Does Game-Based Learning Work? Results from Three Recent Studies

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ABSTRACT

The Department of Defense (DoD) is faced with challenges in expanding technology-based solutions that can make Warfighters more efficient, effective, knowledgeable, and flexible. Of growing importance to the DoD is the potential of using Commercial Off the Shelf (COTS) game-based learning in the armed forces for increasing combat readiness. The recruits of today not only understand technology in everyday use, they expect it. These young recruits are "digital natives" who were raised in a digital environment surrounded by inexpensive, yet highly interactive gaming systems. To get the most from our new "best and brightest," new research into game-based learning needs to focus on military use. The objective of these projects was to add definitive research in the area of game-based learning.

Three research studies were conducted at a national university to examine the difference in academic achievement among students who did and did not use video games in learning. Three different video games were added to approximately half the classes of freshmen Introduction to Business and Technology courses, 3rd year Economics courses, and 3rd year Management courses. Identical testing situations were used in all courses while data collected included game use, test scores, gender, ethnicity, and age. ANOVA, chi-squared, and t tests were used to test game use effectiveness. Students in classes using the game scored significantly higher means than classes that did not. There were no significant differences between genders, yet both genders scored significantly higher with game play. There were no significant differences between ethnicities, yet all ethnic groups scored significantly higher with game play. Students 40 years and under scored significantly higher with game play, while students 41 and older did not.

These studies add definitive research in the area of game-based learning. The DoD now has studies proving the efficacy of digital game-based learning and how it can improve learning.

ABOUT THE AUTHOR

Dr. Rick Blunt, Director of Plans and Programs for the DoD Advanced Distributed Learning Initiative, graduated from the United States Naval Academy and received his commission in 1981. He was designated a Naval Flight Officer in 1983 as a Fighter Radar Interceptor Officer. During his 20-year career he attained the rank of Commander and served with Fighter Squadrons 161 and 171 flying the F-4 Phantom II and Fighter Squadrons 202, and 101 flying the F-14 Tomcat. Rick has served in several leadership positions throughout his career from the operational squadron level through major staff levels including as Deputy Director for Learning Technologies for the Assistant Secretary of Defense for Reserve Affairs. Rick was a consultant with Booz Allen Hamilton before becoming a University Profressor teaching Game and Simulation Programming.

Rick's interest and work in the Game-Based Learning, e-Learning, and Knowledge Management area spans several years. He is also the author of two books: Communities at the Speed of Business: Communities of Practice as Peer-to-Peer Learning Networks and Knowledge Management in the New Economy as well as original research on creating Virtual Learning Communities and has presented at several national conferences. His areas of expertise include Game and Simulation design and development, e-Learning strategy development, organization design, change management, application analysis, and curriculum design supporting blended solutions; and Communities of Practice. Dr. Blunt's Ph.D. is from Walden University where his field of research was Game-Based Learning.

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BACKGROUND

The public and private sectors are faced with challenges in expanding technology-based solutions that can make their personnel more efficient, effective, knowledgeable, and flexible. Of growing interest in some sectors, such as the Department of Defense, is the potential of using commercial off-the-shelf (COTS) game-based learning for increasing learning and performance. Over the past 25 years, games have evolved from black-and-white blips made by hobbyists into a complex multi-billion dollar industry. Over the past 5 years, interactive digital entertainment — computer and video games, has made significant strides in developing immersive worlds, interactive stories, massively multiplayer on-line communities, while tackling a broader range of themes and human experience. The military recruits and entry-level civilians of today not only understand technology in everyday use, they expect it (Oehlert, 2007). These young workers are *digital natives* who were raised in a digital environment surrounded by inexpensive, yet highly interactive gaming systems. Today's college generation grew up with video games from infancy. They can process more information not only faster but in a different way than most experienced academicians can.

Some educators see games as a useful and perhaps even necessary learning environment suitable for learners of all ages. However, there are obstacles to this blending. One issue concerns the translation of the *fun* elements in games to the settings of institutional learning where intellectual content is king. According to Mark Oehlert (2007), Director of the Defense Acquisition University's Game and Simulation Department:

> Adolescent students often complain that they cannot see the relationship between school participation and real life. Adult learners view the manipulation of teaching strategies for entertainment value as transparent and reject hybrid experiences as patronizing. Critics of educational game design say that products have erred too far in the direction of weightiness and away from the attraction of play.

Indeed, "designers have been tempted to hold children's play at arm's length, by referring to games for education as 'serious' games and thus completely different from the idle pastimes of the young" (Corbeil, p. 163).

To get the most from our new *best and brightest*, new research into game-based learning must be done. This study may help answer some of the questions now surrounding game-based learning and determine the relationship between the use of video games and learning as measured on standardized tests. It provides answers to both skeptics and supporters.

STATEMENT OF THE PROBLEM

Because of the pervasive presence of technology while they were growing up, today's college-level students learn differently than the way most college instructors learned while they were growing up without technology (Prensky, 2001, pp. 35-46). Yet, there is not enough research to determine the relationship between video games and learning.

During the Training 2006 Conference and Expo, David Milliken, founder of Blueline Solutions, spoke about the growing game-based learning industry:

> Right now the industry is small, but growing quickly. There's about $100 million in the corporate sector and at $25 million in the defense sector that I know about. This is more than twice what it was last year. I believe the game-based learning industry will grow at the rate of Moore's Law for the next several years (2006).

However, Dr. Jan Cannon-Bowers (2006), eminent researcher in the field of the science of learning, challenged the efficacy of game-based learning during a panel discussion with Milliken:

> Simulations. We have plenty of empirical studies about simulations over the last 25 years. We know simulations work. We know simulations improve performance. We know simulations improve learning. Yet, I challenge anyone to show me a literature review of empirical studies about game-based learning. There are none. We are charging head-long into game-based learning without knowing if it works or not. We need studies.

In 2006, $125,000,000 was spent on game-based learning without knowing if it works or not. The problem addressed by this research, then, was to determine the relationship between the use of video games and learning.

PURPOSE OF THE STUDIES

The purpose of the three studies was to determine the relationship between the use of video games and learning. Determining relationships, cause, or reason, for preexisting differences in groups of individuals (Wallen & Fraenkel, 2001, pp. 330-348) is the strengths of the casual-comparative study. The basic causal comparative approach starts with an effect (test scores) and seeks possible causes (game play).

THEORETICAL FRAMEWORK

The frameworks that make good learning environments and good video games are, in many ways, similar and complimentary. There are many similarities between John Keller's ARCS model for learning and the generally accepted attributes of good games.

The ARCS Model

In an article summarizing the research upon which his attention-relevance-confidence-satisfaction (ARCS) model is based and giving examples of actual use of the system, Keller (1987) noted, "No matter how motivated learners are when they begin a course, it is not too difficult to bore them, if not kill their interest totally" (p. 2). The ARCS model consists of four conceptual categories related to human motivation as well as a set of specific strategies (see Keller, 1987, pp. 4-5), which may improve the general motivational aspects of a course of study.

Attention
Many simple techniques can get attention, but the difficulty lies in sustaining attention. "The goal is to find a balance between boredom and indifference versus hyperactivity and anxiety" (Keller, 1987, p. 3).

Relevance
Perceived relevance with regard to schoolwork or future career goals may or may not be present intrinsically in a given course of study. Keller (1987) held that a perception of relevance could come from the method of instruction, whether or not it is inherent in the content.

Confidence
Whether one succeeds or not, regardless of external factors or innate ability, depends to a great degree on one's feelings of confidence in the possibility of success.

Satisfaction
A problem can arise if the perceived use of these techniques intrudes on the student's rightful sphere of control. This is particularly likely to happen when the activities in question are those from which the student derives intrinsic satisfaction. "A challenge is to provide appropriate contingencies without over controlling, and to encourage the development of intrinsic satisfaction" (Keller, 1987, p. 6).

Good Video Game Design

Video game design has changed tremendously over the years. It has gone from a single programmer designing a game to a team of individuals with multi-million-dollar budgets working for several years to produce a single game.

It seems as if every devoted gamer wants to be a game designer. Many think they can do it easily, because they know how to program or have a great idea for a game. But how do you go from having a great idea to producing a great game?

Rules
The rules of a game depend on the game genre. These rules define what actions or moves a player can and cannot make; where they can and cannot go, and how they will win the game. Players do not get most of the games rules from the game's instructions. They are inherent to the game and govern the playing process (Bartle, 2004; Rollings & Adams, 2003).

Goals / Objectives
The goals and objective of a game establish the game's rules of play and the criteria for winning. Goals and Objectives define the victory condition, how the game will decide the winner.

Challenge
Games can be competitive in different ways. Some games have clearly defined competition, one player wins, and the other loses. In other games, contestants compete to achieve the highest score. The competition can be with another player, non-player, or the players themselves.

Engagement
Interactivity is how the player interacts or acts within the game world. The way the player jumps, shoots, or

dunks; how they interact with their competition or enemies; what motions, and actions they can make. Another term for the way a player operates in the game world is the game's interaction model.

Video games require players to be part of the learning environment. Their decisions typically affect the course of the game (Prensky, 2000). For example, in a virtual management situation the student has the opportunity to try different responses to a potential question. The student may decide first to hire additional staff, but if that does not produce the desired result, on another play attempt may decide to implement a technological solution instead. This enables the student to experience a situation from multiple perspectives (LoPiccolo, 2005). It further provides feedback to the student, increases real-life, problem-solving skills, and causes the student actually to be part of the learning environment, rather than a passive recipient of someone else's experience (Prensky, 2000).

Gee (2004) reported in his study of video games as a learning tool that this type of learning allows students to be situated within the learning environment and an active contributor to it. Active learners embark on a process of discovery through video game play, allowing students to develop their own understanding and concept of both content and environment (Gee, 2004). Students are more likely to remember their experiences and be able to connect them to future situations and are more likely to engage and invest in the learning goals and outcomes presented by the game (Barab, Barnett, & Squire, 2002; Gee, 2004). Doyle and Brown (2000) emphasized the enjoyment students have from playing video games increases their willingness both to invest in a game-based learning process and to remain motivated and engaged, even when challenged or facing difficult tasks. Furthermore, from a management perspective, games offer one of the few opportunities for students to develop skills and experience in certain areas, such as developing soft skills outside the work environment (Walters & Coalter, 1997).

In the real world, constructivist learning such as players experience in a video game provides one of the few truly three-dimensional (3-D) learning constructs available to the classroom teacher (DeKanter, 2005). Game-based learning anchors all the related learning components in a larger task or problem, just as managers would experience in real-world situations (DeKanter, 2005). It provides authentic tasks and environment, both challenges and supports the learner's critical thinking processes, and encourages trying out alternative views or methods without substantial risk to the player (DeKanter, 2005). In constructivism, knowledge and learning become "personally constructed by the learner and cannot be delivered in exact form from one mind to another" (Kirkley & Kirkley, 2005, p. 44). The learner not only must negotiate knowledge and meaning with others in the gaming environment, but often must construct entirely new concepts and personal models of how the world works (Kirkley & Kirkley, 2005). As such, according to Gary (2003, p. 3):

> Gaming doesn't just build workplace skills. It also appears to foster attitudes toward work that hiring managers want to see…the more frequent the respondent's game-playing activity, the stronger his attachment to the organization he worked for, the more likely he was to care about his relationships with his coworkers, and the greater his flexibility and motivation to work hard.

RESEARCH DESIGN AND METHODOLOGY

Three causal-comparative (ex-post facto) studies were conducted at an East Coast University to examine the difference in academic achievement between students who did and did not use video games in learning. A video game was added to half the classes teaching 1st year business students, 3rd year economics students, and 3rd year management students. Identical testing situations were used in each respective course while data collected included game use, test scores, gender, ethnicity, and age. ANOVA, chi-squared, and t tests were used to test game use effectiveness.

Instructors

Some instructors started using the video games as teaching supplements in 2005. It was the individual instructors who did or did not choose to use the video game as a learning supplement. Standardized testing assessments were prepared from a bank of test questions provided to instructors with the text used in all classes. Identical testing situations and test materials were provided to all students, with a similar time-limit, position of testing in the semester, and directions also provided to all students. Table 1 shows the instructor demographics of the study.

Table 1: Instructor Demographics

	BUSN115	ECON312	MGMT303
Instructors who did not use games	7	3	4
Instructors who used games	4	2	5

Game Choices

Business: Industry Giant II
BUSN 115 provides an introduction to business and the environments in which businesses operate. Students are introduced to the roles of the major functional areas of business and to the interrelationships among them. Organizational theories and techniques are examined, and economic, cultural, political, and technological factors affecting business organizations are evaluated.

Industry Giant II is a business simulation where players are in control of a complete corporation, everything from the land that the company sits on to the construction of new buildings, product transportation, development, resource collection, and financial management all in one game. The premise behind Industry Giant II is quite simple, to take a small wad of cash and turn it into big business. The single player modes presented in Industry Giant II are numerous, from a vast collection of scenarios to the ability to setup endless games, as well as the exceptional tutorial campaigns.

Economics: Zapitalism
ECON312 Principles of Economics introduces the field of economics and shows how a system-level understanding of the interaction between micro- and macroeconomics greatly improves the quality of one's analysis. Microeconomic concepts, such as supply and demand and the theory of the firm, serve as foundations for analyzing macroeconomic issues. Macroeconomic topics include gross domestic product (GDP), fiscal and monetary policies, and international topics such as global trade and exchange rates. The course also shows how human behavior and decision making translate into observable economic-system measures of performance. Emphasis is placed on interpreting economic variables and events, using fundamental analytical methods, and applying these to real-world issues

Zapitalism is a sophisticated business simulation where the student runs a retail business on the imaginary island of Zapinalia. Zapitalism is targeted at students who are ready to explore business and economics. Designed by an ex-Morgan Stanley financial analyst, it models real-world economics, simulates actual business and sales cycles, and Incorporates competitive pricing structures.

Management: Virtual U
MGMT303 Principles of Management examines the fundamental management theories and the evolution of management thought and action within the last century. Emphasis is balanced equally between an understanding of traditional management practices and the changing requirements of management in a dynamic, global marketplace. Students learn how to develop and utilize effective problem solving, team building, leadership, and communications skills to meet the unpredictable nature of the business enterprise of tomorrow

Virtual U is designed to foster better understanding of management practices. It provides students, teachers, and parents the unique opportunity to step into the decision-making shoes of a university president. Players are responsible for establishing and monitoring all the major components of an institution, including everything from faculty salaries to campus parking. As players move around the Virtual U campus, they gather information needed to make decisions such as decreasing faculty teaching time or increasing athletic scholarships. However, as in a real college or university, the complexity and potential effects of each decision must be carefully considered. And the Virtual U Board of Trustees is monitoring every move. Virtual U models the attitudes and behaviors of the academic community in five major areas of higher education management:

- Spending and income decisions such as operating budget, new hires, incoming donations, and management of the endowment;
- Faculty, course, and student scheduling issues;
- Admissions standards, university prestige, and student enrollment;
- Student housing, classrooms, and all other facilities; and
- Performance indicators.

The studies generated a variety of data sets, allowing comparison of various student groupings with relevance to whether they did or did not participate in the game. Data sets also included gender, race, and age.

The various data groups were compared using a bank of standardized test questions provided with the course text. All students used the same text for their respective business, economics, or management course. Therefore, using questions from the texts ensured that students had the same access to text and class content apart from game use and reinforces the credibility of results as being attributable to participation in the game.

RESULTS

This section contains the overall data analysis, presentation, interpretation, and explanation of the data. Tables and figures are given in order to make the data analysis clear. Outcomes are clearly interpreted

within the context of the research questions. Data collected included student test scores, class number, test score, gender, ethnicity, and age. Because of the type of data produced, and to test the effectiveness of the game supplement, means tests, ANOVA, chi-squared tests, and *t* tests were performed. Data from this research were analyzed and results were obtained using Microsoft Excel. These tests were based on different pairs of sample data as laid out in the six questions and accompanying hypothesis previously described.

To ensure video game use was the only variable, one-way ANOVA tests were used to determine if there was any significant difference between instructor grade means. There were seven instructors. One instructor never used the game in the class. Four instructors used the game in some, but not all, of their classes. Two instructors used the game in all their classes. The ANOVA tests determined there was no significant difference between Instructor means who taught with or without the game.

Study One: Business Students and Industry Giant II

A research study was undertaken at an East Coast University to examine the effectiveness of adding a simulation game as a supplement to an Introduction to Business and Technology course. Approximately one-fifth of students participated in the game playing, drawn randomly across courses and instructors. The overall purpose of this study was to examine the effectiveness of the addition of the video game, Industry Giant II, as a supplement to the BUSN 115 Introduction to Business and Technology class.

Study 1, Research Question 1

What is the difference in academic achievement between students who use video games in learning and those who do not? Table 2 shows the Descriptive Statistics of the first study.

Table 2: Study 1 Descriptive Statistics (Business)

	N	Min	Max	Mean	Std. Deviation
Grade w/o Game	801	15	100	79.18	16.16
Grade w/Game	227	58	100	91.50	11.74
Combined Sample	1028	15	100	81.90	16.12

Table 3 shows the One-tail *t* Test, Figure 1 shows the means of test scores with and without game play, and Figure 2 shows the distribution of grades with and without game play.

Table 3: Study 1 Statistical Test

One-tail t Test Hypothesis 1.1	*No Game*	*Game*
Mean	79.17	91.50
Variance	261.23	137.82
Observations	801	227
df	494	
t Stat	-12.75	

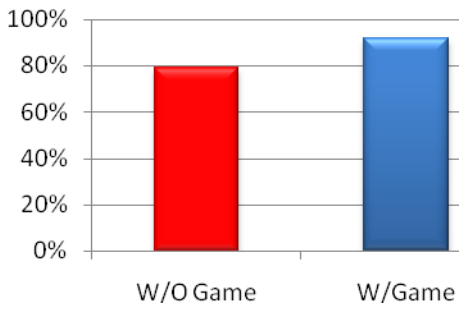

Figure 1. Average with and without game play

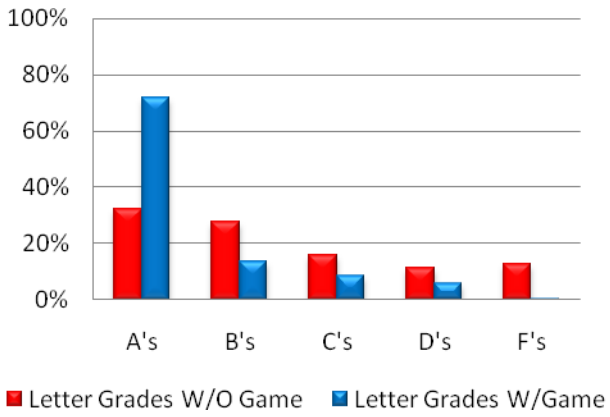

Figure 2: Study 1 Distribution of Letter Grades

Study Two: Economics Students and Zapitalism

This research tested whether adding a simulation game to a college level economics course improved student understanding and application of concepts, as measured by standardized tests. Significant elements included game participation, with a substantial improvement in test scores for students playing the video game Zapitalism. The overall purpose of this study was to examine the effectiveness of the addition of the video game, Zapitalism, as a supplement to the ECON 312 Principles of Economics class.

Study 2, Research Question 1

What is the difference in academic achievement between students who use video games in learning and those who do not? Table 4 shows the Descriptive Statistics of the second study.

Table 4: Study 2 Descriptive Statistics (Economics)

	N	Min	Max	Mean	Std. Deviation
w/o Game	234	0	100	77.86	27.01
w/Game	322	65	100	94.81	9.011
w/o Game: Male	161	0	100	78.65	26.78
w/o Game: Female	73	0	100	76.12	27.63
w/Game: Male	189	65	100	94.07	9.30
w/Game: Female	133	66	100	95.85	8.50
Combined Sample	556	0	100	86.23	20.58

Table 5 shows the One-tail *t* Test, Figure 6 shows the means of test scores with and without game play.

Table 5: Study 2.1 Statistical Test

One-tail t Test: Hypothesis 2.1	*No Game*	*Game*
Mean	77.85	94.80
Variance	729.85	81.19
Observations	234	322
df	271	
t Stat	-9.23	

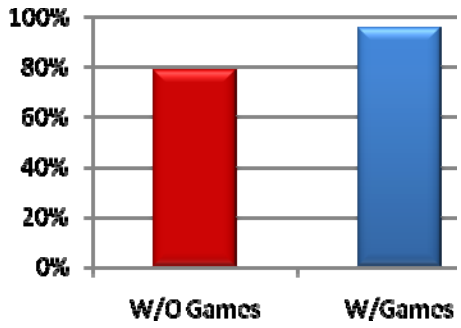

Figure 6. Average with and without game play

Study 2, Research Question 2

What is the difference in academic achievement between male and female students who use video games in learning and those who do not? Figure 7 show the means of gender test scores with and without game play while Figure 8 shows the distribution of grades with and without game play.

Table 6: Study 2.2 Statistical Test

One-Way ANOVA Test: Hypothesis 2.2	*Male*	*Female*
Mean	94.07407	95.84962
Variance	86.60	72.24
Observations	189	133
Pooled Variance	80.68	
df	320	
t Stat	-1.74	

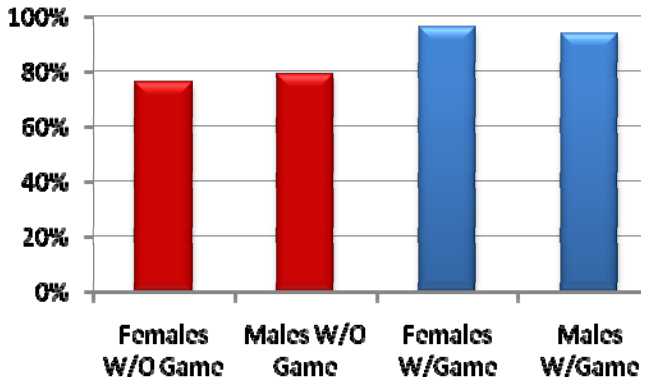

Figure 7. Gender, with and without game play

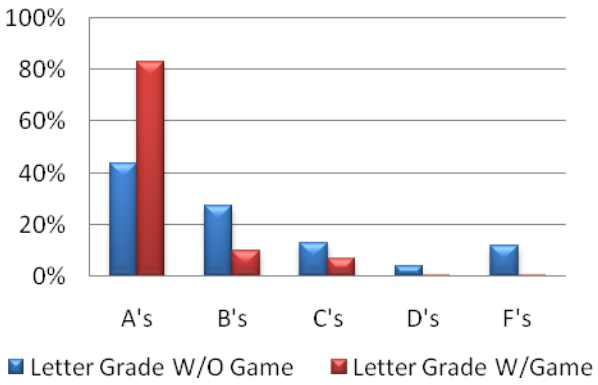

Figure 8: Study 2 Distribution of Letter Grades

Study Three: Management Students and Virtual U

A causal-comparative study was conducted at an East Coast University to examine the difference in academic achievement between students who did and did not use video games in learning. A video game, Virtual-U, was added to half the classes teaching 3rd year management

One-tail *t* Test: Hypothesis 3.1	*No Game*	*Game*
Mean	68.42	89.99
Variance	411.13	280.45
Observations	252	326
df	482	
t Stat	-13.65	

students. Identical testing situations were used while data collected included game use, test scores, gender, ethnicity, and age. ANOVA, chi-squared, and t tests were used to test game use effectiveness. The overall purpose of this study was to examine the effectiveness of the addition of the video game as a supplement to the MGMT 303 Principles of Management class.

Study 3, Research Question 1

What is the difference in academic achievement between students who use video games in learning and those who do not? Table 7 shows the Descriptive Statistics of the third study.

Table 7: Study 3 Descriptive Statistics (Mgmt)

	N	Min	Max	Mean	Std. Deviation
All w/o	252	17	102	68.43	20.28
All w	326	22	105	89.99	16.75
Male w/o	152	17	102	69.57	20.11
Female w/o	100	20	100	66.70	20.51
Male w/	192	22	105	90.68	16.63
Female w/	134	30	102	89.01	16.92
White w/o	47	28	100	72.15	20.23
White w	26	50	100	83.96	16.50
Black w/o	175	17	102	67.64	20.89
Black w	225	30	105	89.43	17.52
Hispanic w/o	30	33	92	67.20	16.24
Hispanic w	56	22	102	92.43	15.16
Asian w	19	80	101	97.74	5.11
18-20 w/o	46	20	93	63.59	18.61
18-20 w	34	60	100	92.79	9.36
21-30 w/o	140	17	100	65.20	21.00
21-30 w	209	22	105	90.16	16.92
31-40 w/o	48	33	100	76.88	16.52
31-40 w	49	60	105	96.37	8.64
41-50 w/o	18	50	102	83.39	14.38
41-50 w	34	30	105	76.97	22.74
Combined Sample	578	17	105	80.57	21.26

Table 8 shows the One-tail *t* Test, Figure 9 shows the means of test scores with and without game play.

Table 8: Study 3.1 Statistical Test

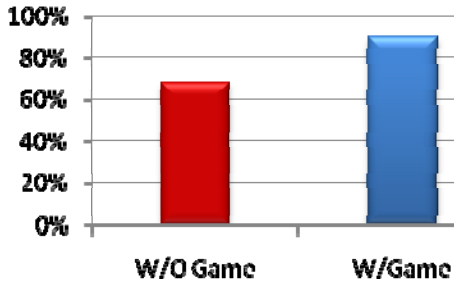

Figure 9. With and without game play

Study 3, Research Question 2

What is the difference in academic achievement between male and female students who use video games in learning and those who do not? Figure 10 shows the means of gender test scores with and without game play.

Table 9: Study 3.2 Gender ANOVA Test

Source	*df*	*F*	*p-value*
Treatment	3	66	1.12E-36
Error	574		
Total	577		

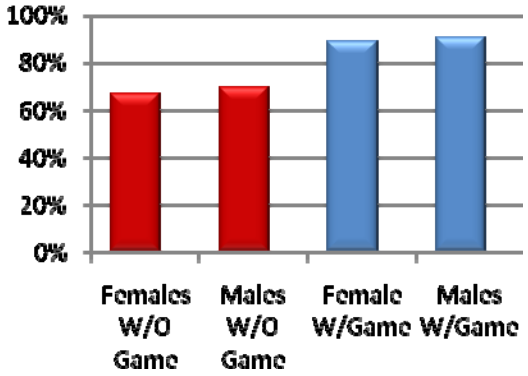

Figure 10. Gender, with and without game play

Study 3, Research Question 3

What is the difference in academic achievement between ethnic groups of students who use video games in learning and those who do not?

Table 10 shows the ANOVA test results while Figure 11 show the means of ethnic test scores.

Table 10: Study 3.3 Ethnicity ANOVA Test

Source	*df*	*F*	*p-value*
Treatment	6	34	1.16E-35
Error	571		

Total	577

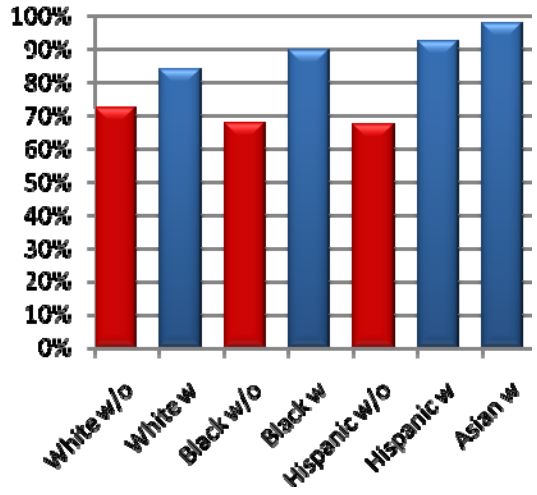

Figure 11. Ethnicity, with and without game play

Study 3, Research Question 4
What is the difference in academic achievement between age groups of students who use video games in learning and those who do not?

Table 11 shows the ANOVA test results while Figure 12 show the means of age test scores with and without game play while Figure 13 shows the distribution of grades with and without game play.

Table 11: Study 3.4 Age ANOVA Test

Source	*df*	*F*	*p-value*
Treatment	7	38	1.35E-44
Error	570		
Total	577		

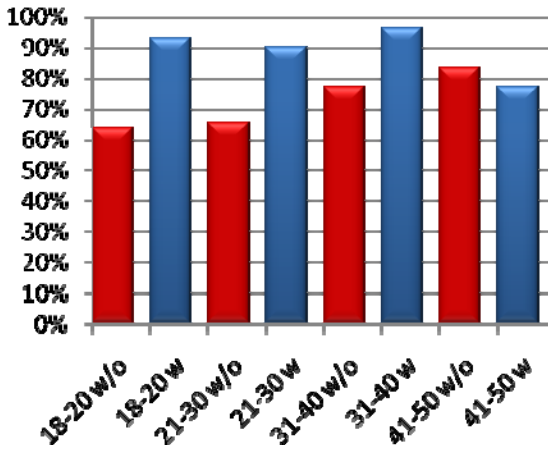

Figure 12. Age groups, with and without game play

Although not a finding, of particular note within the Age groups is the 41-50 without game students scored significantly higher than the 18-20 without game students. Also, although the 41-50 with game students was not significantly lower than the 41-50 without game students, it was, however lower. This anecdotal evidence reinforces the perception that older age groups learns better through parochial "tell-test" methods they grew up with than through technology-enhanced environments.

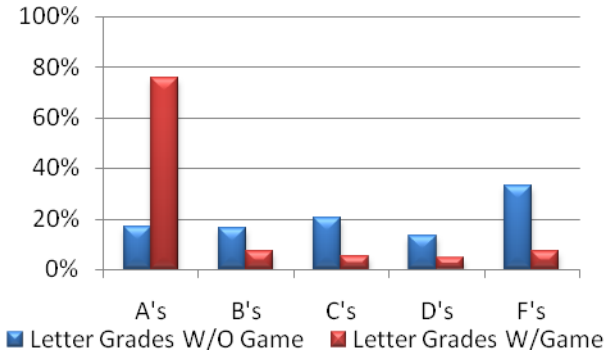

Figure 13: Study 3 Distribution of Letter Grades

Recommendations for Further Study

As this study is one of the first of its kind, there is plenty of research work left concerning game-based learning. As previously noted, Dr. Jan Cannon-Bowers (2006) recently challenged the efficacy of game-based learning: "I challenge anyone to show me a literature review of empirical studies about game-based learning. There are none … We need studies." Consequently, this study presents several areas for additional research:

1. Several studies of other participants using other games.
2. Studies of COTS games that could easily be adapted to teaching.
3. Studies into why there is a positive relationship between learning and video games.
4. Studies into the costs of using COTS video games versus custom content video games.
5. Studies into the presentation of different learning styles in learning video games.
6. Studies into the parental acceptance of game-based learning.
7. Studies of business models (learning industry v gaming industry) to fully integrate game-based learning and pc-based simulations into e-learning companies.
8. Studies on what impact using game-based learning will have on academic programs focusing on Instructional Systems Design (ISD) majors such as how curriculum will have to change.
9. Studies to explore the relationship between attrition and video game-based learning.

Conclusion

In the year 2006, $125,000,000 was spent on game-based learning without knowing if it works or not. The problem addressed by this research, then, was to determine the relationship between the use of video games and learning. A causal-comparative exploratory study was conducted to examine the difference in academic achievement between students who use video games in learning and those who do not, differences based on gender, ethnicity, or age. Historical test scores from classes of students from a nationally known university in Arlington, VA who did and did not participate in game play were examined. A management video game was added to approximately half the students' curriculum of 3rd year (junior) business students. Identical testing situations and test materials were provided to all students. Data collected included student test scores, class number, test score, gender, ethnicity, and age. Because of the type of data produced, and to test the effectiveness of the game supplement, means tests, ANOVA, chi-squared tests, and *t* tests were performed.

The data analysis found classes using the game had significantly higher means than those classes that did not use the game. There were no significant differences between male or female scores, regardless of game play, while both genders scored significantly higher with game play than without. There were no significant differences between ethnic groups, while all ethnic groups scored significantly higher with game play. Lastly, students age 40 year and under scored significantly higher with game play, those students 41 and older did not.

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