) = 3.385$, $p = .068$. The greatest part of the variability in the post-test scores was described by the pre-test scores: $F(1, 133) = 39.095$, $p <. 001$. Looking at word and phrase meanings and spelling separately yielded similar results. A MANCOVA exploring gains in knowledge of word and phrase meanings and spelling revealed no significant differences, $F(2,128) = 1.605$, $p = .205$. Thus, the hypothesis could not be supported.

Hypothesis 2 predicted that participants who played games that met Malone's (1984) three conditions would have different levels of engagement than participants who played games that did not. The difference in engagement between participants who played *Shoot 'Em* and those who played *Scramble 'Em* was not significant: $F(1, 133) = .800$, $p = .373$. As a covariate, pre-test score was not significantly correlated with engagement: $F(1, 133) = .001$, $p = .980$. Hence, the hypothesis was rejected in this case.

Research Question Two: *Gender, Minority Status, and SES*

In regards to this area of demographic effects, the researcher asked the following question in relation to gender, minority status, and SES: If such differences exist, do they vary based on participants' gender, minority status, or socio-economic status?

Hypothesis 3 predicted that participant sex and game type played, either separately or in combination, made a difference in engagement and content knowledge gain (as measured by pre- and post-test scores), in that students of different genders playing the different digital games, would have different levels of engagement and content knowledge gains. The overall MANCOVA was not significant for the game played, $F(2,128) = 1,440$, $p = .241$, sex, $F(2,128) = 1.195$, $p = .306$, or the two together, $F(2,128) = .085$, $p = .918$. A MANCOVA exploring spelling and word and phrase meanings separately revealed no significant differences for game played, $F(3,123) = 1.192$, $p = .316$, sex, $F(3,123) = .197$, $p = .898$, or the two together, $F(3,123) = .079$, $p = .971$. Thus, the hypothesis was not supported.

Hypothesis 4 predicted that minority status and game type played, either separately or in combination, made a difference in engagement and content knowledge gain (as measured by pre- and post-test scores). The overall MANCOVA was not significant for game played, $F(2,128)=1.262$, $p=.287$, or the combination of game played and minority status, $F(2,128)=1.649$, $p=.196$. However, the MANCOVA was significant for minority status alone, $F(2,128)=3.169$, $p=.045$. A follow-up univariate tests showed that minority status had significant correlations to post-test scores $F(1,129)=5.113$, $p=.025$. The mean post-test score for participants with minority status was 12.92, while the mean post-test score for participants without minority status was 14.69.

Separate analysis showed that minority status was correlated with spelling, $F(1,125)=2.007$, $p=.153$, but was related to word and phrase meanings, $F(1,125)=6.686$, $p=.011$. The mean word and phrase meanings post-test score for participants with minority status was 6.60, while the mean word and phrase meanings post-test score for participants without minority status was 7.93. In this case, the hypothesis was supported.

Hypothesis 5 predicted that socio-economic status and game type played, either separately or in combination, made a difference in engagement and content knowledge gain (as measured by pre- and post-test scores). The MANCOVA explored game played and socio-economic status as independent variables, with post-test scores and engagement as dependent variables and pre-test scores, gender, and minority status as covariates. The overall MANCOVA was not significant for game played, $F(2,128)=2.003$, $p=.139$, socio-economic status, $F(2,128)=2.371$, $p=.097$, or the two together, $F(2,128)=.279$, $p=.757$. A MANCOVA exploring word and phrase meaning and spelling was not significant for game played, $F(3,123) = 1.308$, $p = .275$, socio-economic status, $F(3,123) = 1.253$, $p = .294$, or the two together, $F(3,123) = .198$, $p = .898$. Thus, the hypothesis was rejected.

Research Question Three: Common Themes

In regard to the examination of descriptive data, the researcher asked the following question: What common themes will arise out of the participant sample as a result of participation in the experiment? This data was collected through an open-ended question on the Game Engagement Questionnaire that asked participants to provide comments and feedback concerning the experience. Results revealed three common themes that emerged among the participants as they played the games. Note that two of

the thirty-six comments simply indicated that the participants had no comments (e.g., “no,” “nothing that I know of”).

The largest category of participant comments (20 out of 36, or 56%) consisted of praise of the games or the experience as a whole (e.g., “I really enjoyed myself and I wouldn't mind playing daily. I helps warm up my brain. I loved it.”; “This was a great experience”; “I think this is a great way to learn a new language by incorporating games that make you think by recalling the information from your memory”). While much of the praise was nonspecific, one participant commented on the level of engagement felt when playing *Scramble 'Em* as he/she stated,

> The game made me feel in the zone. Like if I was to be in an angry mood, it would bump all focus and calm me down. Great experience, I think it could be one of those modern games, but the graphics need more support.

This comment on engagement aligned with the participant's Game Engagement Questionnaire Average, which was 2.211, approximately one standard deviation above the mean of 1.837 for *Scramble 'Em* players and the overall mean of 1.807.

The second-largest category of participant comments (9 out of 36, or 25%) consisted of statements that the game had helped the participant learn the material. (e.g., “Learned a little French today, I think more people should have to do this to broaden their minds.” “This was a great experience, I actually could tell the difference from both tests after playing the game”).

Among participants that played *Shoot 'Em* and whose scores were not excluded due to scoring 90% or greater on the pre-test, three of the five who indicated the game had helped them learn the material scored the same on the pre-tests and post-tests. One of

the five scored 1 point lower on the post-test than on the pre-test, and one scored 1 point higher on the post-test than on the pre-test. This may indicate that the participants' perception of their learning may not match their actual performance.

Among participants that played *Scramble 'Em* and whose scores were not excluded due to scoring 90% or greater on the pre-test, two of the three scored 1 point lower on the post-test than on the pre-test and one scored 4 points higher on the post-test than on the pre-test. This may indicate that the participants' perception of their learning may not match their actual performance.

Five of the 36 comments (14%) spoke about the games' difficulty. Some comments were "That game was hard!" and "The words were easy enough to spell, but I'm kinda bad at arcade games." The two brief comments given referred to *Shoot 'Em*. Another participant commented on *Shoot 'Em's* focus on spelling, and how it rendered the game more difficult for beginners as he/she said, "Not for first time learners of French. Needs to be more vocab & understanding rather than spelling." One participant left a longer comment concerning the effectiveness of *Shoot 'Em,* regarding both the game's difficulty and the possibility that game elements may have distracted the participant from actual learning.

> The game itself was fun, for an educational game, however, it did not seem to help me understand the phrases better, because though I would get the answer incorrect, it did not tell me what the correct answer was. Therefore I was not able to better my understanding. Also I became more caught up in the elements (avoiding "aliens" and catching up w/the letters) and didn't focus on the material.

A fifth participant commented at length on the difficulty and effectiveness of *Scramble 'Em* as a learning tool and game, "I played the game Scramble Em, (sic) and personally I was only guessing trying to get the letters in the correct order rather than actually playing the game to learn the phrases." If either game did indeed distract participants from the material they were attempting to learn, then that may help explain the lack of significant differences in pre-test and post-test scores.

Summary

In summary, 136 students at a southeastern community college, all aged eighteen or older, participated, with sixty-seven playing *Scramble 'Em* and sixty-nine playing *Shoot 'Em*. Ninety-one of the participants had racial minority status, while forty-five were white. Fifty-one participants were female and eighty-five were male. Ninety-nine participants were of lower socio-economic status, as indicated by receiving Pell Grants, while thirty-seven were not.

Participants took the pre-tests and post-tests to measure knowledge gain. The pre-test and post-test consist of twenty multiple-choice questions each, with each correct question representing one point. Both test results were normally distributed. The word and phrase meaning and spelling components of the pre-test and post-test consisted of ten multiple-choice questions each, with each correct question representing one point. Both word and phrase meaning and spelling test results were normally distributed for both pre-tests and post-tests. The Game Engagement Questionnaire consisted of nineteen questions with three possible values each: *yes, sort of,* and *no*. To create a composite score, *yes* was scored as 3, *sort of* as 2, and *no* as 1, and the scores of all nineteen

questions were totaled, creating a scale of nineteen to fifty-seven. The results of the Game Engagement Questionnaire were normally distributed.

The study addressed three research questions, the first two of which were addressed quantitatively, through analysis of pre-tests, post-tests, and Game Engagement Questionnaire results, and the last of which was addressed through content analysis of open-ended responses. Analysis of Research Question 1 revealed no significant differences in content knowledge gain (as measured by pre- and post-test scores) and engagement between the participants who played *Shoot 'Em* and those who played *Scramble 'Em.* Analysis of Research Question 2 revealed significant differences in content knowledge gain, specifically in the meaning of words and phrases, between white participants and those with minority status, but found that the scores did not vary with regard to game played. Analysis of Research Question 3 found three major themes: (1) nonspecific praise of the game in particular or the project as a whole, (2) statements that the game helped the participant learn the French phrases, and (3) comments about the games' difficulty. Ultimately, the results of the study did not find significant differences in engagement or knowledge gain, either in spelling or comprehension of meaning, between participants playing *Shoot 'Em* and *Scramble 'Em*.

The following chapter concludes with a discussion of the findings and their implications on integrating games into teaching and learning. Recommendations for educators are also provided to offer ideas on how to implement games to promote the learning of content. Suggestions for further research to help build and expand on the findings of this research are given.

CHAPTER V

DISCUSSION

This chapter discusses the findings, outcomes, and implications of the study. It begins with a summary of the study as a whole, and continues with an exploration of the conclusions that can be drawn from the results of each research question. Implications of the study for educational practice are addressed. The chapter concludes with a discussion of the limitations of the study and suggestions for further research.

Summary of Study

Video and computer games are ubiquitous in American society (Entertainment Software Association, 2015; Lenhart et al., 2008). People of all genders, SES, ages, races, and ethnicities play digital games (Andrews, 2008; Entertainment Software Association, 2015; Herselman, 1999; Lenhart et al., 2008), although people of different genders (Andrews, 2008; Annetta, Mangrum, et al., 2009; The NPD Group, 2014) and socio-economic statuses (Andrews, 2008; Herselman, 1999) approach gaming differently.

Educational digital games are similarly widespread (PR Newswire, 2011; Takeuchi & Vaala, 2014). As Vogel et al.'s (2006) meta-analysis shows, extensive research comparing game-based learning to traditional classroom techniques exist, and it overwhelmingly indicates that digital games are effective at increasing engagement and content knowledge. However, little research exists comparing differences between different types of educational games, and more research is needed comparing knowledge gain and engagement among students of different races, genders, and socio-economic statuses.

This study explored the differences in engagement, as measured by Brockmyer et al.'s (2009) Game Engagement Questionnaire, and French content knowledge, as measured with pre-tests and post-tests. The study also examined any further differences between male and female students, minority and non-minority students, and students of low and high socio-economic status, as determined by Pell Grant status.

Educational game design theory is largely rooted in Csikszentmihalyi's (1997) work on flow and engagement. Kiili (2005), Gee (2005), and Papert (1998) proposed flow-based theories favoring broad, complex, user-driven learning environments, and disfavoring shorter, more linear games, especially those that take a Behaviorist drill-and-practice pedagogical approach.

Other theorists and researchers embrace simpler games. Lacasa et al. (2008) noted that shorter, simpler games could be used as a part of a larger learning environment, which could include multiple forms of media, games, reflections, and projects. Each component of the learning environment need not fulfill all of Gee's (2005) or Papert's (1998) conditions to be a part of an ecosystem that did.

Baek (2008) noted that shorter, simpler games may be the only games a teacher can realistically use, given the time constraints of curriculum, testing, and other required activities in the classroom, as well as the older, less powerful hardware many schools and classrooms possess. Tsekleves et al. (2016) noted three major categories of obstacles toward the adoption of learning games in education: technical, financial, and educational. Casual games can address financial and technical obstacles because of their lesser hardware requirements and easier learning curves, and can address educational obstacles in part because they require dedicated class time to play, and in part because a number of

shorter, more-focused games can be more easily integrated to address specific portions of a course's curriculum.

Malone (1984) studied short, drill-and-practice style learning games and created a theory of engaging learning based on the concept that high levels of curiosity, fantasy, and challenge led to greater intrinsic motivation on the part of the players. Malone's theory forms the basis of this study.

Because educational digital games have become so widespread, educators and game designers need empirical, comparative information as to what types of games lead to the greatest engagement and content knowledge gains. This need for comparative information led to three research questions.

Research Question One: Are different levels of content knowledge gain (as measured by pre- and post-test scores) and engagement generated by educational digital video games that meet all of Malone's (1984) three conditions of intrinsic motivation (*challenge*, *curiosity*, and *fantasy*) as opposed to games that do not meet Malone's (1984) conditions?

Research Question Two: If such different levels of content knowledge gain and engagement exist, do they vary based on participants' gender, minority status, or socio-economic status?

Research Question Three: What common themes arise from participants' post-participation comments?

The researcher selected the Buensoft French suite for comparison because it included several short games of different types that all addressed the same lists of French phrases and words. A pilot study done by the researcher and his chair (Dedeaux &

Hartsell, 2011) provided a framework for this study, as well as insight into techniques that did and did not work. The researcher conducted a preliminary study to determine which games most closely adhered to Malone's (1984) three conditions of *curiosity, fantasy,* and *challenge*. The results indicated that *Shoot 'Em,* an educational version of *Space Invaders,* most closely matched Malone's three conditions, and that *Scramble 'Em,* an electronic word scramble puzzle, least closely matched.

Both *Shoot 'Em* and *Scramble 'Em* focused heavily on spelling, and so the researcher developed twenty-question multiple choice pre-tests and post-tests that measured participants' knowledge of the target words and phrases' spelling as well as meaning (see Appendices F and G). The pre-tests and post-tests were validated by an experienced instructor of French. Engagement was measured by Brockmyer et al.'s (2009) Game Engagement Questionnaire (see Appendix C), which had been extensively validated prior to publication, and which is being used with the permission of Dr. Brockmyer. The participants also answered a brief demographic survey, which included an opportunity for open-ended responses or additional commentary.

The study took place at an open-admissions community college in the southeastern United States, in a Windows-based on-campus computer lab. The researcher conducted all research sessions in person. The pre-tests, post-tests, and Game Engagement Questionnaires were paper-based, and pens and headphones were provided for students who did not have or wish to use their own.

The researcher recruited community college students to be participants by word of mouth and by visiting classes in various subjects with instructor permission. Participants were offered a small cash incentive to participate. Participants who scored 90% or above

on their pre-tests were eliminated from the analysis, but they still received their incentive and were allowed to complete the session.

One hundred ninety-six students participated, and 59 were eliminated. The remaining 136 provided usable data sets. Of the 136 participants who were not eliminated, 91 were racial minorities, while 45 were white. Fifty-one were female and 85 were male. Ninety-nine were of lower socio-economic status, as indicated by receiving Pell Grants, while 37 were not.

Participants were assigned a number randomly, which served as an anonymous identifier. Participants with an even number played *Shoot 'Em,* and participants with an odd number played *Scramble 'Em*. At the start of each session, the researcher explained the process to the participants and gave each one an information sheet about the study, with the researcher's and the chair's contact information (see Appendix H). The participants then had one minute to view Buensoft's electronic flashcards for the phrases they would be studying. They then took the pre-test. After the pre-test, the participants played their assigned game for fifteen minutes. Then, they took the post-test and completed the Game Engagement Questionnaire. Participants did not have a time limit when they took the pre-test, post-test, or Game Engagement Questionnaire. The researcher remained present to assist in any technical issues or questions participants had. No major technical difficulties, such as power outages or hard drive failures, occurred during testing.

The researcher analyzed the results of the pre-tests, post-tests, and Game Engagement Questionnaires using SPSS, through a series of three MANCOVA with a follow-up ANCOVA. Engagement and post-test scores served as dependent variables for

the MANCOVA. In the first MANCOVA, video game played and socio-economic status served as the independent variables, while pre-test scores, gender, and minority status served as covariates. In the second MANCOVA, video game played and minority status served as the independent variables, while pre-test scores, gender, and socio-economic status served as covariates. In the third MANCOVA, video game played and gender served as the independent variables, while pre-test scores, minority status, and socio-economic status served as covariates. Open-ended comments were analyzed by content analysis to determine what themes arose from the participants' responses. These analyses revealed answers for the initial research questions.

Research Question One: Are different levels of content knowledge gain (as measured by pre- and post-test scores) and engagement generated by educational digital video games that meet all of Malone's (1984) three conditions of intrinsic motivation (*challenge*, *curiosity*, and *fantasy*) as opposed to games that do not meet Malone's conditions? The researcher found no significant differences between content gain or engagement between participants who played *Shoot 'Em*, which adhered to Malone's three conditions, and *Scramble 'Em*, which did not. The researcher, in fact, found no significant differences in scores between pre-tests and post-tests at all, indicating that neither of the games may have been effective.

Research Question Two: If such different levels of content knowledge gain and engagement exist, do they vary based on participants' gender, minority status, or socio-economic status? No significant differences existed between scores based on gender or socio-economic status. The researcher found that minority participants (mean of 12.92) had significantly lower post-test scores than non-minority participants (mean of 14.69),

and that these differences were significant only in the area of word and phrase meanings, not spelling. The mean word and phrase meanings post-test score for participants with minority status was 6.60, while the mean word and phrase meanings post-test score for participants without minority status was 7.93.

Research Question Three: What common themes arise from participants' post-participation comments? Thirty-six of the participants responded to the open-response question, and three main themes arose from those comments. The largest number, 20 (56%), praised the game and the experience as a whole. Most left non-specific praise, such as "This was a great experience," and one specifically addressed the engagement he or she felt when playing *Scramble 'Em,* writing that

> The game made me feel in the zone. Like if I was to be in an angry mood, it would bump all focus and calm me down. Great experience, I think it could be one of those modern games, but the graphics need more support.

The second-largest group of responses (9, or 25%) noted that the games helped them learn. However, seven of the nine participants' pre-test and post-test scores did not reflect an increase in French language knowledge, indicating that they did not fully understand their own level of knowledge or learning.

Five of the thirty-six participants who left responses (14%) commented on the games' difficulty. Two participants noted that the difficulty of the games distracted them, making it difficult or impossible to focus on the French language words or phrases. If other participants experienced that distraction, but did not make note of it, that may have helped explain the lack of significant differences between pre-test and post-test scores.

Conclusions and Discussion

The results of the quantitative analysis and the themes arising from the participants' comments led to a number of possible conclusions. The lack of significant differences in content knowledge gain and engagement between participants who played *Shoot 'Em* and *Scramble 'Em* does not conform to Malone's (1984) theory, and must be explored. Likewise, the overall lack of difference between pre-test scores and post-test scores among all participants bears examination. The differences that did exist, between the content knowledge gain of minority and non-minority participants, raised questions relevant to those who wished to use digital games for educational purposes.

One area of note was the difference between demographics concerning ethnicity. The results revealed significant differences between pre-test and post-test scores, but only for participants with and without minority status. Participants with minority status scored significantly lower on general post-tests and word and phrase meanings post-tests than participants without minority status. However, this was the only area in which the study revealed a difference. This difference may be a case of the well-documented ethnic-group differences in multiple-choice test scores, in which participants of some ethnic groups, including African Americans, tend to score lower in general on multiple-choice tests (Arthur, Edwards, & Barrett, 2002; Potosky, Bobko, & Roth, 2005; Ryan, 2001).

In terms of learning content, there was no significant difference between pre-test and post-test scores overall, whether taken together or divided between word and phrase meanings and spelling. The experience of playing these games did not seem to affect content gain in any way, regardless of the game played or the participants' socio-

economic status, minority status, or sex. In short, neither *Shoot 'Em* nor *Scramble 'Em* seemed particularly effective at teaching the material in this context.

As studies by Hwang et al. (2015), Ku et al. (2014), Price et al. (2016), and Vogel et al. (2006) show, digital games can be effective in teaching and reinforcing material. The question remains as to why the pre-test and post-test scores did not differ in this study. This could be possible that neither *Shoot 'Em* nor *Scramble 'Em* were effective as teaching tools, but only as tools for study and practice to reinforce material that had already been introduced.

Furthermore, the question as to why participants playing the two games did not differ significantly in engagement must be explained. *Scramble 'Em* may have engaged the participants as a puzzle, even though the game did not meet Malone's (1984) conditions for an engaging digital game. Word scrambles are popular and widely-published puzzles in non-digital form, which implies that they are engaging in their own way. Further, *Shoot 'Em's* difficulty, as reported by multiple participants, may have negatively impacted participants' engagement scores. Although both games were simple, that simplicity may have produced its own learning difficulty, since over 58% of the participants frequently played in-depth games of various sorts, and over 16% rarely or never played digital games. Additionally, participants may have required some time to adjust in using the keyboard controls for an arcade-type game such as *Shoot 'Em.*

Frustration with the difficulty level of the games, especially *Shoot 'Em*, may have distracted the participants from the content knowledge and negatively affected self-reported engagement scores. Malone's (1984) element of *challenge* may have been *too* present in *Shoot 'Em.* Additionally, some participants commented that they were

distracted by the in-game elements of both *Shoot 'Em* and *Scramble 'Em,* such as sound effects in both games, shots fired by the aliens in *Shoot 'Em,* and trying to beat the timer in *Scramble 'Em,* and thus were unable to focus on the content.

The results of this study have failed to support Malone (1984). Perhaps this gives more weight to Papert (1998), Gee (2005), and Harel and Papert (1991), who hold that open-ended, exploratory, user-guided games are superior for learning, and that casual, linear, drill-and-practice games are of little value as educational tools.

Implications

This study may have varying implications for individuals in different fields. Some implications primarily impact educators deciding which games to use, in what capacities, and to what extent. Knowing that drill and practice games perform poorly as teaching tools and better used as tools for reinforcing material that has already been learned can help educators use such games at the best time in the cycle of instruction and for the most effective purposes.

There was no difference in engagement between *Shoot 'Em* and *Scramble 'Em*, and one possible explanation was that a digital version of an engaging activity, such as a word scramble puzzle, may be engaging due to the nature of the activity, even though the digital version itself does not fulfill Malone's (1984) three conditions of *challenge, curiosity,* and *fantasy. Scramble 'Em* is an electronic version of the word scramble puzzle, examples of which appear in many newspapers, apps, and puzzle books. As such, it may have possessed appeal that did not depend upon its digital attributes or its adherence to Malone's conditions. Educators should keep this in mind when selecting activities, games, and choosing whether game use is even advantageous in a given situation.

Another possible explanation of the lack of differences in engagement between *Shoot 'Em* and *Scramble 'Em* may have been the difficulty of the games. Five participants left comments specifically relating to the difficulty of the games, four of them commenting upon *Shoot 'Em's* difficulty, and one commenting upon *Scramble 'Em*. If the games' difficulty was too high for the participants, excessive frustration may have impacted overall engagement. Educators can avoid this problem by allowing their students time to learn any games that will be used, and by choosing games with adjustable difficulty levels when possible.

Educators may also find that effective game use takes too much time to do within the confines of class time. As Baek (2008) noted, teachers face a number of serious time constraints that limits the use of digital games within class time. In rare cases, educators can receive grants or special permission to conduct a large-scale digital game educational study. For instance, Lester et al. (2014), Nietfeld et al. (2014), and Rosas et al. (2003) replaced several classrooms' traditional instruction with purpose-build educational games for an extended period, but this is not something that most instructors can do without outside help. However, shorter games may still have a role, if they are played regularly. In some circumstances, educators may find it easier to allot ten to fifteen minutes per class meeting over the course of a semester than it would be to set aside five or more days for game play, even though the total amount of time would be similar. Shorter, more casual games can, by definition, be played more completely in short, divided segments than immersive, long-playing adventure games.

Meaningful educational use of digital games may require out of class use, which leads to questions of access and the digital divide. College instructors can require the use

of on-campus computer labs, but K-12 educators will have to provide the means for students to play educational games outside of class time, knowing that some of their students may lack computers at home or reliable transportation to a public library or similar site.

Increases in mobile computing power, especially in the area of iOS and Android phones, may provide some relief from the digital divide as even older phones and tablets are capable of both casual and long-playing enthusiast games. Long-playing enthusiast games from the PS/2 and Xbox generation are available on phones and tablets, and have been for several years. *The Bard's Tale*, for example, is an enthusiast role-playing game released for Xbox and PS/2 in 2004, for iOS in 2011, and for Android in 2012. Games such as this could be used to help improve access to learning.

Game designers may find other implications of this study to be relevant. As stated previously, drill-and-practice games did not perform well as methods of teaching material that had been briefly introduced. Instead this type of game should be used to reinforce existing material that has been learned. Game designers should keep this in mind, along with the purpose of the games they are designing, and only use drill-and-practice games for reinforcement and practice purposes.

Educational game designers should prioritize targeted learning over the ability to play a game in a relatively short time frame. The lack of significant difference in content knowledge gain between the pre-test and post-test implied that any games or activities used to learn and reinforce foreign language learning required more time commitment than the fifteen minutes allowed in the study. This time commitment also affects instruction as educators must allow in-class opportunities to play games as Baek (2008)

notes. Educational game designers can also focus on the home market, creating mobile, PC, and console games in various formats to teach specific skills and content while aligning that content with public school curriculum standards.

Finally, game designers should keep in mind the ever-increasing power of mobile computing and the vast penetration of smart phones and tablets throughout the world. Statistica (2015) estimates 147.6 million Americans played mobile games in 2014, and projects this to increase to over 200 million by 2018. Designers who can harness the vast and growing popularity of mobile gaming are more likely to find success, both financially and in terms of education.

Publishers seeking to determine which games to include in textbooks and other educational packages should understand that the games may not fit well into an already crowded class schedule (Baek, 2008; Tsekleves et al., 2016). Even if the games themselves are short, they likely require enough replaying that they will place stress on the time needed. Thus, any included games may need to be played outside of class time as reinforcement. Publishers should consider providing a variety of games for a variety of purposes. Puzzles that are inherently engaging may be just as effective as drill and practice games. Publishers should consider taking advantage of the potential of virtual worlds and long-play games that follow Papert's (1998) principles.

Limitations

For practical and logistical reasons, each participant's role in the study had to be completed in one sitting. This proved to be a serious limitation because this allowed immediate short-term memory to play a disproportionate role in the outcome. Additionally, the study's instruction and reinforcement session differed substantially

from the actual classroom learning environment, which more often features multiple days of instruction prior to a major summative assessment. In this case, long-term learning is of primary importance to educators.

Other limitations include an uneven distribution of participants according to demographics. First, there were more males (N=85) than females (N=51). A gap also existed with socio-economic status with 99 lower-SES participants and 37 higher-SES participants. Finally, in term of minority status there were 91 minority participants and 45 white participants. Although the statistical tests used were robust in the face of these differences, the demographic imbalances could make the experiences, themes, and responses less generalizable. Furthermore, the demographic imbalance may have affected the themes arising from the open-ended responses.

Although the incentive made data collection possible, it may have introduced an additional limitation. Many of the participants were there for the incentive and had little or no personal interest in the subject material or the study itself. On the other hand, a lack of interest on the part of participants could have made the study more analogous to the studied population. Conversely, the desire for the incentive could have created a desire to please the researcher; some participants may have been biased more favorably than they would otherwise have been.

The researcher, following the pattern of the literature, limited the study to a single institution to increase internal validity and remove possible confounding factors, as well as to make the study logistically feasible. However, a single institution in a single region of the United States cannot produce results that could be broadly and confidently generalized to other regions or groups. For similar reasons of internal validity and

feasibility, as well as the desire to find effective educational games that could be played within the time constraints inherent in the K-12 classroom (Baek, 2008), the researcher compared two casual, drill-and-practice games. Therefore, the study's results cannot be generalized with longer-playing, in-depth enthusiast games of the sort that Papert (1998) recommends. The study can likewise not be generalized to other types of casual games, including free-to-play, puzzle-based games, tower defense games, and physics-based games.

Suggestions for Further Research

Although neither *Shoot 'Em* nor *Scramble 'Em* effectively taught the participants French words and phrases, either or both games may be effective as reinforcement and study tools. A follow-up study could test this by addressing participants' experience on two separate days. The participants would be taught language content on the first day. On the second day, the participants would take the pre-test, play their respective games, and take the post-test and Game Engagement Questionnaire. If the researcher had access to large undergraduate lecture classes, the study could be done in a single week, avoiding the limitations of recruiting participants across several months. A single class section could contain sufficient number of participants for the study, and two classes with similar meeting times almost certainly could provide the researcher with enough participants. If several sections met at similar times, the researcher could potentially become involved with the participants to detect small-scale effects.

Further research could include assigning each of two or more short, casual games to different class sections of the same course, preferably taught by the same instructor. A small amount of time every class meeting could be set aside to play the learning games,

and the pre-tests and post-tests could be integrated with the course's curriculum, providing both formative and summative assessment of both groups' progress. This would eliminate any problems caused by unfamiliarity with the games, and it would provide sufficient total play time to show any differences in the effectiveness of the games.

Alternately, researchers could develop a cross-platform, mobile, casual educational game aligned with appropriate curricula, and deploy it within an actual class environment. The researchers would test the game in terms of effectiveness and voluntary student use; that is do the student participants play the learning game voluntarily outside of the class environment, when they have access to other, non-educational digital games, video, music, and social media? Such a study would reexamine Iten and Petko's (2016) findings that students' willingness to play serious learning games is more related to their expectation of learning than their expectation of fun and enjoyment.

Another area to examine is using different grade levels in various locations. Similar studies could be performed across multiple age groups, bringing in elementary, middle, and high school students as well as college students. Age could be a factor in the effectiveness of using games for language learning, and including everyone would help add to the findings of this study. In addition, including different aged participants across multiple geographical areas within and beyond the United States could reveal interesting results not anticipated. Location of the participants could produce results that might be indicative of the culture, education system, values, beliefs, and gaming experiences.

Alternatively, future studies could abandon Buensoft specifically, and other drill-and-practice casual games in general. Instead, comparing two or more in-depth,

exploratory, self-guided games that follow Papert (1998), Harel and Papert (1991), and Gee (2005) theories might produce better results. Later studies could also examine games specifically designed for mobile devices, comparing them against each other, against PC-based drill-and-practice games, and against more in-depth games. Similarly, a future study could compare drill-and-practice games to in-depth, exploratory, self-guided games, although such games would need to be shown to increase content knowledge beforehand. Despite the difficulties involved in making a rigorous and fair comparison of drill-and-practice and in-depth, exploratory, self-guided games, in terms of results and in terms of adherence to Malone's (1984) theory, the resulting insights would be valuable.

Researchers may also find qualitative approaches valuable in comparing different educational games, and, indeed, case studies can be the most feasible methods for examining the effects of multifaceted, learner-driven, in-depth digital game-based learning programs. Schools interested in implementing and comparing game-based learning initiatives could participate in mutual, comparative action research, in which two or more schools enact different game-based learning initiatives and share and compare findings.

Summary

The lack of significant differences between pre-test and post-test scores, across all demographics and categories, implies that in this context neither *Shoot 'Em* nor *Scramble 'Em* effectively taught the content. Participant comments indicate that one possible reason may have been an over-focus on the game elements. Similarly, participants rated both games as the same with regard to engagement, noting *Shoot 'Em's* difficulty especially.

Ultimately, neither *Shoot 'Em* nor *Scramble 'Em* was an effective teaching tool in this context. The lack of significant content gain may also be indicative of the lesser educational value of drill-and-practice games as a whole, or it may simply indicate an insufficiency in these particular games in this particular context. Either of these games may still have value as a form of reinforcement or study tool, but this conclusion is a topic for future research.

APPENDIX A

GAME ASSESSMENT QUESTIONNAIRE

Game Assessment Questionnaire **Participant Number_____**

Malone (1984) defines *Fantasy* as "a system that evokes mental images of physical objects or social situations that are not actually present" (p. 9). Please rate each game you played as to its level of *fantasy*, relative to short, casual games. Mark your choice with an X.

Game	Very Low	Low	Average	High	Very High
Match 'Em					
Scramble 'Em					
Shoot 'Em					
Snake 'Em					

Malone (1984) defines *Challenge* as "a goal whose outcome is uncertain" (p. 6). Please rate each game you played as to its level of *challenge*, relative to short, casual games. Mark your choice with an X.

Game	Very Low	Low	Average	High	Very High
Match 'Em					
Scramble 'Em					
Shoot 'Em					
Snake 'Em					

Malone (1984) defines *Curiosity* in games by stating that "...environments should be neither too complicated nor too simple with respect to the user's existing knowledge. They should be *novel* and *surprising*, but not completely incomprehensible" (p. 10). *Curiosity* includes audio and visual effects, humor, and timing new elements properly (Malone, p. 11). Please rate each game you played as to its level of *curiosity*, relative to short, casual games. Mark your choice with an X.

Game	Very Low	Low	Average	High	Very High
Match 'Em					
Scramble 'Em					
Shoot 'Em					
Snake 'Em					

Use this space to write any additional comments or opinions you want to share. If you need more space, you may use the back of the questionnaire.

APPENDIX B

GAME ENGAGMENT QUESTIONNAIRE – ORIGINAL VERSION

Game Engagement Questionnaire
Please circle the answer that best fits your opinion of the game you played today.

1 I lose track of time	Yes – Sort of – No
2 Things seem to happen automatically	Yes – Sort of – No
3 I feel different	Yes – Sort of – No
4 I feel scared	Yes – Sort of – No
5 The game feels real	Yes – Sort of – No
6 If someone talks to me, I don't hear them	Yes – Sort of – No
7 I get wound up	Yes – Sort of – No
8 Time seems to kind of stand still or stop	Yes – Sort of – No
9 I feel spaced out	Yes – Sort of – No
10 I don't answer when someone talks to me	Yes – Sort of – No
11 I can't tell that I'm getting tired	Yes – Sort of – No
12 Playing seems automatic	Yes – Sort of – No
13 My thoughts go fast	Yes – Sort of – No
14 I lose track of where I am	Yes – Sort of – No
15 I play without thinking about how to play	Yes – Sort of – No
16 Playing makes me feel calm	Yes – Sort of – No
17 I play longer than I meant to	Yes – Sort of – No
18 I really get into the game	Yes – Sort of – No
19 I feel like I just can't stop playing	Yes – Sort of – No

Now, a few questions about you. Please **Circle** the answer that best applies to you:
Race:
African-American Hispanic White Another Race

Gender:
Female Male

Do You Receive Pell Grants?
Yes No

Please give feedback about the games, the tests, or the experience as a whole. If you need more room, you may write on the back of the paper.

APPENDIX C

GAME ENGAGEMENT QUESTIONNAIRE – REVISED

Game Engagement Questionnaire **Participant Number_____**

Please circle the answer that best fits your experience playing the game you played today.

1 I lose track of time	Yes – Sort of – No
2 Things seem to happen automatically	Yes – Sort of – No
3 I feel different	Yes – Sort of – No
4 I feel scared	Yes – Sort of – No
5 The game feels real	Yes – Sort of – No
6 If someone talks to me, I don't hear them	Yes – Sort of – No
7 I get wound up	Yes – Sort of – No
8 Time seems to kind of stand still or stop	Yes – Sort of – No
9 I feel spaced out	Yes – Sort of – No
10 I don't answer when someone talks to me	Yes – Sort of – No
11 I can't tell that I'm getting tired	Yes – Sort of – No
12 Playing seems automatic	Yes – Sort of – No
13 My thoughts go fast	Yes – Sort of – No
14 I lose track of where I am	Yes – Sort of – No
15 I play without thinking about how to play	Yes – Sort of – No
16 Playing makes me feel calm	Yes – Sort of – No
17 I play longer than I meant to	Yes – Sort of – No
18 I really get into the game	Yes – Sort of – No
19 I feel like I just can't stop playing	Yes – Sort of – No

Now, a few questions about you. Please **Circle** the answer that best applies to you:

1) How would you describe your digital gaming experience?

A) I have very little or no experience with digital games
B) I have moderate experience with digital games
C) I game frequently or very frequently

2) When you play, what types of digital games do you *most often* play?

A) Casual and classic games with reflex elements (Pac-Man, Space Invaders, Tetris)
B) Casual and classic games without reflex elements (Angry Birds, Farmville, Bejeweled)
C) In-depth action games like Call of Duty, Arkham City, and Left 4 Dead
D) In-depth strategy and role-playing games like Skyrim, Final Fantasy, and Starcraft
E) I frequently play several kinds of games
F) I do not play video games, or very rarely do so

3) Please circle the answer corresponding to your current **age**:

A) Under 18 B) 18-21 C) 22-24 D) 25 years or older

4) Please circle the answer corresponding to your **race**:

A) African-American B) Hispanic C) White D) Another Race

5) Please circle the answer corresponding to your **gender**:

A) Female B) Male

6) Do You receive Pell Grants?

A) Yes B) No

7) Have you taken any classes in the French Language in the last 10 years, or do you have any experience in speaking French?

A) Yes B) No

If you have anything else you'd like to say about the games, the tests, or the experience as a whole, please write it below. If you need more room, you may write on the back of the paper.

APPENDIX D

PRE-TEST – ORIGINAL VERSION

Pre-test
Please write the **LETTER** of the correct answer on your answer sheet. Please do not write your name on this paper or on the answer sheet.

1) What does “je ne comprends pas” mean?
a) Pleased to meet you b) I don’t understand
c) Please speak more slowly d) My name is

2) What does “non” mean?
a) Please b) Okay
c) No d) Pardon me

3) What does “desolé” mean?
a) Please b) Pleased to meet you
c) Pardon me d) I’m sorry

4) What does “je m’appelle” mean?
a) I’m sorry b) I don’t understand
c) Please d) My name is

5) What does “d’accord” mean?
a) Okay b) I’m sorry
c) Pleased to meet you d) So so

6) What does “pardon” mean?
a) Please b) Pardon me
c) Pleased to meet you d) Okay

7) What does “s’il vous plait” mean?
a) Please b) Pleased to meet you
c) Please speak slowly d) I don’t understand

8) What does “enchanté” mean?
a) Pardon me b) Pleased to meet you
c) My name is d) Okay

9) What does “parlez lentement” mean?
a) Pleased to meet you b) Pardon me
c) Please speak slowly d) So so

10) What does “comme ci, comme ça” mean?
a) So so b) Pardon me
c) Pleased to meet you d) My name is

Please continue to the back of the test and answer questions 11-20.

11) How do you say “Please speak slowly” in French?
a) S’il vous plait b) Parlez lentement
c) Je ne comprends pas d) D’accord

12) How do you say “My name is” in French?
a) Comme ci, comme ça b) S’il vous plait
c) Je ne comprends pas d) Je m’appelle

13) How do you say “No” in French?
a) Non b) D’accord
c) Enchenté d) Desolé

14) How do you say “I don’t understand” in French?
a) D’accord b) Comme ci, comme ça
c) Je m’appelle d) Je ne comprends pas

15) How do you say “I’m sorry” in French?
a) Desolé b) Pardon
c) Non d) Parlez Lentement

16) How do you say “Okay” in French?
a) Desolé b) D’accord
c) S’il vous plait d) Comme ci, comme ça

17) How do you say “Pardon me” in French?
a) Parlez lentement b) Pardon
c) D’accord d) S’il vous plait

18) How do you say “Please” in French?
a) S’il vous plait b) Comme ci, comme ça
c) Je m’appelle d) Parlez lentement

19) How do you say “Pleased to meet you” in French?
a) S’il vous plait b) Non
c) Enchanté d) Desolé

20) How do you say “So so” in French?
a) D’accord b) Comme ci, comme ça
c) Desolé d) Je ne comprends pas

APPENDIX E

POST-TEST – ORIGINAL VERSION

Post-Test
Please write the **LETTER** of the correct answer on your answer sheet. Please do not write your name on this paper or on the answer sheet.

1) What does “parlez lentement” mean?
a) Pleased to meet you b) Pardon me
c) Please speak slowly d) So so

2) What does “comme ci, comme ça” mean?
a) So so b) Pardon me
c) Pleased to meet you d) My name is

3) What does “je ne comprends pas” mean?
a) Pleased to meet you b) I don’t understand
c) Please speak more slowly d) My name is

4) What does “non” mean?
a) Please b) Okay
c) No d) Pardon me

5) What does “d’accord” mean?
a) Okay b) I’m sorry
c) Pleased to meet you d) So so

6) What does “enchanté” mean?
a) Pardon me b) Pleased to meet you
c) My name is d) Okay

7) What does “pardon” mean?
a) Please b) Pardon me
c) Pleased to meet you d) Okay

8) What does “s’il vous plait” mean?
a) Please b) Pleased to meet you
c) Please speak slowly d) I don’t understand

9) What does “desolé” mean?
a) Please b) Pleased to meet you
c) Pardon me d) I’m sorry

10) What does “je m’appelle” mean?
a) I’m sorry b) I don’t understand
c) Please d) My name is

Please continue to the back of the test and answer questions 11-20.

11) How do you say “Pleased to meet you” in French?
a) S’il vous plait b) Non
c) Enchanté d) Desolé

12) How do you say “So so” in French?
a) D’accord b) Comme ci, comme ça
c) Desolé d) Je ne comprends pas

13) How do you say “Please speak slowly” in French?
a) S’il vous plait b) Parlez lentement
c) Je ne comprends pas d) D’accord

14) How do you say “My name is” in French?
a) Comme ci, comme ça b) S’il vous plait
c) Je ne comprends pas d) Je m’appelle

15) How do you say “I’m sorry” in French?
a) Desolé b) Pardon
c) Non d) Parlez Lentement

16) How do you say “Okay” in French?
a) Desolé b) D’accord
c) S’il vous plait d) Comme ci, comme ça

17) How do you say “No” in French?
a) Non b) D’accord
c) Enchenté d) Desolé

18) How do you say “I don’t understand” in French?
a) D’accord b) Comme ci, comme ça
c) Je m’appelle d) Je ne comprends pas

19) How do you say “Pardon me” in French?
a) Parlez lentement b) Pardon
c) D’accord d) S’il vous plait

20) How do you say “Please” in French?
a) S’il vous plait b) Comme ci, comme ça
c) Je m’appelle d) Parlez lentement

APPENDIX F

PRE-TEST – REVISED

Pre-test **Participant Number_____**

Please write the LETTER of the correct answer on your answer sheet. Please do not write your name on this paper or on the answer sheet.

1) What does “je ne comprends pas” mean?
a) Pleased to meet you b) I don’t understand
c) Please speak more slowly d) My name is

2) What does “non” mean?
a) Please b) Okay
c) No d) Pardon me

3) What does “désolé” mean?
a) Please b) Pleased to meet you
c) Pardon me d) I’m sorry

4) What does “je m’appelle” mean?
a) I’m sorry b) I don’t understand
c) Please d) My name is

5) What does “d’accord” mean?
a) Okay b) I’m sorry
c) Pleased to meet you d) So so

6) What does “pardon” mean?
a) Please b) Pardon me
c) Pleased to meet you d) Okay

7) What does “s’il vous plaît” mean?
a) Please b) Pleased to meet you
c) Please speak slowly d) I don’t understand

8) What does “enchanté” mean?
a) Pardon me b) Pleased to meet you
c) My name is d) Okay

9) What does “parlez lentement” mean?
a) Pleased to meet you b) Pardon me
c) Please speak slowly d) So so

10) What does “comme ci, comme ça” mean?
a) So so b) Pardon me
c) Pleased to meet you d) My name is

Please continue to the back of the test and answer questions 11-20.

11) How do you say “Please speak slowly” in French?
a) S’il vous plaît b) Parlez lentement
c) Sil v’oux plaîte d) Parlays l’entment

12) How do you say “My name is” in French?
a) Je n’comprende pas b) Ja me pelle
c) Je ne comprends pas d) Je m’appelle

13) How do you say “No” in French?
a) Non b) N’one
c) Désoel d) Désolé

14) How do you say “I don’t understand” in French?
a) Je n’comprende pas b) Ja me pelle
c) Je ne comprends pas d) Je m’appelle

15) How do you say “I’m sorry” in French?
a) Non b) N’one
c) Désoel d) Désolé

16) How do you say “Okay” in French?
a) Pardonne b) Pardon
c) D’accord d) Dac’corde

17) How do you say “Pardon me” in French?
a) Pardonne b) Pardon
c) D’accord d) Dac’corde

18) How do you say “Please” in French?
a) S’il vous plaît b) Parlez lentement
c) Sil v’oux plaîte d) Parlays l’entment

19) How do you say “Pleased to meet you” in French?
a) Com’ çi, Comme sa b) Comme ci, comme ça
c) Enchanté d) Enchentae

20) How do you say “So so” in French?
a) Com’ çi, Comme sa b) Comme ci, comme ça
c) Enchanté d) Enchentae

APPENDIX G

POST-TEST – REVISED

Post-Test **Participant Number_____**

Please write the LETTER of the correct answer on your answer sheet. Please do not write your name on this paper or on the answer sheet.

1) What does “parlez lentement” mean?
a) Pleased to meet you b) Pardon me
c) Please speak slowly d) So so

2) What does “comme ci, comme ça” mean?
a) So so b) Pardon me
c) Pleased to meet you d) My name is

3) What does “je ne comprends pas” mean?
a) Pleased to meet you b) I don’t understand
c) Please speak more slowly d) My name is

4) What does “non” mean?
a) Please b) Okay
c) No d) Pardon me

5) What does “d’accord” mean?
a) Okay b) I’m sorry
c) Pleased to meet you d) So so

6) What does “enchanté” mean?
a) Pardon me b) Pleased to meet you
c) My name is d) Okay

7) What does “pardon” mean?
a) Please b) Pardon me
c) Pleased to meet you d) Okay

8) What does “s’il vous plaît” mean?
a) Please b) Pleased to meet you
c) Please speak slowly d) I don’t understand

9) What does “désolé” mean?
a) Please b) Pleased to meet you
c) Pardon me d) I’m sorry

10) What does “je m’appelle” mean?
a) I’m sorry b) I don’t understand
c) Please d) My name is

Please continue to the back of the test and answer questions 11-20.

11) How do you say “Please” in French?
a) S’il vous plaît
b) Parlez lentement
c) Sil v’oux plaîte
d) Parlays l’entment

12) How do you say “No” in French?
a) Non
b) N’one
c) Désoel
d) Désolé

13) How do you say “Please speak slowly” in French?
a) S’il vous plaît
b) Parlez lentement
c) Sil v’oux plaîte
d) Parlays l’entment

14) How do you say “Pardon me” in French?
a) Pardonne
b) Pardon
c) D’accord
d) Dac’corde

15) How do you say “I don’t understand” in French?
a) Je n’comprende pas
b) Ja me pelle
c) Je ne comprends pas
d) Je m’appelle

16) How do you say “My name is” in French?
a) Je n’comprende pas
b) Ja me pelle
c) Je ne comprends pas
d) Je m’appelle

17) How do you say “Pleased to meet you” in French?
a) Com’ çi, Comme sa
b) Comme ci, comme ça
c) Enchanté
d) Enchentae

18) How do you say “Okay” in French?
a) Pardonne
b) Pardon
c) D’accord
d) Dac’corde

19) How do you say “So so” in French?
a) Com’ çi, Comme sa
b) Comme ci, comme ça
c) Enchanté
d) Enchentae

20) How do you say “I’m sorry” in French?
a) Non
b) N’one
c) Désoel
d) Désolé

APPENDIX H

AUTHORIZATION AND CONSENT FORM

THE UNIVERSITY OF SOUTHERN MISSISSIPPI
AUTHORIZATION TO PARTICIPATE IN RESEARCH PROJECT

Consent is hereby given to participate in Timothy Dedeaux's dissertation research project, entitled Not Created Equal: A Comparison of Two Educational Computer Games.

Procedures: Participants will be randomly assigned into one of two groups. Participants will be briefly instructed about a list of French vocabulary words, will take a pre-test, will play one of two educational video games, take a post-test, and complete a game engagement questionnaire. Participation will take approximately one hour of the participants' time.

Participant Rights: Participation is completely voluntary, and participants may withdraw at any time without penalty, prejudice, or loss of benefits. Participants will remain anonymous: their names will not be attached to any data. New information that develops during the project will be provided if that information may affect willingness to continue participation.

Data Use: Questionnaire, Pre-Test, and Post-Test data will be combined for analysis. Research is being undertaken as a requirement for Timothy Dedeaux's doctoral dissertation under the direction of his committee and its chair, Dr. Taralynn Hartsell. There is a possibility that results will be published in academic-related journals and/or presented at conferences.

Risks: for the participants will be minimal. Participants will be identified with numbers, so no personal or identifiable information will be attached to the pre-tests, post-tests, or questionnaires. All data will be maintained in a secured location and password-protected on the computer. After the research is completed, the physical copies of the pre-tests, post-tests, and surveys will be destroyed after one year.

Potential Benefits: Participants will gain French language knowledge during the process, have an opportunity to experience the educational software, and be exposed to a freeware language program that they may wish to use in the future for French or other language learning (Buensoft publishes free learning games for several languages, including Spanish & German).

In completing and returning the attached tests and questionnaire the respondent gives permission for this anonymous and confidential data to be used for all purposes described above.

Questions concerning the research, at any time during or after the project, should be directed to the researcher, **Timothy Dedeaux,** at (769) 798-7006, or the dissertation committee chair, **Dr. Taralynn Hartsell,** at (601) 266-4669. This project and this consent form have been reviewed by the Human Subjects Protection Review Committee, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601) 266-6820

APPENDIX I

IRB APPROVAL

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.6820 | Fax: 601.266.4377 | www.usm.edu/irb

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **12110603**
PROJECT TITLE: **Not Created Equal: A Comparison of Two Educational Computer Games**
PROJECT TYPE: **Dissertation**
RESEARCHER(S): **Timothy Dedeaux**
COLLEGE/DIVISION: **College of Education & Psychology**
DEPARTMENT: **Curriculum, Instruction, & Special Education**
FUNDING AGENCY/SPONSOR: **N/A**
IRB COMMITTEE ACTION: **Expedited Review Approval**
PERIOD OF APPROVAL: **01/17/2013 to 01/16/2014**

Lawrence A. Hosman, Ph.D.
Institutional Review Board

Human Subjects Research Application
The University of Southern Mississippi
Institutional Review Board

irb@usm.edu

Timothy Dedeaux 769-798-7006

Name _____ Phone _____

timothy.dedeaux@eagles.usm.edu w469047

E-Mail Address _____ Campus ID # _____

Mailing Address (address to receive information regarding this application)

305 N. 19th Avenue Hattiesburg MS 39401

Street City State Zip Code

Education & Psychology Curriculum, Instruction, and Special Education

College/Division _____ Dept. _____

5057

Department Box # _____ Phone _____

Title Not Created Equal: A Comparison of Two Educational Computer Games

Funding Agencies or Research Sponsors _____

Grant Number (when applicable) _____

○ New Project

◉ Dissertation ○ Thesis

○ Renewal or Continuation: Protocol # _____

○ Change in Previously Approved Project: Protocol # _____

Timothy Dedeaux 10-10-2012

Researcher Name (type) DATE

Taralynn Hartsell

Advisor Name (if applicable) (type)

David Daves

Department Chair Name (type)

APPENDIX J

IRB RENEWAL

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5116 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional-review-board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **CH12110603**
PROJECT TITLE: **Not Created Equal: A Comparison of Two Educational Computer Games**
PROJECT TYPE: **Change to a Previously Approved Project**
RESEARCHER(S): **Timothy Dedeaux**
COLLEGE/DIVISION: **College of Education & Psychology**
DEPARTMENT: **Curriculum, Instruction, & Special Education**
FUNDING AGENCY/SPONSOR: **N/A**
IRB COMMITTEE ACTION: **Expedited Review Approval**
PERIOD OF APPROVAL: **01/06/2014 to 01/05/2015**

Lawrence A. Hosman, Ph.D.
Institutional Review Board

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