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INVESTIGATING GENDER DIFFERENCES IN STUDENT PREFERENCES FOR
AND ACHIEVEMENT WITH EDUCATIONAL GAMES

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Education
in the Department of Educational Research, Technology, and Leadership
in the College of Education
at the University of Central Florida
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ABSTRACT

The purpose of this study was to investigate the choice behavior and achievement of male and female high school students who are given an option of taking a 36 week American History course in either a game-based format or a web-based format. It was hypothesized that (a) males would enroll more frequently in the game-based course than females, (b) there would be no significant difference in achievement between males and females in the game-based course or across course formats, and (c) there would be no significant interaction between gender and the selection of course format.

The study consisted of a sample of 7,962 11th grade students who enrolled in American History during the 2009/2010 school year at the Florida Virtual School (FLVS). Students planning to take 11th grade American History at FLVS were given the choice of enrolling in a game-based class format or a standard web-based online class format. A chi-square test of independence was used to analyze enrollment rates. An independent t test was used to analyze achievement based on gender in the game-based course. A two-way factorial analysis of variance (ANOVA) was used to analyze achievement data based on gender across course formats, enrollment, and the interaction of gender and enrollment.

The chi-square results indicated that there is a relationship between gender and enrollment. Males chose to enroll in the game-based format of the course more frequently than females and females chose to enroll in the web-based format of the course more frequently than males. The independent t test results indicated that there is no significant difference in achievement based on gender in the game-based course. The ANOVA results indicated that there are significant differences in achievement based on gender as well as enrollment, but there are no

significant differences in achievement based on the interaction of gender and enrollment. Implications for researchers, teachers, administrators, game developers, and funders are provided.

I dedicate my dissertation to my wife Jessica, my children Brodie and Ellie,
and my parents Michael and Donna.

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CHAPTER ONE: INTRODUCTION

A wide range of policy-makers, researchers, and educators see video games as important learning tools for future education starting with the U.S. President. President Obama envisions “educational software that’s as compelling as the best video game” so students are stuck on a game that is teaching them something other than how to blow something up (The White House, 2011). The ability for games to engage and motivate learners while assessing complex skills was a goal of the National Education Technology Plan (2010).

Policy-makers are not alone in seeing the promise of games enhancing the way we learn. Researchers and educators see games as part of a fundamental change in education, shifting from passive acquisition of someone else’s ideas to active learning experiences that empower people to inquire, critique, create, collaborate, problem solve, and create understanding (Dede & Barab, 2009). Educational games can provide learners with higher order thinking skills and train individuals for high-performance situations that require complex decision-making through reinforcing skills seldom used, teaching how experts approach problems, and team building (Federation of American Scientists, 2006). Games help students learn to think in innovative ways (Shaffer, 2006) and experience first-hand how members of a profession think, behave, and solve problems (Gee, 2005). Gee and Hayes (2010) suggest that the interest in games is due to the fact that they are built around problem solving in an environment that encourages playfulness and exploration. Students that are playing games are being better cultivated and mentored for society, which is creating an equity crisis for students who lack access to such games (Gee & Hayes, 2010).

One reason to use video games in education is based on a desire to use learning tools that reflect the rapidly changing technological environment that students use (Prensky, 2010). Video

games are now played in 72% of American households and 33% of gamers say that playing computer or video games is their favorite entertainment activity (Entertainment Software Association, 2011). In 2010, the average gamer spent 8 hours a week playing video games (Entertainment Software Rating Board, n.d.). Americans now spend more time online playing games than e-mail (The Nielsen Company, 2010). The Pew Research Center reports that 97% of American teens play video games (Lenhart, Jones, & Macgill, 2008). Notably, 76% of students say they play video games, compared with 49% of non-students (Lenhart, et al., 2008).

Consumers spent \$25.1 billion on games in 2010 (Entertainment Software Association, 2011). The bestselling video game genre by units sold in 2010 was Action with 21.7%, following by Sports and Shooters, 16.3% and 15.9% respectively (Entertainment Software Association, 2011). Companies in the video game industry are reporting significant use of their products. Sony Computer Entertainment (SCE), one of the leading providers of popular video game consoles, reported that the PlayStation®3 computer entertainment system reached a milestone of 50 million units worldwide (Sony Computer Entertainment Inc., 2011). Zynga, a social network game developer, reports having 232 million monthly active users and 60 million daily active users playing their games (Zynga, 2011).

Evidently, the majority of children and young adults today play video games and the video game industry continues to flourish. Research on the effectiveness of video games for facilitating learning, however, remains mixed. Two literature reviews on the effectiveness of video games for learning have found positive instructional benefits when using instructional video games (Dempsey, Rasmussen, & Lucassen, 1994; Vogel et al., 2006), while two other reviews have found mixed results and concluded that there is a lack of high quality empirical research (Hays, 2005; Randel, Morris, Wetzel, & Whitehill, 1992).

Vogel et al. (2006) found significantly higher cognitive gains and attitudes with students using interactive simulations or games compared to traditional teaching methods. Similarly, Dempsey et al. (1994) suggested that “technology-based instructional gaming has a wide spectrum of utility for learning” (p. 5). Hays (2005) concluded that some games provide effective instruction for some tasks some of the time, but cautioned that these results may not be generalizable to other games or instructional programs. Randel et al. (1992) concluded that whether games should be used for educational purposes depends on subject matter.

Video games, as with any media (Clark, 1983), have been shown to be effective, if well designed (Hays, 2005). Clark (2007) has suggested that games are promising vehicles that could motivate students at all ages to engage in the extensive, long-term practice that is necessary to tune, automate, and transfer complex skills. Clark’s vision, however, assumes that all students find games to be appealing enough to motivate students to use games for extensive, long-term practice.

The specific problem addressed by this study is that there is a void of research on whether or not females, when given the choice, will choose to use video games for learning as frequently as males and subsequently, when they do choose to use video games, will their achievement be equal to the achievement of males. A small number of studies have investigated students’ preferences for video games in education using self-report questionnaires and found that males prefer video games more than females (Bourgonjon, Valcke, Soetaert, & Schellens, 2010; Chen, Chen, & Liu, 2010). These findings are based on studies of respondents’ behavioral intentions rather than their actual behavior, which may not be the same. For example, it may be that females state on a questionnaire that they prefer conventional methods over video games, but

actually choose to enroll or participate in educational games more than conventional methods of instruction.

In addition, it appears that the majority of game players (58%) are male (Entertainment Software Association, 2011) and numerous studies have found that males consistently have significantly more experience playing video games than females (Blumberg & Sokol, 2004; Bonanno & Kommers, 2005; Eglesz, Fekete, Kiss, & Izso, 2005; Entertainment Software Association, 2011; Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010; Jackson et al., 2008; Papastergiou, 2009; Terlecki et al., 2011). Such experience differences are found across 5th grade, 8th grade, 11th grade, and college age students (Greenberg, et al., 2010) and present a concern for the adoption of educational video games given that experience has been shown to be a predictor for student's video game engagement (Hoffman & Nadelson, 2010) and preference for video games (Bourgonjon, et al., 2010).

Studies have also found gender similarities and differences in the genres and play modes gamers play. Males prefer physical games (e.g., action, racing, sports) (Greenberg, et al., 2010; Hamlen, 2011; Joiner et al., 2011; Terlecki, et al., 2011) and active (intensive, twitch speed, keys or buttons) and strategic (manipulating and allocating resources) play modes (Kinzie & Joseph, 2008). Females prefer traditional games (e.g., classic board games, puzzles) (Bonanno & Kommers, 2005; Greenberg, et al., 2010; Joiner, et al., 2011) as well as creative (develop characters, build, or modify aspects of the environment) and explorative (navigating simulated layouts) play modes (Kinzie & Joseph, 2008). College females identified their favorite genre as racing (Terlecki, et al., 2011). Both males and females enjoy adventure games (Hamlen, 2011; Terlecki, et al., 2011) with 14-18 year olds preferring them the most (Eglesz, et al., 2005; Greenberg, et al., 2010).

While males and females may enjoy playing similar types of games, research results suggest that males have greater experience playing games (Blumberg & Sokol, 2004; Bonanno & Kommers, 2005; Eglesz, et al., 2005; Greenberg, et al., 2010; Jackson, et al., 2008; Papastergiou, 2009; Terlecki, et al., 2011) and that males may prefer games more than females (Bourgonjon, et al., 2010; Chen, et al., 2010; Hess, 2010). Despite these gender differences, females have been found to perform equally well as males when using games for learning (Annetta, Mangrum, Holmes, Collazo, & Cheng, 2009; Joiner, et al., 2011; Papastergiou, 2009; Vogel, et al., 2006). The problem is that we do not know if females, when given the choice, will choose to use video games for learning as frequently as males and subsequently, when they do choose to use video games, will their achievement be equal to the achievement of males.

Purpose of the Study

The purpose of this study was to investigate the actual choice behavior of male and female high school students who are given an option of taking a 36 week American History course in either a game-based format or a web-based format and the subsequent achievement of those students in the chosen courses. In the 2009/2010 school year, the Florida Virtual School began offering “American History – Conspiracy Code,” which is a full course in American History in the form of an action adventure video game. Florida Virtual School students who were eligible to take American History were sent an email message inviting them to participate in a beta test. Students who were part of the beta test were enrolled in the game-based format of the American History course. The students taking American History who were not part of the beta test were enrolled in the standard web-based, online format. Both courses were taught by Florida Virtual School instructors over a 36 week period providing students with 1 credit.

Research Questions and Hypotheses

Five research questions explored the potential gender differences that may exist when students are given a choice of enrolling in a standard web-based course or an alternative game-based course. The following is a complete list of research questions and related hypotheses.

1. Is there a relationship between gender and the selection of class format (enrollment)?
Hypothesis 1: There is a relationship between gender and enrollment. Males will choose to enroll in the game-based format of the course more frequently than females.
2. Is there a difference in achievement based on gender in a game-based course?
Hypothesis 2: There are no significant differences in achievement based on gender in a game-based course.
3. Is there a difference in achievement based on gender across course formats?
Hypothesis 3: There are no significant differences in achievement based on gender across course formats.
4. Is there a difference in achievement based on enrollment?
Hypothesis 4: There are no significant differences in achievement based on enrollment.
5. Is there a difference in achievement based on the interaction of gender and enrollment?
Hypothesis 5: There are no significant differences in achievement based on the interaction of gender and enrollment.

Overview of Research Method

The study used a sample consisting of 11th grade students who enrolled in American History during the 2009/2010 school year at the Florida Virtual School (FLVS). Students planning to take 11th grade American History course at FLVS were given the choice of enrolling in a game-based class format or a standard web-based online class format. A chi-square test of independence was used to test the first research question. An independent *t* test was used to test

the second research question. Finally, a two-way factorial analysis of variance was used to test the remaining research questions (three through five). Operational definitions for variables are defined below in alphabetical order.

Achievement: The average of the two numeric semester grades a student received.

Web-Based Format of American History: The FLVS course on American History that is of the same online format as the majority of other FLVS course offerings.

Enrollment: The student's selection of either the standard web-based or game-based class format.

Game-based Format of American History: The FLVS course on American History that is in the format of an action adventure game called Conspiracy Code.

Gender: The sex of the enrolled student categorized as either male or female.

Refer to Chapter Three for details on the research method of this study.

Overview of Conceptual Framework

Figure 1 identifies and illustrates the relationship between key variables of interest and provides a conceptual framework for this study. Research on gender differences in video game experience and preferences for video games provide an empirical foundation for the conceptual framework. The relationship between gender and experience is well established based on empirical research, which finds that males have greater experience playing video games compared to females (Blumberg & Sokol, 2004; Bonanno & Kommers, 2005; Bourgonjon, et al., 2010; Eglesz, et al., 2005; Greenberg, et al., 2010; Jackson, et al., 2008; Papastergiou, 2009; Terlecki, et al., 2011).

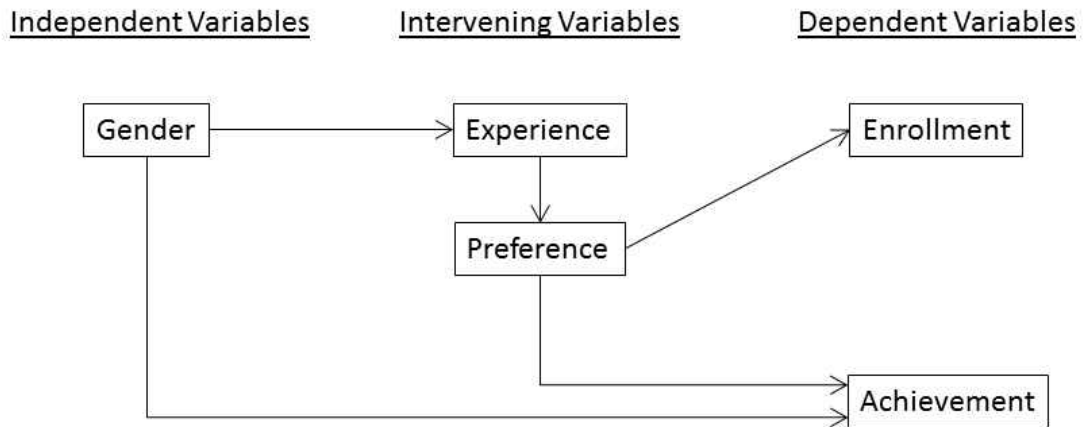


Figure 1: Framework Illustrating Relationship between Gender, Enrollment, and Achievement

Traditional theories explaining this relationship are based on features of the environment or society external to the individual (e.g., children learn at a young age video games are more appropriate for boys, boys own game systems more than girls, games are masculine in nature, physical context is male dominated) (Greenberg, et al., 2010; Hamlen, 2010). New theories take into account research findings that show biological gender differences in the experience of rewards while playing video games (Hoeft, Watson, Kesler, Bettinger, & Reiss, 2008) to suggest that the confidence that keeps males in a motivational cycle of video game play is based on how males experience video games to be rewarding in the brain (Hamlen, 2010).

Bourgonjon et al. (2010) used structural equation modeling to identify experience as a predictor for video game preference. Logic suggests that preference should be a predictor for enrollment behavior. Finally, gender and achievement have been found to be independent of one another (Annetta, et al., 2009; Joiner, et al., 2011; Papastergiou, 2009; Vogel, et al., 2006).

Females have been found to perform equally well as males when using games for learning. It is not clear from the research if there is a relationship between preference for video games and achievement using video games. Refer to Chapter Two for details reviewing related literature.

Significance of Study

The results of the present study are significant for researchers investigating questions about game-based learning, educators responsible for implementing game-based learning, and decision makers responsible for funding game-based learning initiatives.

Researchers

Researchers have examined the factors explaining the preference for video games using a path model where experience has been empirically shown to be a critical factor (Bourgonjon, et al., 2010). Gender has been widely shown to be a predictor for experience (Blumberg & Sokol, 2004; Bonanno & Kommers, 2005; Bourgonjon, et al., 2010; Eglesz, et al., 2005; Greenberg, et al., 2010; Jackson, et al., 2008; Papastergiou, 2009; Terlecki, et al., 2011). Researchers have also found no significant differences in academic achievement between gender (Annetta, et al., 2009; Joiner, et al., 2011; Papastergiou, 2009; Vogel, et al., 2006). However, researchers have not looked past student preferences to see if, when given a choice, females actually choose to enroll in a game-based course significantly less frequently than males or how males and females perform in terms of academic achievement if they take a game-based course based on such a choice. The existing research base has also relied almost exclusively on self-report questionnaires. The present study adds empirical research, based on actual student behavior, to determine the characteristics of students who may benefit from using game-based courses (Hess, 2010).

Educators (Teachers and Administrators)

It is important for teachers and administrators to know if males and/or females prefer game-based courses and if males and females perform differently in game-based versus more conventional web-based or classroom courses. When making instructional decisions there is always the influence of policy-makers, thought leaders, and commercial interests who want to advance a particular new technology or approach to learning. While questions of effectiveness and efficiency are frequently considered in this context, the appeal of instruction is increasingly important (Reigeluth, 1999). After all, one of the key drivers of game-based learning is the assumed appeal that would lead students to want to learn more or spend more time learning. It is important to understand the nature of this appeal to different learners and how this appeal translates into performance. The present study provides empirical research to inform these instructional decisions.

Game Developers and Funders

Perhaps most importantly, this research will help inform equitable funding decisions for game-based learning. There is a question of fairness that arises when the cost of game-based development efforts are considered in the context of potential gender differences in preferences for those developments. Why should money be spent on developments that only one group might prefer or benefit from? Current preferences research indeed suggests that males prefer games more than females, which suggests caution in completely replacing current forms of instruction with game-based learning forms. The present research helps inform if this caution should be expanded or retracted.

CHAPTER TWO: LITERATURE REVIEW

Chapter One provided a context for the study by examining visions for the use of games in education, the current environment in which games are used, and the problem of potential gender differences in the use of educational video games. The purpose of Chapter Two is to review the literature on the independent, intervening, and dependent variables of the study. The review can be described in terms of Cooper's (2003) Taxonomy of Literature Reviews. Research findings are the central interest and focus of the review. However, research methods and theories were considered. The goal of the review is to integrate past literature from a neutral perspective in an exhaustive manner. It is organized conceptually and is intended to benefit researchers, policymakers, educators, and the general public.

Review Strategy

Cooper's (1988, 2003) research synthesis procedure was used to conduct the review using the following five stages: (a) problem formulation, (b) data collection, (c) data evaluation, (d) analysis and interpretation, and (e) presentation of the results.

The evidence considered relevant for the present review consists of peer-reviewed theories and research findings for gender similarities or differences in experience, preferences, enrollment, or achievement with video games, specifically educational video games.

The goal of the data collection stage was to obtain all relevant, high quality, published and unpublished research. The data collection was conducted by searching academic databases and subsequent bibliographies of articles found. These data sources and the terms used to search each source are described in Table 1 below.

Table 1
Academic Databases and Search Strategies

Database	Search Strategy
The Education Resource Information Center (ERIC)	(Educational Games OR Video Games) AND (Student Attitudes OR Elective Courses OR Academic Achievement OR Performance) in SU Descriptor AND gender OR male OR female OR boy OR girl Limit to peer-reviewed
PsycInfo, PsycARTICLES, and PsycBOOKS	(Computer Games OR Simulation Games) AND (Student Attitudes OR Child Attitudes OR Adolescent Attitudes OR Computer Attitudes OR Preferences) in SU Subject Terms AND gender OR male OR female OR boy OR girl NOT violence Limit to peer-reviewed
Academic Search Premier	(Educational Games OR Video Games OR Computer Games) AND (Academic Achievement OR ATTITUDE (Psychology)) in SU Subject Terms AND gender OR male OR female OR boy OR girl Scholarly (Peer Reviewed) Journals
Educational Full Text and Education Index Retro	(Electronic Games OR Educational Games) <in> Subject(s) AND (gender OR male OR female OR boy OR girl) <in> Smart Search AND ((Preferences OR Attitudes OR Achievement Motivation OR Achievement)) <in> Subject(s) Limited to: PEER_REVIEWED
Web of Knowledge	Topic=(educational video game) AND Topic=(preference or achievement or attitude)

Collected data were then evaluated using the criteria described in Table 2 to determine valid studies for inclusion in the review.

Table 2
Literature Review Inclusion and Exclusion Criteria

Inclusion Criteria	<ol style="list-style-type: none"> 1. Included only peer reviewed articles, when peer review settings were available. 2. Focused search on high school or secondary school audiences, but included studies that focused on preferences or achievement with similar audiences (e.g., middle school). 3. Focused search on educational games, but included studies that focused on game-like environments (e.g., simulations).
Exclusion Criteria	<ol style="list-style-type: none"> 1. Excluded articles that did not address gender. 2. Excluded articles that focused on violence or addiction in video games. 3. Excluded articles that did not indicate any aspect of preferences, attitudes, or motivation, or did so with a different focus (e.g., attitude as instructional outcome). 4. Excluded articles that appeared to be the same article published in a different journal. 5. Excluded articles that focused on non-digital games (e.g., physical education games) or gambling games. 6. Excluded articles that focused only on teacher attitudes.

The results of the data collection and evaluation effort yielded forty articles after removing duplicates. The contribution from each data source to this result is described in Table 3 below.

Table 3
Search Results and the Number of Articles Included in the Review by Source

Data Source	Search Results	Duplicates Removed	Included in Review
The Education Resource Information Center (ERIC)	29	9	4
PsycInfo, PsycARTICLES, and PsycBOOKS	55	6	18
Academic Search Premier	20	5	4
Educational Full Text and Education	12	4	3

Data Source	Search Results	Duplicates Removed	Included in Review
Index Retro			
Web of Knowledge	15	1	3
Referenced from general Web searching, bibliography searching, or personal communication references	8	0	8
Total Included			40

The results of the literature review along with analysis and interpretation are provided in the following sections.

Conceptual Framework

Figure 2 identifies and illustrates the relationship between key variables of interest and provides a conceptual framework for this study. Research on gender differences in video game experience and preferences for video games provide an empirical foundation for the conceptual framework.

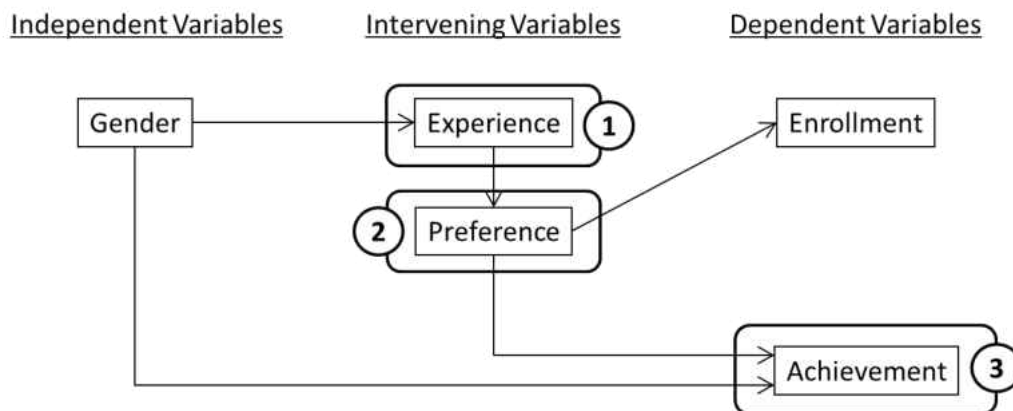


Figure 2: Framework Illustrating Relationship between Gender, Enrollment, and Achievement with Annotated Review Focus Areas

Figure 2 also annotates the three focus areas of this literature review (1) gender differences in experience playing video games, (2) gender differences in preferences for playing video games, and (3) gender differences in achievement when using video games for learning.

Gender Differences in Experience

Gender differences in experience consist of differences in the frequency of how often video games are played by each gender and how each gender experiences motivations to play video games.

Frequency of Game Play Differences

Males play games more frequently than females (Blumberg & Sokol, 2004; Bourgonjon, et al., 2010; Eglesz, et al., 2005; Greenberg, et al., 2010; Jackson, et al., 2008; Papastergiou, 2009; Terlecki, et al., 2011). This finding has been made by educational, psychology, and informatics researchers in China, multiple European countries (e.g., Belgium, Hungary, and Greece), and regions within the United States (e.g., Northeast and Midwest) across elementary age students to university undergraduate age students.

In two large studies ($n = 858$ in one and $n = 1,242$ in the other) that surveyed the average number of hours students (5th grade to university) play video games, males were found to play games at least twice as much in a week (Bourgonjon, et al., 2010; Greenberg, et al., 2010). In the Bourgonjon et al. survey (2010) of 858 Flemish secondary student s (age 12 to 20), the average number of hours males spent playing games weekly ($M = 6.96$, $SD = 7.42$) was significantly more than the average number of hours females spent playing games weekly ($M = 2.16$, $SD = 4.15$); $t(707) = 11.82$, $p < .001$, Cohen's $d = .80$. In the Greenberg et al. survey (2010) of 1,242

5th grade, 8th grade, 11th grade, and university students, the average number of hours males spent playing games weekly (18.6) was significantly more than the average number of hours females spent playing games weekly (8.2) ($p < .001$) and this level of significance was found when each age level was compared individually as well.

A smaller study of 88 Greek high school Computer Science students also found a significant difference in the frequency of game play between males ($M = 3.00$, $SD = 0.82$) and females ($M=2.21$, $SD=0.78$) ($F(1,86) = 21.165$, $p < .001$) (Papastergiou, 2009). However, the scale used to measure the frequency of game play was not the same as the hourly per week scale used in the Bourgonjon et al. (2010) and Greenberg et al. (2010) studies. In the Papastergiou study (2009), students were asked to specify how often they played computer games outside of school on a 4-point scale (1= “never”, 2 = “several times per month”, 3 = “several times per week”, and 4 = “everyday”). This less specific difference between males playing several times per week and females playing more than several times per month is compatible with the finding that males play at least twice as much weekly as females.

A large survey of 602 mainland Chinese students (average age of 12.16) and 604 U.S. students (average age was 12.10), using a similar scale to the Papastergiou study (2009), also found that males ($M = 3.96$, $SD = 1.74$) play games significantly more than females ($M = 2.57$, $SD=1.47$) ($F = 266.96$, $p < .001$) (Jackson, et al., 2008). In the Jackson et al. study (2008), students were asked to specify how often they played videogames on a 7-point scale (1 = “I do not play videogames”, 2 = “about once a month”, 3 = “a few times a month, 4 = “a few times a week”, 5 = “every day, but for less than 1 h”, 6 = “every day, for 1-3 h”, and 7 = “every day, for more than 3 h”). These results across both U.S. and Chinese cultures are similar to the results found in the Papastergiou study (2009). In the Jackson et al. study, males were found to play

games a few times a week, while females were found to play games once to a few times a month. US males played more than US females and Chinese males played more than Chinese females (Jackson, et al., 2008).

A large survey ($n = 2,056$) of undergraduate Psychology students, using a similar, but inverted scale to the Papastergiou and Jackson et al. studies scales, also found that males ($M = 2.31$, $SD = 1.34$) play videogames significantly more than women ($M = 3.57$, $SD = 1.41$) ($F(1,491) = 98.35$, $p < .001$, $\eta^2 = .17$) (Terlecki, et al., 2011). In the Terlecki et al. study (2011), students were asked to specify how often they play video games on a 6-point scale (A = “daily”, B = “weekly”, C = “1 to 2X a month”, D = “1 to 2X in 6 mos.”, E = “1 to 2X a year”, and F = “once every few years to not much at all”) (Terlecki & Newcombe, 2005). Thirty-five percent of men were found to play weekly (with 22% playing daily and 16% playing only once a month), while the greatest percentage of women (14%) only played video games one time a month (with less than 10% playing daily, weekly, or fewer than once a month) (Terlecki, et al., 2011).

Two additional studies found that males play video games significantly more than females (Blumberg & Sokol, 2004; Eglesz, et al., 2005). However, these studies used different and less clear measures than the previous studies. Blumberg and Sokol (2004) asked 46 second-grade children and 58 fifth-grade children if they play videogames a lot or a little with children who answered “a lot” being classified as frequent players and children who answered “a little” being classified as infrequent players. Seventy-two percent of the 44% of all children who reported frequent video game play were boys and a chi-square analysis indicated a significant difference in the distribution of male and female frequent players ($\chi^2(1, N = 104) = 5.82$, $p < .02$). Eglesz et al. (2005) surveyed 843 participants (ages ranging from 10 to over 30, 94.8% of

whom were male) and found that woman play computer games significantly less than men (Mann-Whitney test, $p < .005$).

Motivation Differences

Males are motivated to play video games more than females (Greenberg, et al., 2010; Hamlen, 2010) and are twice as likely to be engaged in gaming as females (Hoffman & Nadelson, 2010). These findings have been made by educational and communication researchers in Midwestern and Southeastern regions of the United States across 4th, 5th, 8th, and 11th grade students as well as university students.

Males find videogames significantly more engaging and gratifying than do females (Greenberg, et al., 2010; Hoffman & Nadelson, 2010). Using a concurrent triangulation mixed method study of 189 college students motivational engagement with videogames, Hoffman and Nadelson (2010) found that males were almost twice as likely to be engaged in gaming as females. In a separate large survey ($N = 1,242$) of 5th-, 8th-, 11th-grade, and university students, Greenberg et al. (2010) found that males were consistently stronger in all measured motives to play videogames than females ($p < .001$). In the Greenberg et al. study, students were asked about their motives for playing videogames on a 36-item questionnaire where each item represented a statement followed by a 7-point scale with responses ranging from strongly agree to strongly disagree. Items measured nine motivational factors: arousal (e.g., “playing video games makes me excited”), diversion (e.g., “I play video games when I should be doing something else”), social interaction (“my friends and I get together to play video games”), fantasy (e.g., “video games let me pretend I’m someone else”), challenge (e.g., “I play the game until I get to a certain level”), hi-tech (e.g., “I like to play video games because they look really

cool”), ego (e.g., “I play video games because I can be strong”), competition (e.g., “When I lose to someone, I want to play them again and beat them”), and realism (e.g., “I play video games because the characters in the games are a lot like real people”). Primary motivations for both males and females are competition ($M = 4.72$ for males, $M = 4.15$ for females) and challenge ($M = 4.52$ for males, $M = 3.92$ for females) (Greenberg, et al., 2010). The largest gender differences in motivation are arousal ($M = 4.46$ for males, $M = 3.37$ for females) and social interaction ($M = 4.30$ for males, $M = 2.55$ for females).

Two studies provide a basis for explaining why males are more motivated to play video games as found in the Hoffman and Nadelson (2010) study and the Greenberg et al. (2010) study. Hoefft, Watson, Kesler, Bettinger, and Reiss (2008) used functional magnetic resonance imaging to study males and females as they played video games. Twenty-two young adults played a video game while their brain activity was monitored. All participants showed brain activation in the mesocorticolimbic center, which is related to reward and addiction. However, males had higher levels of activation in this region of the brain while they played the game and there was a significant relationship between the level of activation they experienced and their achievement in the game (Hoefft, et al., 2008). Based in part on this finding, Hamlen (2010) surveyed 118 fourth- and fifth-grade students and created a two-stage least squares regression model to estimate the endogenous relationship between how good students feel they are at playing video games and how much time they spend playing them in a typical week. Second stage regression results revealed that boys choose to play video games more, which in turn elevates their confidence in their abilities regarding game play, and the confidence provides further motivation for playing more. This motivational cycle was not found for girls, suggesting they are not motivated by the types of rewards offered by games (Hamlen, 2010).

In conclusion, males are motivated to play video games more than females (Greenberg, et al., 2010; Hamlen, 2010) and are twice as likely to be engaged in gaming as females (Hoffman & Nadelson, 2010).

Summary of Experience Differences and Impact on Study Design

Gender differences in experience consist of differences in the frequency of how often video games are played by each gender and how each gender experiences motivations to play video games. A common result across all of these studies is that males spend significantly more time playing video games than females. This conclusion covers various age ranges and cultures. In addition, males are motivated to play video games more than females (Greenberg, et al., 2010; Hamlen, 2010) and are twice as likely to be engaged in gaming as females (Hoffman & Nadelson, 2010). Given that males spend significantly more time playing video games than females (Blumberg & Sokol, 2004; Bourgonjon, et al., 2010; Eglesz, et al., 2005; Greenberg, et al., 2010; Jackson, et al., 2008; Papastergiou, 2009; Terlecki, et al., 2011), that experience has been identified as a predictor for video game preference (Bourgonjon, et al., 2010), and that males are more motivated to play videogames, this contributes to the present studies hypothesis that males will choose to enroll in a game-based version of an educational course more than females.

Gender Differences in Preferences

Gender differences in preferences consists of potential differences in the preferences of students to use video games for education and potential differences in the preferences of students for certain types of games, play modes, or strategies used to learn new games.

Differences in Preferences for Video Games in Education

Females do not prefer using video games in education (Bourgonjon, et al., 2010; Chen, et al., 2010). While males appear to be more in favor of the idea (Bourgonjon, et al., 2010; Hess, 2010), there may be general opposition across genders (Chen, et al., 2010). However, both males and females believe that video games offer learning opportunities (Bourgonjon, et al., 2010). These findings have been made by a very limited number of educational researchers in the U.S., Taiwan, and Belgium across elementary age students to university undergraduate age students.

The finding that females do not prefer using video games in education is based on two survey studies (Bourgonjon, et al., 2010; Chen, et al., 2010) and one mixed methods study (Hess, 2010). In the Bourgonjon et. al (2010) survey of 858 Flemish secondary student s (age 12 to 20), each student was asked to rank 3 items relating to preference for video games on a 5 point Lickert scale, ranging from 1 (“Strongly disagree”) to 5 (“Strongly agree”). The three questions concerning preference for video games were: 1) “If I had the choice, I would choose to follow courses in which video games are used”, 2) “If I had to vote, I would vote in favor of using video games in the classroom”, and 3) “I am enthusiastic about using video games in the classroom.” Results from these items indicate that females do not prefer video games in the classroom ($M = 2.69$, $SD = 1.12$), while males are significantly more in favor of the idea ($M = 3.49$, $SD = 1.14$) ($t = -10.43$, $p < .001$), yet even males are not in full agreement (Bourgonjon, et al., 2010). A similar cautious result was found in a separate survey of the perceptions of 30 Taiwanese university students (20 male, 10 female) conducted by Chen et al. (2010) where students were asked to rank-order 30 statements about online games. The study found that approximately 56.5% of the participants are philosophically opposed to online gaming for education. In particular, the study found that 71.4% of the female participants were opposed to online gaming for education (Chen,

et al., 2010). Finally, in a mixed methods study comparing the learning experiences and outcomes of 92 students enrolled in a web-based American History course and 92 students enrolled in a game-based American History course, gender demographic data collected described fewer females ($n = 41$) than males ($n = 51$) enrolling in the game-based option (Hess, 2010).

In conclusion, a small number of studies have investigated students' preferences for video games in education using self-report questionnaires and found that females do not prefer using video games in education (Bourgonjon, et al., 2010; Chen, et al., 2010) and that while males appear to be more in favor of the idea (Bourgonjon, et al., 2010; Hess, 2010), there may be general opposition to the idea across genders (Chen, et al., 2010).

Gender Differences in Preferences for Genres and Modes of Game Play

Gender differences exist in the preferences for game genres and modes of game play. Males prefer more physical games with active and strategic play modes (Bonanno & Kommers, 2005; Eglesz, et al., 2005; Greenberg, et al., 2010; Hamlen, 2011; Jackson, et al., 2008; Kinzie & Joseph, 2008; Terlecki, et al., 2011). Females prefer traditional and racing games as well as games that provide for creative and explorative play modes (e.g., The Sims) (Bonanno & Kommers, 2005; Greenberg, et al., 2010; Hamlen, 2011; Kinzie & Joseph, 2008). These findings have been made by educational and communication researchers in China and the mid-Atlantic and Midwestern regions of the United States. These studies focused on a wide range of ages from 4th grade students through university students.

Males prefer physical games with active and strategic play modes (Bonanno & Kommers, 2005; Eglesz, et al., 2005; Greenberg, et al., 2010; Hamlen, 2011; Jackson, et al., 2008; Kinzie & Joseph, 2008; Terlecki, et al., 2011). Physical games (e.g., action, racing, and sports) are the

most preferred game genre for males and the male preference for physical games is significantly stronger than females across 5th, 8th, 11th, and university age groups ($p < .001$) (Greenberg, et al., 2010). Similarly, Hamlen (2011) found that fourth- and fifth grade males overwhelmingly (77% of males) preferred action games. At the undergraduate level, males have been found to prefer sports games most (Terlecki, et al., 2011). In a cross cultural study of 12 year olds, Chinese males indicated their top three videogames were Counter Strike (32), QQ (14), and Popcart (11) and US males indicated their top three videogames were Football (18), Grand Theft Auto (18), and Halo (18) (Jackson, et al., 2008). In a study of middle school students, boys were found to prefer active (where a player responds quickly, using rapid-fire techniques) and strategic (where a player must manipulate resources) play modes significantly more than girls (Kinzie & Joseph, 2008).

Females prefer traditional and racing games as well as games that provide for creative and explorative play modes (e.g., The Sims) (Bonanno & Kommers, 2005; Greenberg, et al., 2010; Hamlen, 2011; Kinzie & Joseph, 2008). Traditional games (e.g., classic board games, puzzles) are the most preferred game genre for females and the female preference for traditional games is significantly stronger than males across 5th, 8th, 11th, and university age groups ($p < .001$) (Greenberg, et al., 2010). Hamlen (2011) found that fourth- and fifth- grade females were fairly split between action (35%) and simulation games (36%). At the undergraduate level, females have been found to prefer racing games (Terlecki, et al., 2011). In a cross cultural study of 12 year olds, Chinese females indicated their top three videogames were QQ (23), Shooting Mouse (11), and Popo (9) and US females indicated their top three videogames were the Sims (29), Mario Brothers (25), and Driving/Racing games (11) (Jackson, et al., 2008). In a study of middle school students, girls were found to prefer creative (where a player creates elements

during play) and explorative (where physical space and travel are simulated through the layout of the game arena) play modes significantly more than males (Kinzie & Joseph, 2008).

In conclusion, gender differences exist in the preferences for game genres and modes of game play. Males prefer more physical games with active and strategic play modes (Bonanno & Kommers, 2005; Eglesz, et al., 2005; Greenberg, et al., 2010; Hamlen, 2011; Jackson, et al., 2008; Kinzie & Joseph, 2008; Terlecki, et al., 2011). Females prefer traditional and racing games as well as games that provide for creative and explorative play modes (e.g., The Sims) (Bonanno & Kommers, 2005; Greenberg, et al., 2010; Hamlen, 2011; Kinzie & Joseph, 2008).

Summary of Preference Differences and Impact on Study Design

Gender differences in video game preferences consist of differences in preferences to use video games in education and preferences to play various kinds of games in various manners. The limited studies on preferences for video games in education provide evidence that females may not prefer to use video games in education (Bourgonjon, et al., 2010; Chen, et al., 2010; Hess, 2010). With respect to preferences for game types and modes, males prefer physical games (e.g., action, racing, and sports) with active and strategic play modes and females prefer traditional games (e.g., classic board games, puzzles) and racing games as well as games that provide creative and explorative play modes (e.g., The Sims). These conclusions contribute to the present studies hypothesis that males will choose to enroll in the alternative game-based version of the course more than females and that females will choose to enroll in the standard web-based version of the course more than the alternative game-based version of the course. However, given that the game used in the present study is an adventure game that incorporates puzzles and classic board games, it would seem to align with the preferences of both genders.

Gender Differences in Achievement

There is no evidence of gender differences in achievement when using educational video games (Annetta, et al., 2009; Joiner, et al., 2011; Papastergiou, 2009; Vogel, et al., 2006). This finding has been made by educational researchers in the United States, the United Kingdom, and Greece with fifth-grade students, high school students, and undergraduate students (Annetta, et al., 2009; Joiner, et al., 2011; Papastergiou, 2009).

Prior research has found no significant differences in achievement based on gender when using an educational game. In a pre-/post-test study of 74 fifth-grade students experience playing a multiplayer educational gaming application for several days in the middle of a unit on simple machines, Annetta et al. (2009) found significant differences in gain scores ($p < .01$), but not based on gender ($p > .05$). Finally, in a pre-/post-test study of 158 undergraduate students who played a video game used to support learning of Mechanical Engineering during a Mechanical Engineering course, Joiner et al. (2011) found no significant gender differences in learning based on differences in scores on pre- and post-tests.

Prior research has also found no significant differences in achievement based on gender across game and non-game formats. In a pre-/post-test study of 88 high school students randomly assigned to either a gaming application ($n = 47$) or a non-gaming one ($n = 41$), Papastergiou (2009) found no significant difference $F(1,83) = 2.519$, $p = .116$ in the learning gains that males and females achieved through the use of the game. Similarly, in a meta-analysis of 32 studies reporting cognitive gains between traditional classroom teaching and computer gaming or interactive simulation teaching, Vogel et al. (2006) found no significant differences based on gender.

In conclusion, there is no evidence of gender differences in learning gains when using educational video games (Annetta, et al., 2009; Joiner, et al., 2011; Papastergiou, 2009; Vogel, et al., 2006). This conclusion contributes to the hypotheses of the present study that there are no significant differences in achievement based on gender in a game-based course or across course formats.

Conclusion

Chapter Two has reviewed the literature on gender differences in experience with video games, preferences for video games, and performance results when educational video games are used. It was found that males have more experience playing video games, females do not necessarily prefer educational video games when surveyed, and there are not likely to be any significant achievement differences between males and females. These conclusions influenced the design of the present study, which is the focus of Chapter Three.

CHAPTER THREE: METHOD

Chapter Three presents the design and method of this study. The chapter is divided into seven main sections including: (a) population and sample, (b) research design, (c) intervention, (d) instruments, (e) procedure, (f) data analysis, and (g) limitations.

Population and Sample

The research population consists of high school American History students enrolled in online courses. Online learning opportunities are now available to at least some students in 48 of the 50 states, plus Washington D.C. (Evergreen Education Group, 2010).

The research sample was drawn from students enrolled in American History at the Florida Virtual School in the 2009/2010 school year. The Florida Virtual School (FLVS) is a public school that provides Kindergarten through Grade 12 courses to Florida residents (Florida Virtual School, 2011a). The FLVS student population is diverse. Approximately one-third of students are minorities, with Hispanic and African-American heritage being the predominant minority groups (Florida TaxWatch Center for Educational Performance and Accountability, 2007). All courses at the school are designed according to the State of Florida's Sunshine State Standards (Florida Department of Education, 2011), delivered via the Internet, and accredited by the Southern Association of Colleges and States (SACS) and the Commission on International and Trans-Regional Accreditation (CITA) (Florida Virtual School, 2011a). Credits earned at the school are transferred to the student's public school transcript (Florida Virtual School, 2011b). There are a variety of reasons why a student might enroll in the virtual school ranging from wanting to learn at a faster pace to wanting a way to keep up with the rest of the class (Florida Virtual School, 2011c). The only reason a student would be turned away from the school would

be due to a funding issue that prevents a student from being enrolled in the same course in a traditional school and the virtual school at the same time (C. Conidis, personal communication, September 9, 2011).

The sample consisted of two groups of students who completed American History courses between January of 2009 and October of 2011 at the Florida Virtual School.¹ The two groups are distinguished by the type of American History course in which a student enrolled. The first group, which was referred to as a beta program group by employees of the Florida Virtual School, consisted of students enrolled in the alternative game-based version of American History. The second group consisted of students enrolled in the standard web-based version of American History (see Appendix F) during the same time period as the first group.

To be eligible for membership into the beta group, the student had to be an existing FLVS student and fluent in English. A series of email messages (see Appendices A-E) were sent to 9th, 10th, and 11th grade FLVS students who had not yet completed American History. These email messages described the opportunity to take American History in the form of a game called Conspiracy Code. After a sufficient number of students responded to the email solicitations, a series of email messages were sent to interested students describing the technical requirements for running the game and the need to acquire parental permission. As each interested student obtained permission from parents, the student ran a computer program to check for technical requirements to run the game. FLVS technical support worked with each student to ensure a suitable computer and configuration was used to run the game. Some students were not able to resolve technical issues and withdrew before being activated. The students that were able to

¹ Hess (2010) examined a similar dataset of American History student records from the Florida Virtual School who completed their respective course from April 22, 2009 through February 1, 2010.

obtain permission from parents and meet the technical requirements were enrolled for the game-based American History course.

The sample data consisted of a spreadsheet of 59,113 records. The fields of the spreadsheet were: (a) de-identified student number, (b) gender, (c) course enrollment, (d) segment, (e) final numeric grade, and (f) enrollment status. The range of values for each field is described in Table 4.

Table 4
Descriptions of Sample Data Fields

Field	Values
Student Number	De-identified student number
Gender	M or F
Course Enrollment	“American History” or “American History – Conspiracy Code”
Segment	1 or 2
Final Numeric Grade	0-100
Enrollment Status	“Complete”, “Complete Failing”, “Never Activated”, “Withdrawn Failing”, or “Withdrawn No Grade”

The sample provided contained a large number of incomplete course records, multiple records for a single student, and records where a student was enrolled in only one of the two course segments. The 34,355 records representing incomplete course segments where the student never activated (23,418), withdrew with a failing grade (3,878), or withdrew with no grade (7,059) were removed from the sample.

The remaining 24,758 student records were split into two datasets based on segment. The two segment datasets were then merged based on the de-identified student number resulting in

7,963 student records with a final grade for both segments 1 and 2. The remaining 8,832 student records with only one segment grade (either segment 1 or segment 2, but not both) were removed from the sample. Finally, there was one student record where the gender was not provided, which was removed from the sample as the value could not be interpreted.

The resulting 7,962 student records, representing 7,962 students who completed both segment 1 and segment 2 and received a final grade for each segment, was the sample used for the final analysis. An average final grade was computed based on adding the two individual segment scores and dividing by two.

There were 4,954 females and 3,008 males in the final sample. Over 96% of course enrollments were for the standard web-based American History course (7,682), while less than 4% of course enrollments were for the alternative game-based American History – Conspiracy Code course (280) (see Table 5). The mean of the average final grades was 89.46 ($SD = 7.554$).

Table 5
Gender and Course Enrollment Frequencies

		Course Enrollment		
		American History	American History – Conspiracy Code	Total
Gender	Female	4826	128	4954
	Male	2856	152	3008
Total		7682	280	7962

Research Design

A causal comparative (ex post facto) research design was used to examine potential differences in student enrollment and grade performance between an educational video game and a standard web-based course based on gender. The Florida Virtual School has invested in creating an educational game and a standard web-based course by which to learn American History where both courses are of equivalent credit. This is a unique and valuable research setting. The present study analyzed initial data from this natural setting to begin investigating the role of gender in relation to educational video games. This “relatively inexpensive correlational approach can provide a preliminary survey of hypotheses, and those which survive this can then be checked through the more expensive experimental manipulation” (Campbell & Stanley, 1963, p. 64) as this unique educational program evolves out of a beta phase.

Intervention

The intervention in this study consisted of a choice between a standard web-based American History course and an alternative game-based American History course. Both courses offered the student the same full credit of American History. In addition, both courses are independent, self-paced formats time (C. Conidis, personal communication, March 23, 2012).

Standard Web-based American History Course

The standard web-based American History course uses a standard learning management system web-based user interface (see Appendix G). The commercial product is called BrainHoney and is made by Agilix. The student is initially provided with general information when entering the web-based course to familiarize students with the online course and the

instructor. The general information includes: 1) pace, 2) course materials, 3) getting started, and 4) course syllabus. Students are given the choice of choosing the pace of the course they'd like to take. The traditional pace (completing the course in two segments [32-36 weeks]) is the recommended pace. A pace guide provides a table showing which lessons to complete for each week. Students need to contact an instructor to change their pace. The course materials page informs students that they will need a computer with access to the internet and a printer, the ability to construct visual presentations like a poster, and the Flash player. The getting started page provides guidance on organizing the student's workspace, organizing the student's time, and maximizing the student's learning (i.e., checking email, looking at returned work, looking at schedule, and checking the gradebook).

The web-based interface provides a series of tabs at the top of the screen used for navigation. The tabs are: 1) View [modules], 2) Grades, 3) Objectives, 4) Activity, and 5) Communicate. The View tab, which allows students to view course modules, is the primary tab. A navigation tree is on the left hand side of View tab with links to expand or contract each of the course's 10 modules to reveal the module's lessons. The course is divided into two segments. The first segment covers modules 1 (Introduction) through 5 (Civil Wrongs vs. Civil Rights). The second segment covers modules 6 (Manifest Destiny vs. American Imperialism) through 10 (The Recent Past). To help the student keep track of where they are in the course, green checkmarks appear in the navigation tree showing them lessons they have viewed. The Activity tab also provides a list showing each module and lessons within each module the student has viewed as well as the time and duration each lesson was viewed. The web-based interface allows students to jump between modules and lessons freely, but students are encouraged to follow their pace guide, which tells them which lessons to focus on each week.

The first activity of each module provides the student with the objectives of that module. The second activity of each module provides the student with the module's progress chart, which lists the assignments due for the module along with the estimated time necessary to complete each assignment for planning purposes. The rest of the module is composed of lessons and links to assignments and assessments. There are approximately 6 lessons in each module. Activities within each lesson include: reviewing web page content, engaging in interactive self-check quizzes, responding to questions, writing assignments and essays, watching videos, listening to speeches, and participating in discussion-based assessments. Once a student is issued a grade in either course, they no longer have access to the course content. However, while a student is in the course he or she can interact with the content as much as he or she would like (C. Conidis, personal communication, September 9, 2011).

Alternative Game-based American History Course

The alternative game-based American History course uses a standard learning management system web-based user interface and a single-player, 3D-platform, espionage-themed adventure game (see Appendix H). The commercial web-based interface is called SiTi and is made by 360ed (the developers of the game). The student is initially provided with general announcements when entering the web-based interface. Along the top of the web-based interface are a series of tabs used for navigation. The tabs are: 1) Home, 2) Messages, 3) Assignments, 4) Grades, 5) Forum, 6) Clues, 7) Resources, and 8) Help. On the home page, the student sees a link at the top of the screen to "Play Conspiracy Code American History." Clicking on this link launches the game.

In the game, students play as Eddie Flash and Libby Whitetree, the two primary characters, as they build their knowledge of American History in order to stop a vast conspiracy that is threatening to erase and change the course of history (The Florida Virtual School, 2011). Activities within the game include: collecting clues, playing concept practice games, responding to questions, writing assignments and essays, completing game-based assessments, and participating in discussion-based assessments (The Florida Virtual School, 2011). Ultimately, students use their knowledge to complete culminating mission assessments (The Florida Virtual School, 2011). Once a student is issued a grade, they no longer have access to the course content. However, while a student is in the course he or she can play as much as he or she would like to play (C. Conidis, personal communication, September 9, 2011).

Instrumentation

Both American History courses align with the Florida Department of Education course description and associated Sunshine State Standards (The Florida Department of Education, 1998). The grading rubrics are the same with the exception that the game-based course is organized by themes and the standard web-based course is organized chronologically.

All FLVS courses are divided into two segments. Both segments are taught by the same instructor and each segment is graded independently. There is no year round, final, average grade. Grades are reported to home school districts by semester and most school districts use semester grades as well. If a student passes one half of the class and not the other, they only have to retake the half of the class they failed and not the entire course.

The standard web-based course uses the standard FLVS Learning Management System (LMS) called Educator developed by UCompass, which underlies the BrainHoney user interface.

The alternative game-based course uses a specialized LMS called SiTi. Both LMS systems report student progress information to the organization's primary information system called the Virtual School Administrator (VSA). The VSA was developed in-house and is used for registration, placement, progress tracking, grades, logs, school information, etc.

Instructors proactively monitor, guide, and advise students in both classes by checking student activity, assessing projects, providing feedback, and conducting discussion-based assessments using a web-based communication interface, email, online conferencing, phone calls, and instant messaging (The Florida Virtual School, 2011). Multiple instructors teach the game-based course and multiple instructors teach the standard web-based course. Some instructors teach both courses (C. Conidis, personal communication, September 9, 2011). Given that multiple instructors teach each course and that some instructors teach both courses, the threat of instructor bias is minimized.

Data Analysis

Three data analysis techniques were used to address the research questions. A chi-square test of independence was used to address the first research question. An independent t test was used to test the second research question. Finally, a two-way factorial analysis of variance was used to test the remaining research questions (three through five). Each analysis technique is described below associated with the respective research question it addresses.

Question 1: Is there a relationship between gender and the selection of class format (enrollment)? To address this question, a chi-square test of independence and correlation coefficient was used.

Question 2: Is there a difference in achievement based on gender in a game-based course?

To address this question, an independent t test was used to compare the mean achievement scores between males and females enrolled in the game-based course.

Question 3: Is there a difference in achievement based on gender across course formats?

To address this question, a two-factor analysis of variance (ANOVA) was used with the following factors: 1) enrollment type (between subjects factor) with two levels (alternative game-based and standard web-based) and 2) gender (between subjects factor) with two levels (male and female). The dependent variable was the average of the two grades the student received at the end of each segment. The main effect of differences in achievement between gender levels was analyzed.

Question 4: Is there a difference in achievement based on enrollment? To address this question, a two-factor ANOVA was used with the following factors: 1) enrollment type (between subjects factor) with two levels (alternative game-based and standard web-based) and 2) gender (between subjects factor) with two levels (male and female). The dependent variable was the average of the two grades the student received at the end of each segment. The main effect of differences in achievement between enrollment levels was analyzed.

Question 5: Is there a difference in achievement based on gender and enrollment? To address this question, a two factor ANOVA was used with the following factors: 1) enrollment type (between subjects factor) with two levels (alternative game-based and standard web-based) and 2) gender (between subjects factor) with two levels (male and female). The dependent variable was the average of the two grades the student received at the end of each segment. The interaction effect between enrollment and gender was analyzed.

Procedure

To obtain the data used in this study, the researcher completed, signed, and notarized a Florida Virtual School (FLVS) Research Request Proposal. The proposal was submitted to the FLVS Research Committee for consideration through the organization's web-based system. The Research Request Proposal was approved on September 1, 2011.

The researcher then submitted finger prints to FLVS to comply with organizational policies. Once the finger prints were processed, the FLVS research specialist accessed the FLVS in-house information management system known as the Virtual School Administrator (VSA) to pull the relevant data.

Prior to transferring the data to the researcher, the FLVS staff reviewed the data and removed any personally identifiable information to comply with guidance from the university institutional review board. The cleansed data was then exported as a Microsoft Excel formatted file and transferred to the researcher via an FLVS provided secure download mechanism.

The research was conducted with the cooperation and approval of a research committee composed of Florida Virtual School faculty and staff. The University of Central Florida Institutional Review Board (IRB) staff concluded that this study did not require IRB review given that the Florida Virtual School staff provided de-identified data, which precluded the ability to identify human subjects.

Limitations

The study sample was drawn from a virtual high school that offered students a choice in taking American History through either a web-based course or a game-based course. The generalization of results is limited to a similar population and a similar choice in course format.

A description of the two course formats, the sample data, and the procedure used to obtain the sample data are provided in this chapter in order to use the study results in other situations.

The sample data was limited to quantitative enrollment and achievement data.

Explanations for why students chose to enroll in a particular course can only be inferred based on prior studies as neither interviews nor surveys were used. The novelty of the new course (Clark, 1983) or the recruiting strategy of the beta program may have affected the enrollments and achievement results by artificially increasing effort and attention. In addition, a large portion of the sample data represented incomplete student records. The reasons for the numerous withdraws are not documented, but technical issues are believed to be a primary account.

Furthermore, each course is organized differently and therefore the assessments are not the same introducing a possible instrumentation effect. However, both courses are aligned to the same standards and both courses provide the same American History credit back to the home school. In addition, multiple instructors teach the game-based course and multiple instructors teach the standard web-based course. However, some instructors teach both courses (C. Conidis, personal communication, September 9, 2011). Given that multiple instructors teach each course and that some instructors teach both courses, the threat of instructor bias is minimized.

Finally, measures of achievement in the study are constrained to the assessments used in the courses during the active semester when the courses were taught.

CHAPTER FOUR: RESULTS

Chapter Four presents the results of testing the five hypotheses using the causal comparative (ex post facto) study delineated in Chapter Three. Three separate statistical tests were used. The first test addressed the first research hypothesis proposing a relationship between gender and enrollment. The second test addressed the second research hypothesis proposing that there is no significant difference in achievement based on gender in the game-based course. Finally, the third test addressed research hypotheses three through five proposing that there are no significant differences in achievement based on gender, enrollment, or the interaction of gender and enrollment, respectively. The results of each test are described in the following section.

Hypothesis One: Relationship between Gender and Enrollment

The first research question asked if there is a relationship between gender and the selection of class format (enrollment). The hypothesis was that there is a relationship between gender and enrollment. A chi-square test of independence was conducted to test the hypothesis. The results of the test suggests that with an alpha level of .01, the relationship between gender and enrollment is statistically significant (continuity correction = 32.913, $df = 1$, $p < .001$). The continuity correction was used to reduce the error in approximating the probability of the binomial frequencies with the continuous chi-squared distribution.

The frequencies, expected frequencies, and standardized residuals for male and female enrollment rates in the web-based and game-based courses are depicted in Table 6. Males enrolled in the game-based course 152 of the 105.8 expected times. Whereas females only enrolled in the game-based course 128 of the 174.2 expected times. There is a relationship

between gender and enrollment. Males chose to enroll in the game-based format of the course significantly more frequently than females. In addition, females chose to enroll in the web-based course significantly more frequently than males.

Table 6
Contingency Table for Gender and Course Enrollment

			Course Enrollment	
			American History	American History – Conspiracy Code
Gender	F	Count	4826	128
		Expected Count	4779.8	174.2
		Std. Residual	0.7	-3.5
	M	Count	2856	152
		Expected Count	2902.2	105.8
		Std. Residual	-0.9	4.5

Note. F denotes Female and M denotes Male levels of Gender.

Hypothesis Two: Achievement in Game-based Course

The second research question asked if there is a difference in achievement based on gender in a game-based course. The hypothesis was that there are no significant differences in achievement based on gender in a game-based course. An independent *t* test was used to test the hypothesis using achievement data gathered from samples of 152 males and 128 females who enrolled in the game-based course. Fifteen outliers representing the lowest average final grades and consisting of six females and nine males were removed to address concerns of normality in

the sample data. The modified sample data contained 143 males and 122 females. According to Levene's test, the homogeneity of variance assumption was satisfied ($F = .043, p = .837$). The independent t test indicated that the achievement means were not significantly different statistically ($t = -.613, df = 263, p = .540$). The mean grade for females was 92.8 ($SD = 4.178$), while the mean grade for males was 92.5 ($SD = 4.057$). The hypothesis that there is no significant difference in achievement based on gender in the game-based course failed to be rejected. The average grade of males was not significantly different from the average grade of females.

Hypotheses Three through Five: Achievement across Course Formats

Research questions and hypotheses three through five proposed that there are no significant differences in achievement based on gender across course formats, enrollment, or the interaction of gender and enrollment, respectively. To test these hypotheses, a two-way factorial analysis of variance (ANOVA) was conducted.

The sample data violated the assumption of homogeneity of variance as Levene's homogeneity of variance test was statistically significant ($p < .01$). To limit the effect of heterogeneity, a random sample of 280 students from the 7,682 students enrolled in the web-based course was used to achieve equal n 's.

The resulting sample consisted of 560 students where 280 students enrolled in the web-based course and 280 students enrolled in the game-based course. Means and standard deviations for the web-based course before and after the random sample are depicted in Table 7.

Table 7
Web-based Course Means Before and After Random Sampling

	Count	Mean	<i>SD</i>
Before	7,682	90.1	7.235
After	280	89.7	6.907

Hypothesis Three: Gender

The third research question asked if there is a difference in achievement based on gender across course formats. The hypothesis was that there are no significant differences in achievement based on gender across course formats. The results of the ANOVA test suggests that there was a statistically significant difference $F(1,556) = 5.462, p = .02$ in achievement based on gender across course formats with an alpha level of .05. However, only 1% of the variance in grade was explained by gender ($\eta_p^2 = .01$), which is a relatively small effect size (Cohen, 1992). The mean grade for females was 91.2 ($SD = 5.787$), while the mean grade for males was 90.3 ($SD = 6.861$). The hypothesis that there is no significant difference in achievement based on gender across course formats is rejected with reservations given the relatively small effect size. Female grades were significantly higher than male grades statistically, but there is little practical importance ($\eta_p^2 = .01$).

Hypothesis Four: Enrollment

The fourth research question asked if there is a difference in achievement based on enrollment. The hypothesis was that there is no significant difference in achievement based on enrollment. The results of the ANOVA test suggests that there is a statistically significant

difference $F(1,556) = 17.452, p < .001$ in achievement based on enrollment. However, only 3% of the variance in grade is explained by enrollment ($\eta_p^2 = .03$), which is a very small effect size (Cohen, 1992). The mean grade for the web-based course was 89.7 ($SD = 6.907$), while the mean grade for the game-based course was 91.8 ($SD = 5.532$). The hypothesis that there is no significant difference in achievement based on enrollment is rejected with reservations given the relatively small effect size. The grades of students enrolled in the game-based course were significantly higher than the grades of students enrolled in the web-based course statistically, but the difference appears to hold little practical importance ($\eta_p^2 = .03$).

Hypothesis Five: Interaction of Gender and Enrollment

The fifth and final research question asked if there is a difference in achievement based on the interaction of gender and enrollment. The hypothesis was that there is no significant difference in achievement based on the interaction of gender and enrollment. The results of the ANOVA test suggests that there is no statistically significant difference in achievement based on the interaction of gender and enrollment $F(1,556) = 1.544, p = .214$. The mean grade for females taking the web-based course was 90.5 ($SD = 6.061$), while the mean grade for males taking the web-based course was 88.6 ($SD = 7.859$). The mean grade for females taking the game-based course was 92.1 ($SD = 5.309$), while the mean grade for males taking the game-based course was 91.5 ($SD = 5.717$). The hypothesis that there is no significant difference in achievement based on the interaction of gender and enrollment failed to be rejected. The average final grades of males and females are more or less the same for web-based and game-based courses and the average final grades for each course format is more or less the same for males and females.

After completing the ANOVA tests using the modified sample data based on the random sampling from the web-based course group, the first hypothesis examining the relationship between gender and enrollment was revisited. The first hypothesis was previously tested using the original sample data. The hypothesis was tested a second time using the modified sample data derived from the random sampling.

Revisiting the First Hypothesis

The first research question asked if there is a relationship between gender and enrollment. The hypothesis proposed that there is a relationship between gender and enrollment. The hypothesis was supported using the original sample data consisting of 7,682 students in the web-based course. To test this hypothesis with the modified sample, a second chi-square test of independence was conducted. The results of the test suggests that with an alpha level of .01, the relationship between gender and enrollment is again statistically significant (continuity correction = 9.277, $df = 1$, $p = .002$).

The frequencies, expected frequencies, and standardized residuals for male and female enrollment rates in the web-based and game-based courses for the modified sample data are depicted in Table 8. Males enrolled in the game-based course 152 of the 133.5 expected times. Whereas females only enrolled in the game-based course 128 of the 146.5 expected times. In addition, females enrolled in the web-based course 165 of the 146.5 expected times, while males only enrolled in the web-based course 115 of the 133.5 expected times. There is a relationship between gender and enrollment again with the modified sample. Males chose to enroll in the game-based format of the course significantly more frequently than females. In addition, females chose to enroll in the web-based course significantly more frequently than males.

Table 8
Contingency Table for Revisited Gender and Course Enrollment

			Course Enrollment	
			American History	American History – Conspiracy Code
Gender	F	Count	165	128
		Expected Count	146.5	146.5
		Std. Residual	1.5	-1.5
	M	Count	115	152
		Expected Count	133.5	133.5
		Std. Residual	-1.6	1.6

Note. F denotes Female and M denotes Male levels of Gender.

Conclusion

Listed below are the research questions, hypotheses, and a summary of the results.

Conclusions based on this summary of results follows.

1. Is there a relationship between gender and the selection of class format (enrollment)?

Hypothesis: There is a relationship between gender and enrollment. Males will choose to enroll in the game-based version of the course more frequently than females.

Result: A significant relationship between gender and enrollment was found. The hypothesis was supported. Males chose to enroll in the game-based version of the course more frequently than females.

2. Is there a difference in achievement based on gender in a game-based course?

Hypothesis: There is no significant difference in achievement based on gender in the game-based course.

Result: No significant difference in achievement was found based on gender in the game-based course. The hypothesis was supported. Males and females had similar average grades in the game-based course.

3. Is there a difference in achievement based on gender across course formats?

Hypothesis: There is no significant difference in achievement based on gender across course formats.

Result: A significant difference in achievement was found based on gender across course formats. The hypothesis was rejected. In general, females achieved higher average final grades than males.

4. Is there a difference in achievement based on enrollment?

Hypothesis: There is no significant difference in achievement based on enrollment.

Result: A significant difference in achievement was found based on enrollment. The hypothesis was rejected. Students enrolled in the game-based version of the course had higher average final grades than students enrolled in the web-based version of the course.

5. Is there a difference in achievement based on the interaction of gender and enrollment?

Hypothesis: There is no significant difference in achievement based on the interaction of gender and enrollment.

Result: No significant difference was found based on the interaction of gender and enrollment. The hypothesis failed to be rejected. The average final grades of males and females are more or less the same for web-based and game-based courses and the average final grades for each course format is more or less the same for males and females.

In summary, the first research hypothesis that there is a relationship between gender and enrollment was supported. Males chose to enroll in the game-based format of the course more frequently than females and females chose to enroll in the web-based format of the course more frequently than males.

Mixed results were found with research hypotheses two through five, which addressed potential differences in achievement. Research hypothesis two, which proposed no difference in achievement based on gender in the game-based course, was supported. Research hypothesis

three, which proposed no differences in achievement based on gender across both course formats, was rejected. Significant differences in achievement based on gender were found with an alpha level of .05. Research hypothesis four, which proposed no differences in achievement based on enrollment, was rejected. Significant differences in achievement based on enrollment were found with an alpha level of .01. Finally, research hypothesis five, which proposed no differences in achievement based on the interaction of gender and enrollment failed to be rejected. No significant differences were found in achievement based on the interaction of gender and enrollment.

CHAPTER FIVE: DISCUSSION

This study investigated the actual choice behavior and achievement of male and female high school students who were given an option of taking a 36 week American History course in either a game-based format or a web-based format. Prior research in similar educational settings found that males prefer educational games more than females and males have more experience playing video games than females. However, the prior research was based on survey data; it did not look at students' actual behavior given the choice of taking a course in a standard web-based format or in an alternative game-based format. Furthermore, despite the gender differences found in preferences and experience, prior research has not found any differences in achievement between males and females when using an educational game or when scores were compared across game and non-game formats. Findings from prior research were organized using the conceptual framework introduced in Chapter Two to guide the present study (Figure 3).

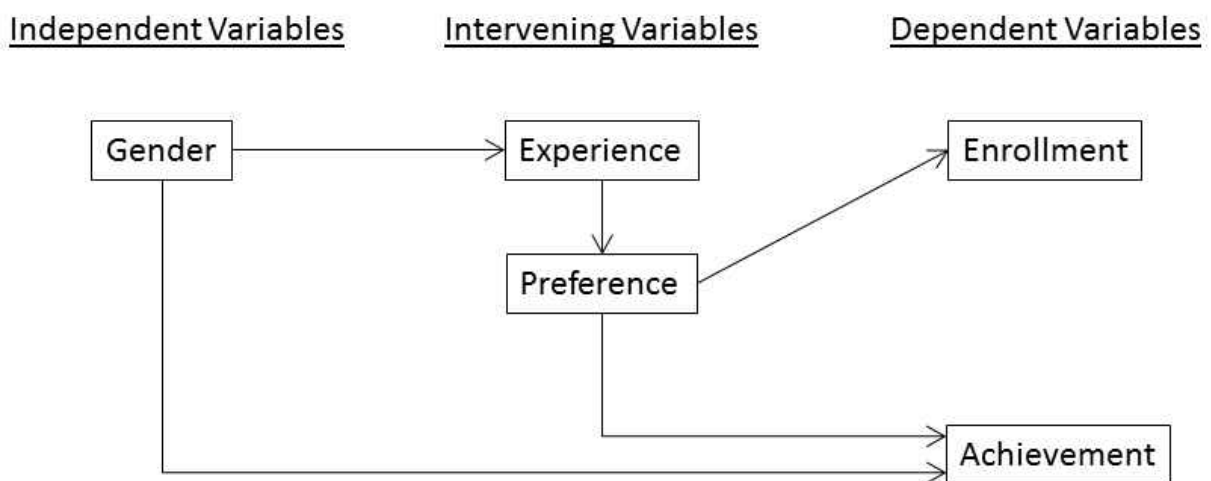


Figure 3: Framework Illustrating Relationship between Gender, Enrollment, and Achievement

Research related to each of the variables identified in the framework delineated the research questions and hypotheses posed in this study to address the original problem. The results from each hypothesis test are discussed below.

Hypothesis One: Relationship between Gender and Enrollment

The first research question asked if there is a relationship between gender and the selection of class format (enrollment). The hypothesis was that there is a relationship between gender and enrollment. A chi-square test of independence was conducted to test the hypothesis. The results of the test suggested that there is a statically significant relationship between gender and enrollment (continuity correction = 32.913, $df = 1$, $p < .001$). Males chose to enroll in the game-based format of the course significantly more frequently than females. In addition, females chose to enroll in the web-based course significantly more frequently than males. The hypothesis that there is a relationship between gender and enrollment was supported.

Two prior studies investigated the relationship between gender and students preferences to use video games in education (Bourgonjon, et al., 2010; Chen, et al., 2010) and one prior study reported gender demographics of students enrollment between a game and non-game-based course (Hess, 2010). All three prior studies suggested that there is a relationship between gender and enrollment consistent with the present study. Males were found to prefer to use video games for education more than females in the prior studies. The present study found the same result that males prefer to use video games for education more than females. It is noteworthy that the present study found a consistent result using a different statistical method from the prior studies. While the present study used a chi square test of independence with U.S. student enrollment data, two of the prior studies used survey methodologies with Flemish (Bourgonjon,

et al., 2010) and Taiwanese (Chen, et al., 2010) students and one of the prior studies reported gender demographics with U.S. student enrollment data (Hess, 2010).

The conceptual framework suggested that (a) the variable of gender is a predictor for video game experience level, (b) experience is a predictor for video game preference, and (c) preference is a predictor for enrollment. The present study did not include experience or preference variables in the sample data, but the results suggest a relationship between gender and enrollment, which is consistent with the transitive relationship found in the conceptual framework. Given that Bourgonjon et al. (2010) found that gender differences in preference are mediated by experience and the research finding that males have significantly more experience than females, it appears that the males in the present study likely had more experience with video games than their female classmates. The relationship between preference and enrollment in the conceptual framework was established based on logic. Students are likely to enroll in the class they prefer. While the present study did not include preference variables in the sample data, it seems that the students who enrolled in the game-based course preferred the game-based course. Finally, it is noteworthy that the results of the present study were correlational – not causal as the conceptual framework suggests. However, the correlational relationship finding is consistent with the causal relationship suggested by the conceptual framework.

The present study finding that there is a relationship between gender and enrollment must be interpreted in light of the study constraints. While there appears to be a relationship between gender and enrollment, the results do not explain why students chose to enroll in a particular course as the sample data was limited to quantitative enrollment and achievement data. Based on prior studies, differences in experience levels with games are a likely explanation for why males enrolled more frequently in the game-based course than females. The way the game was

advertised to students (see Appendices A-F) may be another explanation. Finally, students may have chosen to enroll in a course for a different reason, such as peer pressure. Additional research may be necessary to better understand the factors for a student's preference and subsequent enrollment in a course when given an option between course formats.

The present study was also constrained to data derived from a beta program that limited enrollment into the game-based course to a specific number. As game-based course options mature and increase in scale, researchers may be able to investigate enrollment behavior that is unrestricted between format options.

Hypothesis Two: Achievement based on Gender in Game-based Course

The second research question asked if there is a difference in achievement based on gender in a game-based course. The hypothesis was that there is no significant difference in achievement based on gender in a game-based course. An independent t test was used to test the hypothesis using achievement data gathered from samples of 152 males and 128 females who enrolled in the game-based course. Fifteen outliers representing the lowest average final grades and consisting of six females and nine males were removed to address concerns of normality in the sample data. The modified sample data contained 143 males and 122 females. According to Levene's test, the homogeneity of variance assumption was satisfied ($F = .043, p = .837$). The independent t test indicated that the achievement means were not significantly different statistically ($t = -.613, df = 263, p = .540$). The mean grade for females was 92.8 ($SD = 4.178$), while the mean grade for males was 92.5 ($SD = 4.057$). The hypothesis that there is no significant difference in achievement based on gender in the game-based course failed to be

rejected. The average grade of males was not significantly different from the average grade of females.

According to Levene's test, the homogeneity of variance assumption was satisfied ($F = .200, p = .655$). The independent t test indicated that the achievement means were not significantly different statistically ($t = -.877, df = 278, p = .381$). The mean grade for females was 92.1 ($SD = 5.309$), while the mean grade for males was 91.5 ($SD = 5.717$). The hypothesis that there is no significant difference in achievement based on gender in the game-based course was supported. Female grades were not significantly different from male grades in the game-based course statistically.

The finding that there was no significant difference in achievement based on gender in the game-based course alone is consistent with prior studies (Annetta, et al., 2009; Joiner, et al., 2011; Papastergiou, 2009). The relationship between gender and achievement was a focus area in the conceptual framework to understand which variables influence achievement. Prior studies with elementary, high school, and undergraduate students suggest that gender does not influence achievement using an educational game. Indeed, it seems that despite gender differences in preferences for a particular course format, there are no gender differences in achievement using that format. While females may not have as much experience playing games as their male counterparts, when they do play them in educational contexts, they achieve as much as males. It seems as though educational games that have been studied have either not depended on specialized skills and knowledge that males may have acquired from more frequent experience with games or these skills and knowledge have been made learnable in the games (Hayes, 2005).

In prior studies that examined the relationship between gender and achievement in educational games, it appears that students were not given a choice in using the educational

game. In the present study, students who played the educational game chose to do so, suggesting that they preferred the game-based format. It appears that males and females achieve similar results in educational games whether they are given a choice or not. The finding that there is no significant difference in achievement based on gender in a game-based course seems to be a consistent finding. However, further research may be necessary to look at gender differences in achievement using different genres of educational games. In particular, genres that males and females tend to prefer that do not naturally overlap may serve as good research opportunities. For example, males tend to prefer physical games with active and strategic play modes (Bonanno & Kommers, 2005; Eglesz, et al., 2005; Greenberg, et al., 2010; Hamlen, 2011; Jackson, et al., 2008; Kinzie & Joseph, 2008; Terlecki, et al., 2011), whereas females tend to prefer traditional and racing games as well as games that provide for creative and explorative play modes (e.g., The Sims) (Bonanno & Kommers, 2005; Greenberg, et al., 2010; Hamlen, 2011; Kinzie & Joseph, 2008).

While the present study's finding that there is no significant difference in achievement based on gender in an educational game is consistent with prior studies, the context for the present study involved a choice in course format. Given that students were given a choice of course format, it was important to extend the question of differences in achievement based on gender to both course formats that were available. The third research question expanded the question of gender differences in achievement to consider gender differences independent of the format choice.

Hypothesis Three: Achievement based on Gender across Course Formats

The third research question asked if there is a difference in achievement based on gender across course formats. The hypothesis was that there is no significant difference in achievement based on gender across course formats. The results of the ANOVA test suggests that there is a statistically significant difference $F(1,556) = 5.462, p = .02$ in achievement based on gender with an alpha level of .05. However, only 1% of the variance in grade was explained by gender ($\eta_p^2 = .01$), which is a relatively small effect size (Cohen, 1992). The mean grade for females was 91.2 ($SD = 5.787$), while the mean grade for males was 90.3 ($SD = 6.861$). The hypothesis that there is no significant difference in achievement based on gender across course formats is rejected with reservations given the relatively small effect size. Female grades were significantly higher than male grades statistically, but there is little practical importance ($\eta_p^2 = .01$).

The finding that there is a statistically significant difference in achievement based on gender across course formats is not consistent with prior studies that found no significant difference in achievement based on gender across course formats (Papastergiou, 2009; Vogel, et al., 2006). However, differences in sample sizes may explain the insubstantial inconsistency. The sample size in the present study ($N = 560$) is more than six times the size of the sample size ($N = 88$) in the Papastergiou (2009) study. Furthermore, Vogel et al. suggested caution in interpreting their finding of no significant differences based on gender given a low fail-safe number. Finally, the result that there were significant differences in achievement based on gender may be explained by the random sampling that was performed. There were 7,682 students enrolled in the standard web-based course whereas there were only 280 students enrolled in the alternative game-based course. The large differences in the number of students enrolled in each course was a constraint due to the fact that enrollment in the alternative game-based course was limited as

part of the beta program. It is possible that a different random sample might yield a different result. While a significant difference was found, it was of little practical significance and may simply be attributed to a large sample size.

Hypothesis Four: Achievement based on Enrollment

The fourth research question asked if there is a difference in achievement based on enrollment. The hypothesis was that there is no significant difference in achievement based on enrollment. The results of the ANOVA test suggests that there is a statistically significant difference $F(1,556) = 17.452, p < .001$ in achievement based on enrollment. However, only 3% of the variance in grade is explained by enrollment ($\eta_p^2 = .03$), which is a relatively small effect size (Cohen, 1992). The mean grade for the web-based course was 89.7 ($SD = 6.907$), while the mean grade for the game-based course was 91.8 ($SD = 5.532$). The hypothesis that there is no significant difference in achievement based on enrollment is rejected with reservations given the relatively small effect size. The grades of students enrolled in the game-based course were significantly higher than the grades of students enrolled in the web-based course statistically, but there is little practical importance ($\eta_p^2 = .03$).

The finding that there is a statistically significant difference in achievement based on enrollment is consistent with prior studies that found positive instructional benefits when using educational video games (Annetta, et al., 2009; Dempsey, et al., 1994; Joiner, et al., 2011; Papastergiou, 2009; Vogel, et al., 2006) and is more or less consistent with prior meta-analyses that found mixed results (Hays, 2005; Randel, et al., 1992).

Two prior studies (Hess, 2010; Papastergiou, 2009) similarly compared the achievement of students in a game-based application with the achievement of students in a web-based

application and the results of the present study are consistent with those studies. Students in the game-based format achieved significantly more than students in the web-based format. In the other prior studies, alternative instructional formats were either avoided (Annetta, et al., 2009; Dempsey, et al., 1994; Joiner, et al., 2011) or limited to traditional/conventional classroom teaching methods (Randel, et al., 1992; Vogel, et al., 2006).

It is important to note the study constraints impacting the finding that students enrolled in the game-based course scored significantly higher than students enrolled in the web-based course. First and foremost, there was no way to control for the effect of non-medium variables like differences in the design of each course or differences in the teachers that taught each course (Clark, 1983). However, both courses are aligned to the same curriculum standards and both courses provide the same American History credit back to the home school. In addition, while there were different teachers between the courses, many of the teachers taught both course formats (C. Conidis, personal communication, September 9, 2011), which minimizes the threat of instructor bias.

There was also no way to control for the effect of novelty that may have led students to put forth increased effort and attention towards the game-based course that was likely novel to them, which is a common source of confounding in media comparison studies (Clark, 1983). However, the game-based course did last for an entire year, which should have minimized, or at least reduced, the novelty effect.

Finally, the present study only involved a single adventure game for social studies. Randel et al. (1992) found different learning effects for games in different content areas, concluding that subject matter where specific content can be targeted are more likely to show beneficial effects for games. In the present study, the game targeted specific American History

content that was aligned to state curriculum standards. The finding in the present study that students enrolled in the game-based course achieved significantly higher scores than students in the web-based course is therefore consistent with the types of games Randel et al. (1992) found to have beneficial effects.

Given the study constraints and their potential impact on the finding, it is important to consider the finding that students enrolled in the game-based course achieved significantly higher scores than students in the web-based course in the context of the present study and its purpose. The purpose of this study was to investigate the actual choice behavior and achievement of male and female high school students who were given an option of taking a 36 week American History course. The purpose was not to conduct a media comparison study. The primary reason media formats were compared in the present study was to investigate how students performed in formats in which they chose to enroll. This finding may say more about the influence of preference on achievement than which course format is more effective. In the present study, it can be assumed that the students enrolled in the game-based course format preferred that course based on their enrollment behavior. Given that there was a limited number of students who could enroll in the game-based course option and that some students who did enroll in the game-based course option were forced to switch to the web-based course because they lacked a computer that met the system requirements, it seems possible that not all of the students enrolled in the web-based course option preferred that option.

Further research should investigate: (a) the achievement of students in course formats that they prefer; (b) the achievement of students specifically using game-based formats, while controlling for common sources of confounding in media comparison studies; and (c) potential differences in long term retention using game-based formats that students prefer. Future research

may benefit from using experimental manipulation to investigate the achievement of students in course formats they prefer. In the present study, while students in the game-based course chose to be there, students in the web-based course were likely a mixture of students who preferred and students who didn't prefer to be in the web-based course. One of the reasons to use video games for education is the motivational benefits that games have for individuals that prefer to play them. Do students who learn using educational games that they prefer retain what they learn longer? Looking beyond students' final grades to their scores on standardized tests is a logical extension of the present research to investigate potential longer term retention.

Hypothesis Five: Achievement based on the Interaction of Gender and Enrollment

The fifth and final research question asked if there is a difference in achievement based on the interaction of gender and enrollment. The hypothesis was that there is no significant difference in achievement based on the interaction of gender and enrollment. The results of the ANOVA test suggested that there is no statistically significant difference in achievement based on the interaction of gender and enrollment $F(1,556) = 1.544, p = .214$. The mean grade for females taking the web-based course was 90.5 ($SD = 6.061$), while the mean grade for males taking the web-based course was 88.6 ($SD = 7.859$). The mean grade for females taking the game-based course was 92.1 ($SD = 5.309$), while the mean grade for males taking the game-based course was 91.5 ($SD = 5.717$). The hypothesis that there is no significant difference in achievement based on the interaction of gender and enrollment failed to be rejected. There is no significant difference in achievement based on the interaction of gender and enrollment. The average final grades of males and females are more or less the same for web-based and game-

based courses and the average final grades for each course format is more or less the same for males and females.

This finding is consistent with prior studies (Papastergiou, 2009). Papastergiou (2009) found no significant differences in achievement based on the interaction of gender and the type of intervention (i.e., game and non-game). The relationship between gender and achievement was a focus area in the conceptual framework to understand which variables or interactions between variables influence achievement. As depicted in Figure 4, there was no statistically significant interaction found between gender and enrollment.

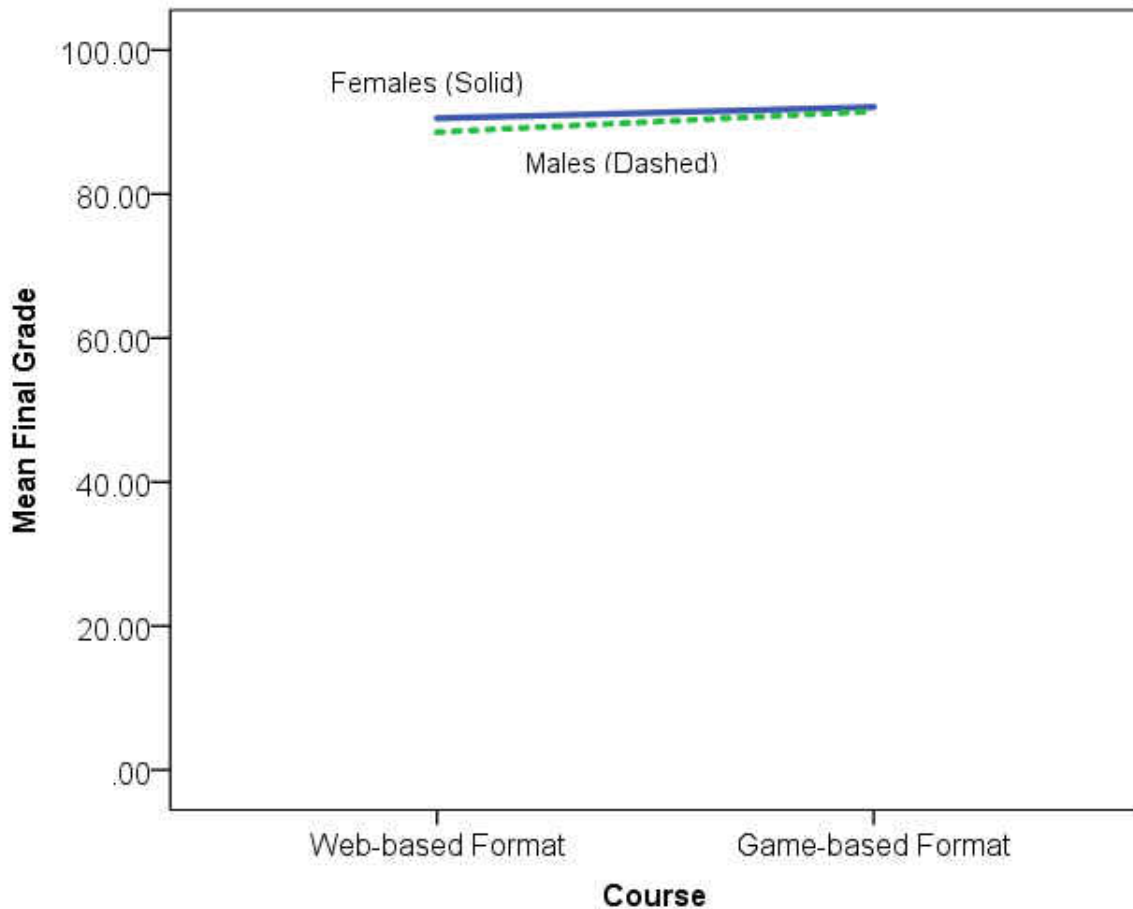


Figure 4. Statistically Insignificant Interaction between Gender and Enrollment

Although no statistically significant interaction was found, the result appeared to imply a possible interaction when the scale of mean final grades was fit to the actual mean final grades as depicted in Figure 5. Males and females performed about equally well in the game-based course, but females performed better in the web-based course. However, this interaction was again not statistically significant.

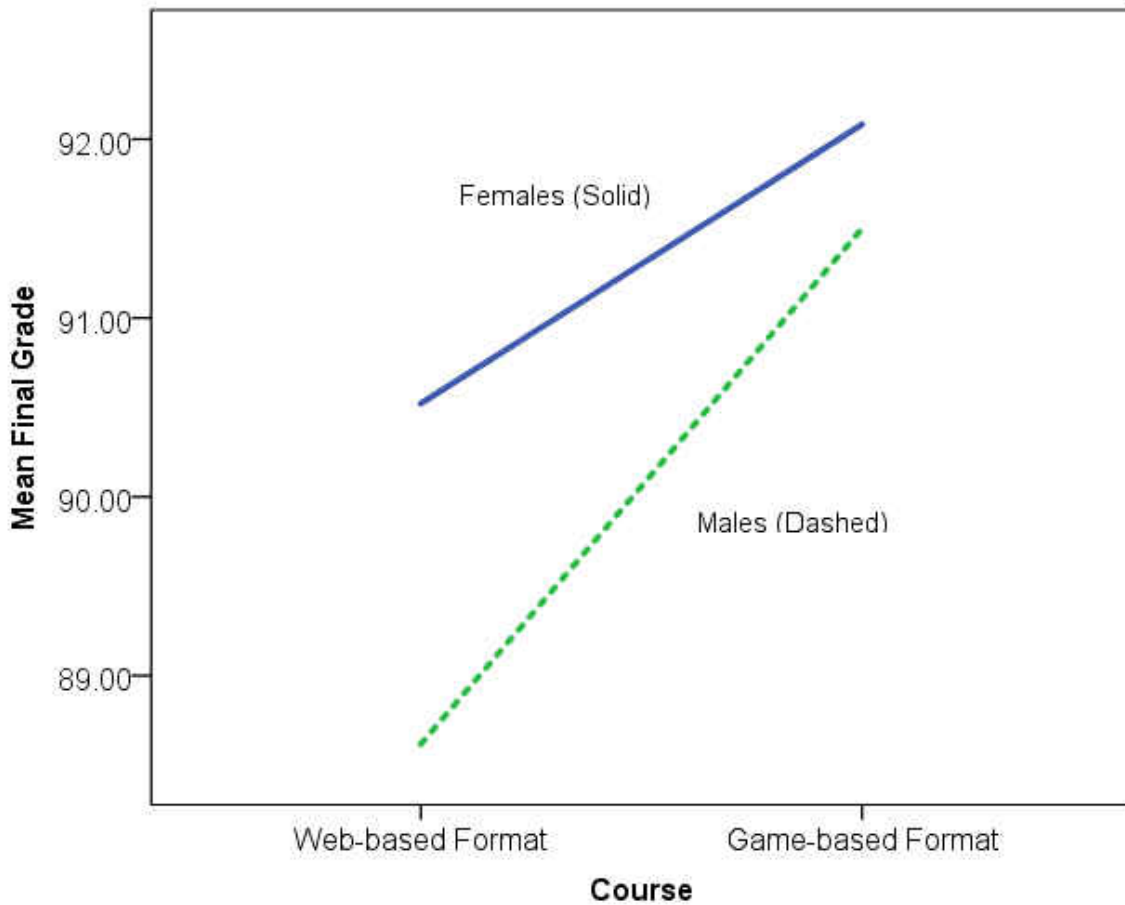


Figure 5. Zoomed in Perspective of Interaction between Gender and Enrollment

Given that the differences in achievement based on the main effects of gender and enrollment were of little practical importance, it is not surprising that the interaction between the main effects was not significant. However, further research may be necessary to examine this

interaction in more detail. Specifically, future research should attempt to control the common sources of confounding in media comparison studies while manipulating preferences as preferences seem likely to impact achievement, especially for males.

Males enrolled more frequently in the game-based course. At the same time, males in the game-based course ($M = 91.5, SD = 5.717$) appeared to have performed better than males in the web-based course ($M = 88.6, SD = 7.859$). Given that males appeared to prefer the game-based course more than females based on their enrollment behavior and the fact that some students who tried to enroll the game-based course were forced to withdraw from it because their computer did not meet the system requirements, it would seem that some of the males enrolled in the web-based course would have preferred to be in the game-based course where they may have performed better.

Implications for Stakeholders

The results of the present study hold a number of possible implications for researchers investigating questions about game-based learning, educators responsible for implementing game-based learning, and decision makers responsible for funding game-based learning initiatives.

Researchers

The results of the present study support prior research suggesting that males prefer educational games more than females. However, the present study provided a different way to investigate the question of preferences by looking at the enrollment records of students who were given a choice between course formats. Researchers should continue to examine student

preferences for and achievement with different course formats using enrollment records where students are given a choice between course formats together with additional research methods to better understand the reasoning behind student preferences using potentially different educational games and game genres.

The results of the present study also support prior research suggesting that students can achieve educational benefits using game-based formats. Researchers should continue to examine the achievement of students using game-based formats, while considering potential gender differences especially when alternative course formats are used and choices are provided between course formats. It appears that students achieve less in course formats they may not have preferred and this may be especially true for males. Ideally, experimental manipulations based on preference could further inform the impact of preference on achievement for males and females.

The conceptual framework that was used to guide the present study should be expanded to look at additional variables that might influence preference or achievement in order to guide future studies. Variables that might influence preference may be defined through qualitative methods with students who have enrolled in a course when given a choice of formats. It may also be necessary to further distinguish between general preferences and specific enrollment in a 36 week course. Demographic variables in addition to gender such as race and socioeconomic status should be considered as possible factors explaining achievement. Ideally, an expanded conceptual framework would be established using structural equation modeling and integrated with the existing path model developed by Bourgonjon et al. (2010) focused on explaining preferences for video games.

Finally, while the present study supported prior research that educational benefits can be achieved using educational games, a logical next step for researchers is to examine longer term measures of achievement such as standardized tests. If students are learning from course formats they prefer and potentially find more motivating than alternative formats, it would be interesting to see if students retain learned knowledge longer using formats they prefer.

Educators (Teachers and Administrators)

Administrators interested in game-based learning as an alternative approach to engage learners should be encouraged by the potential of educational games based on the results of the present study. Students enrolled in the game-based course achieved significantly higher final grades than students enrolled in the web-based course. However, the difference appears to hold little practical importance given that only 3% of the variance in grade was explained by the course format. In addition, the purpose of the present study was not to conduct a media comparison study as the study did not include adequate controls for possible sources of confounding such as uncontrolled differences in instructional method or novelty effects.

Interestingly, it appears that both males and females achieved higher grades in the game-based course, even though males historically have more experience playing video games and in the present study chose to enroll in the game-based course more frequently than females. Another interpretation of the results is that students achieved more in course formats they preferred as all of the students in the game-based course chose to be in that course. Offering students a choice in course formats may be a valuable technique for improving achievement.

Teachers who are deciding where to place their limited energy when teaching a web-based course may consider including educational games in situations where males are achieving

significantly less than their female peers. It appears that both males and females perform about equally well in a game-based course, but females appear to perform considerably better than males in the web-based course. Given that males appear to prefer games more than females and that males and females perform well with educational games, teachers may consider including educational games where specific subject matter content can be targeted into their lessons to engage learners.

Game Developers and Funders

Perhaps most importantly, this research can help inform equitable funding decisions for game-based learning. There is a question of fairness that arises when the cost of game-based development efforts are considered in the context of potential gender differences in preferences for those developments. Why should money be spent on developments that only one gender might prefer or benefit from? Current preferences research indeed suggests that males prefer games more than females, which suggests caution in completely replacing current forms of instruction with game-based learning forms. The results of the present study are consistent with the prior studies that suggest males prefer games more frequently than females as evidenced by the relative enrollment rates between males and females into a game-based course option when given the choice of course format. While there may be concern for investing in game-based course options based on lower enrollment rates by female students, the results of this study suggest that those females that do choose to enroll in a game-based course achieve final grades that are not significantly different from the final grades males achieve.

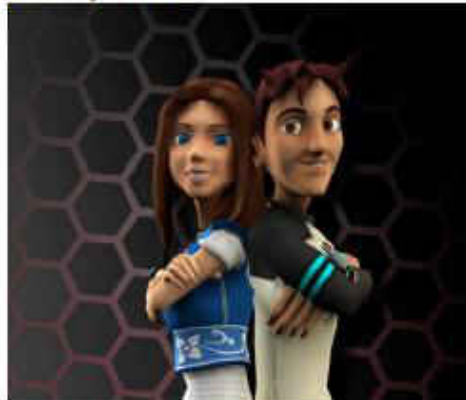
Game developers and funders should continue to fund and develop educational video games that are aligned with learning objectives while being mindful of potential gender

differences in experience and preferences. Given that males tend to have more experience playing games than females and that experience is a predictor for video game preference, game developers and funders of educational games should be sure to focus on the interests of females when designing and promoting educational games. In addition, game developers should continue to ensure that educational games developed do not depend on specialized skills and knowledge that males may have acquired from more frequent experience with games or these skills and knowledge should be made learnable in educational games (Hayes, 2005).

Based on the continuing popularity of video games among today's youth as well as research demonstrating the positive benefits of gameplay, educational games appear to be an attractive option for learning in the 21st century. Perhaps of equal importance going forward is the potential for offering students choices to learn using formats they prefer. The impact of preferences on achievement is certainly an interesting research question as these choices are extended to learners. Finally, this study has added support to the conclusion that females will perform equally well, if not better, than males in educational games. The challenge going forward is to find a way to arrive at equal enrollment rates between males and females when students are given a choice to use an educational game.

APPENDIX A: RECRUITMENT EMAIL MESSAGE #1

Purpose: email to be sent to all FLVS students in grades 9-12 who have not taken American History.
Subject line: High School American History the Game



We Need You!

Conspiracy Code®: American History

Conspiracy Code: American History is an engaging new high school course offered by Florida Virtual School. Students can earn their required American History credit in an exciting game environment. Libby Whitetree and Eddie Flash are special agents helping guide students through an array of clues and spy activities to correct American history.

Would you like to join us? Go to www.flvs.net/conspiracycode and check out this awesome new way to learn American history. Then click on the green box in the upper right corner to SIGN UP for a course!

Are you ready to be one of our agents? You must:

- FIRST** • be a Florida student in grade 9-12 who needs American History credit.
- SECOND** • have successfully completed English 1.
- THIRD** • have access to a PC computer. (The game will not play on MACs)

SIGN UP TODAY!



APPENDIX B: RECRUITMENT EMAIL MESSAGE #2

Purpose: Email to be sent to all FLVS students who are in grade 9- 12 and have not taken American History.
Subject line: We Want You; earn high school American History credit through gaming



Conspiracy Code®: American History

Florida Virtual School is looking for new recruits! We have been upgrading and testing a new version of Conspiracy Code: American History, and now all systems are GO!

Are you interested in learning about American history through a gaming environment? See if you qualify to be one of our new agents by answering the items on our recruit checklist below. If you think you have what it takes to be an agent and want to help us set history right, sign up today.

Recruit Checklist:

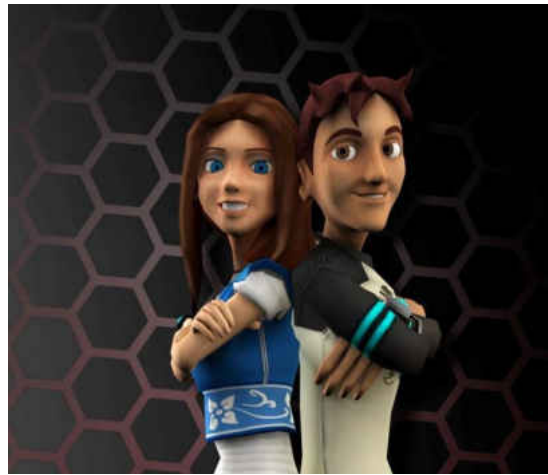
- I am a Florida student in grade 9-12.
- I need American History high school credit.
- I have a PC computer*. (Game will not work on MAC platforms)
- I have successfully completed English 1.
- Visit <http://www.flvs.net/areas/flvscourses/conspiracycode/pages/default.aspx> to see the game. Then login to your FLVS account or click on the green dropdown button on the upper right side to SIGN UP for the course!

Headquarters

*PC system requirements will be verified during registration.



APPENDIX C: INVITATION TO CONSPIRACY CODE



Welcome to **Conspiracy Code[®]: American History**

Hey new recruits! I'm Libby Whitetree and this is Eddie Flash. We are the special agents assigned to this Conspiracy Code Mission. We are looking forward to you joining us here in Covertion City. Some bad dudes are really making a mess of American history and we need your help to unravel this conspiracy!

We'll be sending you several messages to get you ready for this mission. Keep an eye out for these three communications:

FIRST

- We will need to check your computer system to see if it is ready and able to download and run the program. You will receive an email giving you the how-to.

SECOND

- We'd like to find out what you already know about American history and will send you a website to go to for a couple of pre-mission activities.

THIRD

- Your underground contact (online instructor) will begin contacting you later this month to help you get this mission started.

One more thing:

- We'd like you to test out some new spy gadgets and other improvements to Conspiracy Code. We want to know what you think! At the end of each semester you will be asked to take a survey and give us your feedback. Cool, right?

Can't wait to see you in Covertion City!

APPENDIX D: REGISTRATION RESPONSE EMAIL MESSAGE



Congratulations! Your registration for Conspiracy Code: American History has been received. Florida Virtual School is excited that you want to become a new recruit and accept the mission to set history right after criminal minds have mixed up US facts and events!

We need to make sure your computer system is able to download and run the Conspiracy Code program. To find out, just follow the instructions in the attached document.

If your computer is unable to download and run Conspiracy Code you will be given the option to take the regular FLVS American History course. Please call 1-866-322-8324 if the system scan is unsuccessful.

Good luck!

APPENDIX E: INSTRUCTIONS FOR RUNNING SYSTEM REQUIREMENTS



Downloading and Installing the Conspiracy Code Game Manager

The Game Manager can be downloaded from the following URL:

http://www.360ed.com/assets/game/360EdGameManager_Setup.exe

Once the Game Manager has been downloaded, complete the following steps to install the Game Manager and run the System Compatibility Scan. This scan will let you check whether your computer can play the *Conspiracy Code®: American History* game on your machine.

Minimum Hardware Requirements

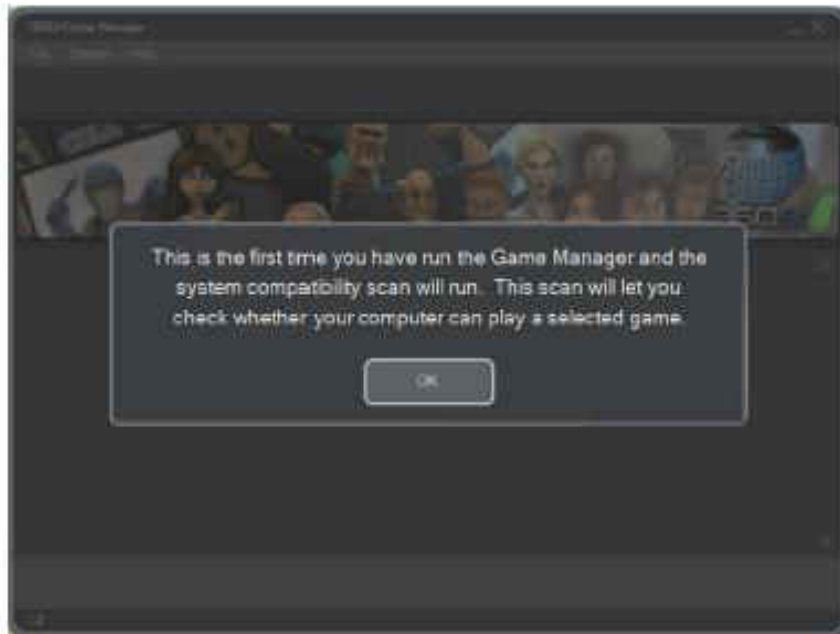
Required:

- Windows® Vista, Windows 7® , or Windows® XP SP 2
- High-speed Internet connection
- Intel-compatible processor, 1.8 GHz or higher
- 1 GB RAM with dedicated VRAM or 1.2 GB RAM with shared VRAM
- 3D graphics processor with support for Shader Model 1.4 and at least 32 MB dedicated VRAM or 128 MB shared VRAM
- DirectX® 9.0c (included) and latest video drivers
- DirectSound® compatible sound card with OGG support
- OpenAL (included)
- Windows® compatible keyboard and two-button mouse
- 1GB available HD space
- Monitor capable of at least 1024x768 resolution (800x600 will work in some cases but it is not supported)
- Modern web browser with enabled support for cookies, JavaScript, and Flash. Supported browsers:
 - Internet Explorer 7 or later
 - Mozilla Firefox 3.0 or later
 - Google Chrome
 - Apple Safari
 - Opera

Recommended:

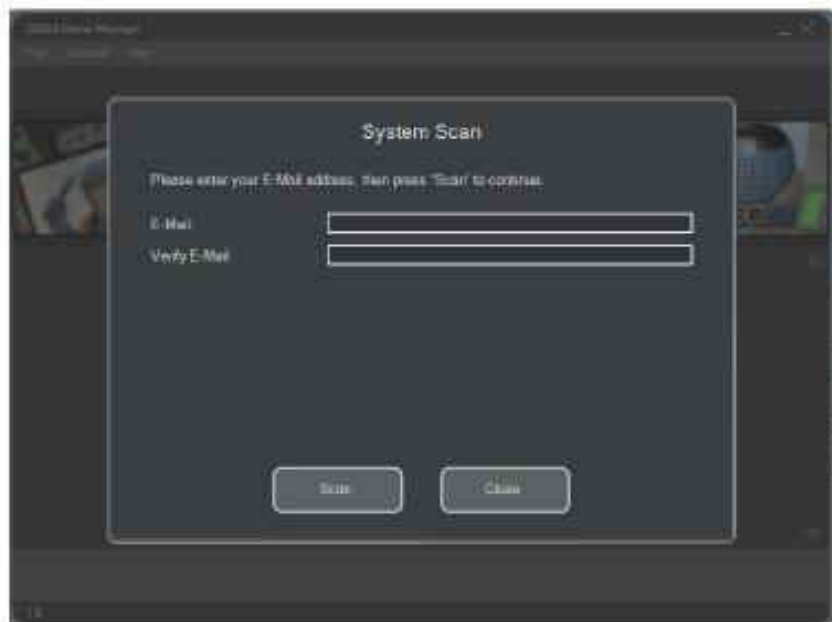
- Dual-core processor, 2.0 GHz or higher
- 1.5 GB RAM, Windows® XP; 2 GB RAM, Windows® Vista or Windows® 7
- 3D graphics processor with support for Shader Model 2.0 and at least 256 MB dedicated VRAM

Note for Macintosh users: We do not support running Conspiracy Code® via Boot Camp, Parallels, VMWare or any other Macintosh-Windows crossover software. If you choose to run Conspiracy Code on an Apple® computer using one of these software packages, we cannot be held responsible for the result and we cannot offer technical support advice for such a configuration.

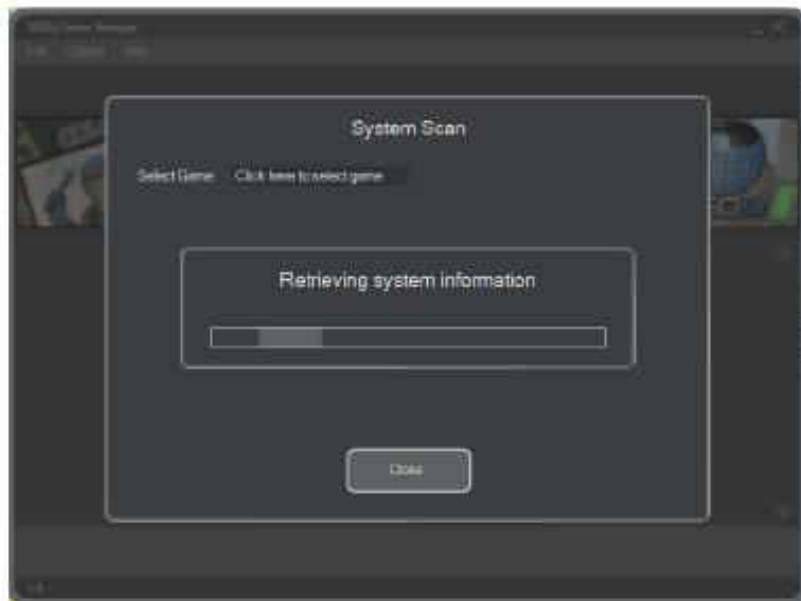


4. Click the "OK" button.

The System Scan screen will appear. Enter your e-mail address in the E-Mail field. Enter it again to verify. **Please note that you must use the e-mail address to which you received this e-mail notification.**



5. Once you've entered your E-mail address information, click the "Scan" button.
6. The system will begin scanning your computer to validate that it is compatible with the Conspiracy Code® American History Game.



7. Once the scan is complete you will see the following screen (if System Scan is successful):

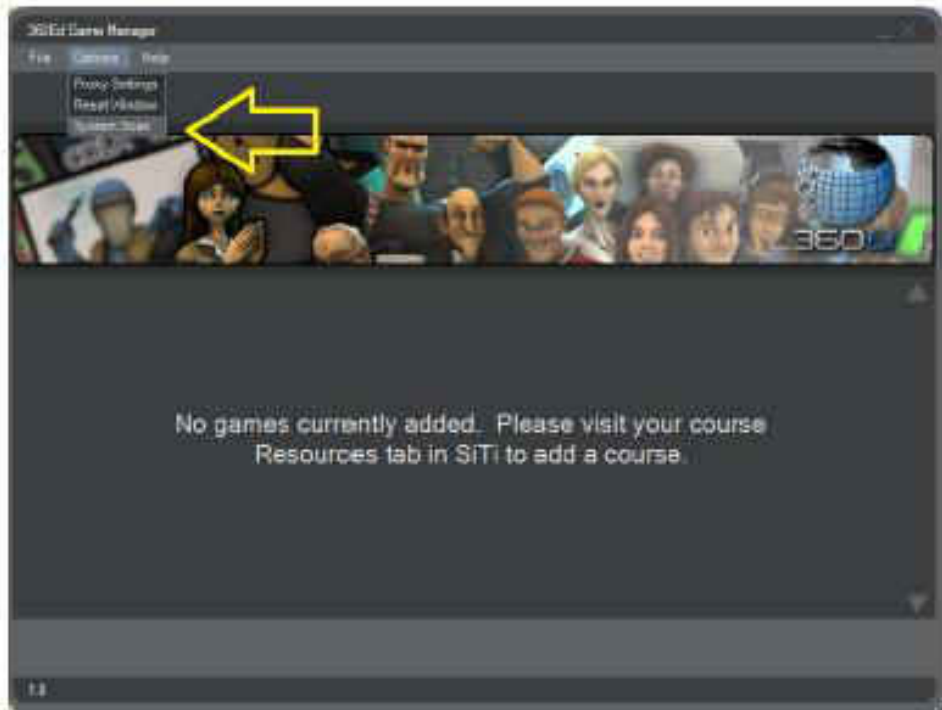


8. After reviewing the System Scan screen you can now close the Game Manager.
 - a. If the System Scan was successful, there is no further action required. You will be contacted by your Teacher regarding the next steps.
 - b. If the System Scan was not successful, Please contact the FLVS help desk at 1-866-322-8324.

Note: If your System Scan is not successful and your computer does not meet the minimum system requirements to run the Conspiracy Code American History game, you will have the option of taking the FLVS standard American History course (version 9).

Running the System Scan Again

1. If you need to run the system scan again, open the Game Manager.
2. From the "Options" menu, select System Scan.



3. The Game Manager will run the System Scan.

APPENDIX F: WEB-BASED COURSE LISTING

Screen shot captured from

<http://www.flvs.net/areas/flvschools/Pages/Course%20Catalog/CourseListing.aspx?CourseID=24>

The screenshot shows the Florida Virtual School website. The browser address bar displays the URL: <http://www.flvs.net/areas/flvschools/Pages/Course%20Catalog/CourseListing.aspx?CourseID=24>. The page features the Florida Virtual School logo and navigation links for Login, Sign Up, Employment, Foundation, and Contact. A search bar is also present. The main navigation menu includes About Us, Course Information, Activities & Resources, Mobile Learning, and FLVS Global. The breadcrumb trail indicates the current location: Home • Course Information • FL Students.

Explore this Section

- About FLVS Courses
- AP Courses
- [Course Catalog >>](#)
 - **FL Students**
 - Courses: Non-FL Students
- Course Progression
- Course Tours
- FAQs >>
- Hardware/Software Reqs
- Honors Credit
- New Courses
- Policies >>
- Summer Courses
- Test Prep for FCAT
- Test Review for AP

FL Students

Like 3 Tweet 0 Share 5

Course Name: American History
Course Code: 2100310
Honors Course Code: 2100320
AP Course Code:
Description:

American history is full of big questions that grab our attention. In this course, you will look at some of the most profound questions that thoughtful Americans still debate. You will research many important events throughout the history of America. In the process, you will witness the development of America from its first settlers to today's superpower status.

Questions about slavery, regulation of business, religious freedom, and how to maintain a stable world order have always been part of the American experiment. Most of the time, the answers are not so simple, but we want to know what you think. To develop your personal beliefs, you will use verified sources, including original documents and the writings of people contemporary with the events.

Equally important, this course will challenge you to apply your knowledge and perspective of history to interpret the events of today. The questions raised by history are endlessly fascinating. We look forward to your participation in the debate.

Access the site link below to view the PDF of the course description from the Florida Course Code directory.

<http://data.fldoe.org/crsCode/912/Social%20Studies/American%20and%20Western%20Hemispheric%20Histories/pdf/2100310.pdf>

Prerequisites: This course is recommended for students in 11th grade. Successful completion of English 1 is strongly recommended.

Estimated Completion Time: 2 segments / 32-36 weeks

The image shows a web browser window with the address bar displaying <http://www.flvs.net/areas/flv>. The page content is as follows:

Completion Time:

Major Topics and Concepts:

Segment 1:

- Geography
- Analyzing the Evidence: Primary vs. Secondary Sources
- Age of Discovery
- Comparing Northern and Southern Colonies
- Declaring Independence
- Lexington and Concord
- Revolutionary War
- Constitutional Convention
- Bill of Rights
- The New Nation Emerges
- You Be the Historian (Honors Lesson)
- Slavery
- Abolition
- Abolition (Honors Lesson)
- Daily Lives of Rural Slaves
- Perspectives on Slavery
- Modern Slavery Discussion
- Territorial Issues
- Life During the War
- The Civil War
- Reconstruction
- The Law Versus Reality
- History Repeats Itself (Honors Lesson)
- Creating Jim Crow
- The 14th Amendment and Brown v. Board of Education
- The Voting Rights Act of 1965
- Asserting Rights: A Lesson in Non-Violent Protests
- Oral History of the 1960s
- Leaders of the Civil Rights Movement
- Civil Rights vs. Civil Wrongs (Honors Lesson)

Segment 2:

- Manifest Destiny
- American Imperialism
- Imperialism (Honors Lesson)
- Dream vs. Reality: Prospecting for Gold
- The Industrial Revolution
- Immigration
- Robber Barons vs. Captains of Industry (Honors Lesson)
- The Populist Movement: The Farmers Organize
- The Standard Oil Monopoly and Sherman Antitrust
- America in Harlem: The Harlem Renaissance
- The 1920's
- Laws and Trials of the 1920's
- Equal Justice For All: 19th Amendment
- Trials of the 1920s
- Heroes, Hoodlums, and Hopefuls (Honors Lesson)
- Emerging World Power
- The Great War
- The Great Depression
- World War II
- Holocaust
- The Home Front (Honors Lesson)
- Cold War
- Korean War
- Vietnam War
- A survey of each decade from 1950 to the early 2000's
- The Presidents
- Rights vs. Safety (Honors Lesson)

Course Assessment and Participation Requirements: Besides engaging students in challenging curriculum, FLVS guides students to reflect on their learning and to evaluate their progress through a variety of assessments. Assessments can be in the form of self-checks, multiple choice questions, writing assignments, projects, research papers, essays, discussion-based assessments, and discussion posts. Instructors evaluate progress and provide interventions through the variety of assessments built into a course, as well as through contact with the student in other venues.

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- Student Newspaper
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- Employment
- Partners
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Ready to sign up for courses? Click here!

[Sign Up](#)

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(800) 374-1430

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APPENDIX G: SCREENSHOTS OF WEB-BASED COURSE

07.03 Immigration

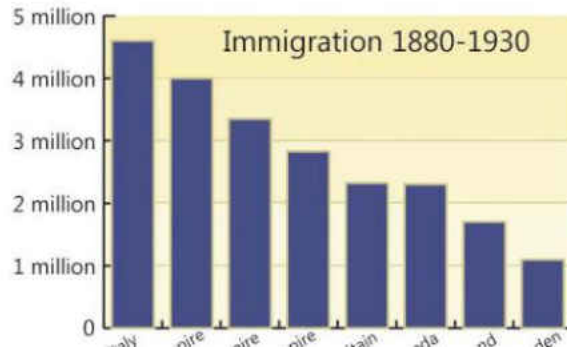


© 2007 Jupiterimages Corporation

As mentioned in the introduction, the period from 1880 to 1930 was a period of unprecedented immigration. People from all over the world were immigrating to America in a search for a better life for their families.

The immigration policy of the United States fluctuated during this time period. Hundreds of thousands of Chinese workers immigrated to the U.S. in the mid-1800s. Their labor was originally welcomed, as they were paid low wages to build railroad and work in mines in the west. However, prejudice and discrimination against the Chinese was common. In 1882, Congress passed the Chinese Exclusion Act. It banned Chinese immigration for a period of ten years. It was later renewed, and this ban lasted for sixty years. This act also forbid Chinese people already in the United States from seeking citizenship.

At the same time, workers were desperately needed to provide labor in urban factories. The United States opened its doors to immigrants from Europe. Over time, significant changes occurred in patterns of immigration. Please view the tables below:

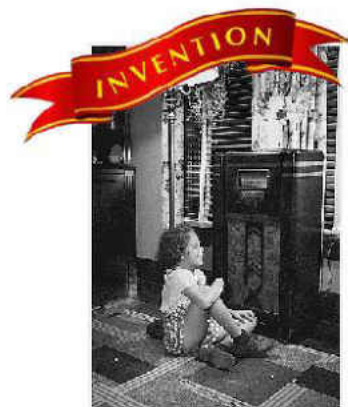


https://www.researchgate.net/publication/316955366/figure/fig/1/figure-fig1/350713311/Immigration-1880-1930

08.03 The 1920s

"You ain't heard nothin' yet." — Al Jolson, first words spoken in movies, in *The Jazz Singer* (1927)

The 1920s were times unlike any other in the history of the United States. It was the beginning of the modern age. The 1920s was known as an age of fads, change, prosperity, and materialism; but it was also a time when movies, automobiles, planes, radio, and a new type of music called "jazz" all became popular. The economy was good and life was good so people began enjoying the new sounds and activities of the time.



Public Domain

President Harding had the first radio installed at the White House. Radios were improved and streamlined during the 1920s and many households owned one.





03.02 Slavery

“Those who were not fortunate enough to run away were made prisoners. It was not the object of our enemies to kill; they wished to take us alive and sell us as slaves.” — Excerpt taken from *To Be a Slave* by Julius Lester

History of African Slavery

To find out about the history of African slavery in America, select each number on the map below in order beginning with number one. Each number will bring up a new window with important information. Use the [graphic organizer](#) to help you organize your thoughts on this topic. This will help you prepare for future assessments.



APPENDIX H: SCREENSHOTS OF GAME-BASED COURSE



Ooh, now THIS is a forum!

- » So... why haven't you helped us?
- » Get off the internet. Seriously.
- » SAL's actin' weirrrrrrd.
- » (leave conversation)

-  Next
-  Pause
-  History



APPENDIX I: COPYRIGHT PERMISSION LETTER

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DAMON REGAN

By: 

Date:

4/12/2012

FLVS Authorized Representative:

Christine Conidis

By: Christine Conidis

Title: Instructional Program Manager

Date:

4/12/2012

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