IDENTIFYING THE BARRIERS TO USING GAMES AND SIMULATIONS IN EDUCATION: CREATING A VALID AND RELIABLE SURVEY INSTRUMENT

By

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To the women in my life who taught me strength and endurance, but, who, most importantly, taught me to enjoy life

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TABLE OF CONTENTS

page

ACKNOWLEDGMENTS 4

LIST OF TABLES 8

LIST OF FIGURES 10

LIST OF ABBREVIATIONS 11

ABSTRACT 12

CHAPTER

1 INTRODUCTION 14

Background 14
Context of the Problem 16
My Professional Background 16
My Current Problem 18
My Future Problem 19
Problem Statement 19
Purpose Statement 20
Research Question 21
Significance of Study 21
Definition of Terms 22
Organization of Study 23

2 REVIEW OF LITERATURE 24

Conceptual Framework 24
Terminology 24
Diffusion of Innovations 25
Demographic Barriers 30
Terminology: 30
Demographic barriers 31
Inexperience with Games and Simulations Barriers 35
Terminology: 35
Inexperience with games and simulations barriers 36
Grade Category Barriers 37
Terminology: 37
Grade category barriers 37
Student Learner-level Barriers 39
Terminology: 39
Student learner-level barriers 39
School-based Barriers 40

Terminology: ... 40
School-based barriers ... 40
Technology-based Barriers ... 44
Terminology: ... 44
Technology-based barriers ... 44
Game-specific Barriers ... 47
Terminology: ... 47
Game-specific barriers ... 47
Synopsis of Reviewed Literature ... 51

3 METHODOLOGY ... 53

Conception of the Instrument ... 53
Participants of the Interview ... 54
Materials and Methods of the Interviews ... 54
Results of the Interviews ... 55
Design and Implementation of the Survey Instrument ... 58
Verifying the Accuracy of the Survey Draft ... 58
Focus group ... 58
Expert review ... 60
Think aloud protocol ... 61
Participants of the Survey Instrument Trial ... 62
About the Survey ... 62
Procedures for Survey Data Collection ... 63
Data Analysis of the Survey Instrument ... 64

4 RESULTS ... 67

Answering my Research Question ... 67
Demographic Results ... 68
Demographic Results about Education and Teaching ... 68
Results about Games and Simulations ... 69
Results about the Potential Barriers ... 70
Defining the Seven Factors ... 72
Issues with negative potential student outcomes ... 73
Technology issues ... 74
Issues specific to games and simulations ... 74
Teacher issues ... 75
Issues with games and simulations in education ... 76
Student issues ... 76
Incorporation issues ... 77
MANOVA Results ... 78
Gender results ... 79
Age results ... 79
Ethnicity results ... 79
Highest degree earned by the respondent ... 80
Grade category taught by the respondent ... 80

Respondents' game play frequency 81
ANOVA Results 81
Gender and issues with negative potential student outcomes 81
Gender and technology issues 82
Gender and teacher issues 82
Game play frequency and technology issues 82
Summary of Statistical Analyses 83

5 DISCUSSION AND IMPLICATIONS 102

Summary of the Study 102
Summary of the Findings 104
Perceived Barriers to the Adoption of Games and Simulations in Education . 104
Issues with negative potential student outcomes 105
Technology issues 107
Teacher issues 109
Issues specific to games and simulations 111
Issues with games and simulations in education 112
Student issues 114
Incorporation issues 115
Grade Category 116
Learner Level 117
Diffusion of Innovations 118
Teacher Inexperience with Games and Simulations 118
Limitations and Delimitations 119
Recommendations 121
Recommendations for Future Research 122
Recommendations for Educators 126
Recommendations for School Administrators 129
Conclusions 130

APPENDIX

A INTERVIEW QUESTIONS 133

B SAMPLE INTERVIEW 137

C INTERVIEW DATA 142

D SURVEY INSTRUMENT 145

E PATTERN MATRIX 152

LIST OF REFERENCES 153

BIOGRAPHICAL SKETCH 162

LIST OF TABLES

Table page

3-1 Demographic information of interviewees 65

3-2 Interview responses to the question “Which grade category would benefit the most to the addition of games and simulations to their curriculum?” 65

3-3 Interview responses to the question “Which learner level would benefit the most to the addition of games and simulations to their curriculum?” 66

4-1 Age of the survey respondents 86

4-2 Ethnicity of the survey respondents 86

4-3 Highest degree earned by survey respondents 87

4-4 Grade category survey respondents teach 87

4-5 How survey respondents use technology in their curriculum 88

4-6 How often do survey respondents play games (board, card, Internet, software, gaming platform, mobile application, etc.) 89

4-7 How survey respondents thought games or simulations could be useful for educational purposes. 89

4-8 Grade category(s) survey respondents thought would benefit from the addition of educational games and simulations. 92

4-9 Learner level(s) survey respondents thought would benefit from the addition of educational games and simulations. 92

4-10 Survey respondents rank how much each of these potential barriers prevent them from using games and simulations 93

4-11 The seven identified factors from the model 96

4-12 Eigenvalues and cumulative variance explained by the model 97

4-13 Correlation matrix for the model 97

4-14 MANOVA results for the demographic and game frequency survey questions 98

4-15 Follow-up ANOVA results on significant (at the .05 level) MANOVA’s 101

4-16 Descriptive statistics for the ANOVA’s involving gender 101

4-17 Descriptive statistics for the ANOVA for game play frequency 101

LIST OF FIGURES

Figure page

4-1 How survey respondents use technology in their curriculum 88

4-2 How survey respondents thought games or simulations could be useful for educational purposes 90

4-3 Survey respondents who thought games and simulations are compatible with their own teaching practices. 90

4-4 Survey respondents who thought games or simulations were too complex for their students to learn the intended lesson 91

4-5 Survey respondents who thought that it would be easy to experiment with an educational game or simulation for one of their lessons 91

4-6 Survey respondents who have seen co-workers using games or simulations in their classroom, teaching practices, curriculum, or lesson plans 92

4-7 Survey respondents rank (0= no barrier to 4= definite barrier) how much each of these potential barriers prevent them from using games and simulations.. 96

4-8 Scree plot for 32-item instrument... 97

LIST OF ABBREVIATIONS

ABE	Adult Basic Education
AHS	Adult High School
ANOVA	Analysis of Variance
ESL	English as a Second Language
FLDOE	Florida Department of Education
GED	General Education Diploma
ISTE	International Society for Technology in Education
MANOVA	Multivariate Analysis of Variance
NCPN	National Career Pathways Network
RCCPN	Research Coast Career Pathways Network

Abstract of Dissertation Presented to the Graduate School
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IDENTIFYING THE BARRIERS TO USING GAMES AND SIMULATIONS IN EDUCATION: CREATING A VALID AND RELIABLE SURVEY INSTRUMENT

By

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Major: Curriculum and Instruction

The purpose of this study was to create a valid and reliable instrument to measure teacher perceived barriers to the adoption of games and simulations in instruction. Previous research, interviews with educators, a focus group, an expert review, and a think aloud protocol were used to design a survey instrument. After finalization, the survey was made available to a group of educators for trial on the Internet. The data from the trial survey was then analyzed.

A portion of the survey required respondents to rate to what degree 32 potential barriers were perceived as an impediment to the adoption of games and simulations into their curriculum. The highest rated barriers included: cost of equipment, lack of time to plan and implement, inability to try before purchase, lack of balance between entertainment and education, lack of available lesson plans/examples, lack of alignment to state standards/standardized testing, inability to customize a game/simulation, and inability to track student progress within the game/simulation. An exploratory factor analysis identified seven factors that accounted for 67% of the variability in the respondents' rankings. These seven factors were: Issues with Negative Potential Student Outcomes, Technology Issues, Issues Specific to Games and Simulations,

Teacher Issues, Issues with Games and Simulations in Education, Incorporation Difficulties, and Student Ability. Interestingly, by using a MANOVA and follow-up ANOVA, several factors were found to have significant interactions with other questions on the survey. For instance, male educators ranked items in the Issues with Negative Potential Student Outcomes category as more of a barrier than female educators. Another gender difference was the ranking of items in the Technology Issues and the Teacher Issues categories; female educators ranked these items as more of a barrier than their male counterparts. Another significant interaction occurred between the Technology Issues category and Respondent Game Play Frequency. Those respondents that did not play games very frequently ranked individual technology barriers higher than those respondents who were more experienced with game playing. Implications of these, and other results, as well as recommendations for further research and for game and simulation implementation for educators and administrators, are discussed.

CHAPTER 1
INTRODUCTION

Background

Presently, electronic games and simulations have been identified as a potential learning tool (Aldrich, 2005; Annetta, Mangrum, Holmes, Collazo, & Meng-Tzu, 2009; Gee, 2003; Halverson, 2005; Hamlen, 2010; Prensky, 2001; Shaffer, 2006; Shaffer, Squire, Halverson, & Gee, 2005; Squire, 2006). Rieber (1996) points out that play and imitation are natural learning strategies, therefore students of all ages can play games to accommodate and assimilate extensive critical thinking and problem-solving skills. Coller and Scott (2009) suggest that a major difference between a game and other common forms of educational media is the degree of interactivity since a game requires the student to respond to the events occurring within the game. This interactivity can cause intense engagement which has been widely accepted as causing deep, meaningful learning experiences (Aldrich, 2005; Annetta, 2008; Cameron & Dwyer, 2005; Coller & Scott, 2009; Gee, 2003; Prensky, 2001; Rieber, 1996; Shaffer, 2006).

Additionally, electronic games, in particular, have become integral parts of our social and cultural environment (Oblinger, 2004). For all of these reasons, educators have been looking for electronic games and simulations to facilitate the learning experience by creating a new learning culture that better corresponds with the habits and interests of students today (Kiili, 2005; Prensky, 2001; Sanford et al., 2006). For example, computer games have been used as powerful mathematical learning tools to support learning of basic arithmetic and problem-solving (Ke & Grabowski, 2007). Additionally, Yip and Kwan (2006) found that students preferred vocabulary lessons supplemented with digital games to the conventional activity-based lessons, which they found boring and tedious. Furthermore, Papastergiou (2009) concluded that a gaming approach to computer science lessons was more effective in improving students' knowledge of the subject and level of motivation than a non-gaming approach to the same lessons.

Moreover, given the ubiquitous nature of gaming, it is understandable that educators would want to use this potential teaching tool to reach all ages, ethnicities, genders, and learning levels. Research has suggested that games and simulations serve groups (i.e. genders, low socio-economic, behavioral problems) that are typically under-served or left behind in learning (Angelone, 2010; Chen, Lien, Annetta, & Lu, 2010; Hamlen, 2010; Robertson, 2012). Consequently, researchers have focused on understanding the pedagogical foundations and limitations of using games and simulations, implementing instructional models to use games and simulations, and trying to identify specific games and simulations to use with particular subjects (Coller & Scott, 2009; Ke & Grabowski, 2007; Kebritchi & Hirumi, 2008; Lim, Nonis, & Hedberg, 2006; Shaffer, 2005).

Additionally, a large portion of research has focused on identifying the benefits of using games and simulations in education (Ke, 2008; Koh, Kin, Wadhwa, & Lim, 2011; Reese, 2007; Ritzhaupt, Gunter, & Jones, 2010; Sanford, Ulicsak, Facer, & Rudd, 2006; Shaffer et al., 2005; Sliney, O'Mullane, & Murphy, 2009; Squire, 2005). Some of the identified benefits include: increasing student motivation and engagement, enhancing problem-solving skills, peer learning and collaboration; facilitating language acquisition, stimulating information assimilation and retention; improving the integration of concepts and thinking cross-functionally; and, learning in a failsafe environment (Ferdig & Boyer, 2007; Gee, 2003; Koh et al. 2011; Reese, 2007; Rosas, Nussbaum, Cumsille, Marianov, Correa, Flores, Grau, Lagos, Lopez, Lopez, Rodriguez, & Salinas, 2003; Royle & Colfer, 2010; Torrente, Del Blanco, Marchiori, Moreno-Ger, & Fernandez-Manjon, 2010; Vos & Brennan, 2010).

Context of the Problem

After hearing about the use of games and simulations in curriculum at an educational conference, I became interested in introducing this form of educational technology at my own school. Unfortunately, it was not an easy process.

My Professional Background

Currently I work in an adult education program, located on a college campus in Florida, developing science curriculum and teaching science for the Adult High School (AHS) and ABE (Adult Basic Education)/GED (General Education Diploma) classes. We have three programs, the ABE/GED program, the ESL (English as a Second Language) program, and the Adult High School program. Recently, I wanted to introduce games and simulations into the curriculum of each of these programs. The FLDOE (Florida Department of Education) offers geographical grants, which are state funded grants designed to increase the number of students in Adult Education programs and, once enrolled, help these students transition into postsecondary educational programs for the career in which they are interested. By working with several co-workers on these geographical grants, I was able to purchase two Xbox® and two Wii® gaming systems, with specifically chosen games, for our three programs. For example, I purchased *Margot's Word Brain* (Wii®) and *My Word Coach* (Wii®) for our ESL and ABE/GED programs to help practice vocabulary words. For AHS classes and GED classes, we have found that games like *Beowulf* (Xbox®) and *Rise of the Argonauts*

(Xbox®) help students to visualize and relate to stories from other time periods, which can be particularly difficult for these types of students. For my own classes, I used games like *Science Papa* (Wii®) in my science classes to reinforce the scientific method. Also, with the lack of a proper scientific lab in our school, the simulated chemical labs exposed my students to equipment and procedures (e.g. electrolysis) that they would not have been able to see otherwise. The Wii® game, *Gravity*, is also great for teaching and demonstrating some principles in Physics as well as teaching problem solving skills. Additionally, in my Health Science Academy, a course designed for students who wish to pursue a healthcare career, I was able to expose the students to simulated emergency rooms (i.e. *Trauma Center* (Wii®), *Trauma Team* (Wii®)) with these gaming systems.

We successfully use computer games and internet games as well as these gaming systems. For example, the ESL program uses a driver's license simulator (http://www.driveredtogo.com/game_drivered.aspx) to help students practice English in addition to learning about driver's licenses. The teachers of the ABE/GED program like the Lumosity webpage (http://www.lumosity.com) for helping students practice basic math skills like times tables, fractions, addition, subtraction, and division through simple games. In the AHS program, we use web-based simulations like iCivics (http://www.icivics.org/) to help demonstrate courtroom procedures, or the Energyville game to demonstrate the consequences of over using nonrenewable resources. For my classes, on the Nobel Prize website, I like to use their blood typing, nervous system, and interactive parts of the cell games. Additionally, Science Discovery has some great

Internet games and simulations, like “Who Wants to Live a Million Years?” which demonstrates the principles of natural selection.

My Current Problem

The current difficulty I face in using games and simulations in Adult Education at my school is that, although several teachers support the use of games and simulations, many more do not. Consequently games and simulations are not being fully adopted in our adult education program. The teachers cite several reasons why they have failed to integrate these instructional tools. Some claim there is no proof that this is a legitimate teaching method. Many also say that adults do not play games; therefore adult students would not learn anything from using games and simulations. Others cite issues like cost and time constraints, lack of access to equipment or software, lack of experience and/or comfort with games, and so on. Without a sufficient understanding as to the barriers of using games and simulations in our classrooms, I cannot approach our administration to ask for help and so the incorporation of this teaching tool likely will lag.

Additionally, I have been asked to speak at professional conferences and workshops about my experience using games and simulations in our adult education program. At every presentation, I have met educators with questions about how to successfully introduce the use of games and simulations in their own educational programs. Questions often include: getting administrators (or peers) on board; finding any usable lesson plans; recommendations for good games or simulations; balancing time (or cost) to use games and simulations; and, a variety of student issues incorporating technology or gaming skills, variation in learning levels, and program (i.e.

Adult High School vs. GED vs. ABE) or grade category (i.e. elementary, pre-secondary, secondary, post-secondary, adult education).

My Future Problem

In my future endeavors, I hope to migrate out of Adult Education and into the college education program on campus. In particular, I would like to teach educational technology to future teachers. Since my college began offering four year degrees, those programs offering education degrees have become the most popular on campus. I want to teach these students new technology tools, like games and simulations, which they can use in their own classrooms. To teach these concepts properly, I need to prepare the students for any resistance that they may face in the use of games and simulations in their classrooms. To be able to do that, I need to know what those barriers are so that I can address each one and offer potential solutions. I consider this a priority since many researchers promote the use of games and simulations in classrooms and yet games and simulations in education are often still considered a novelty. How can I teach future teachers to use this technology knowing that when they begin their teaching careers they will probably be told that this form of educational technology is unavailable for use?

Problem Statement

Despite the popularity of the concept of incorporating games and simulations in education, as well as the potential benefits, some researchers have found that game and simulation adoption into education has been comparatively slow (Gee 2003; Gee & Levine, 2008; Kenny & Gunter, 2011; Koh et al., 2011; Prensky, 2001). For this reason, several researchers have tried to identify the barriers to the adoption of games and simulations in education (Baek, 2008; Becker & Jacobsen, 2005; Boyle, Connolly, Hainey, & Boyle, 2012; Egenfeldt-Nielsen, 2004; KeBritchi, 2010; Kenny & Gunter, 2011; Rice, 2007; Ritzhaupt et al., 2010; Simpson & Stansberry, 2008). However, at present, it has been suggested that researchers are not taking a broad enough approach to identifying the barriers to the adoption of games and simulations in formal education (Bourgonjon, Valcke, Soetaert, De Weaver, & Schellens, 2011).

After extensive research, I failed to find a comprehensive study in the differences of game and simulation adoption across grade categories (i.e. elementary, pre-secondary, secondary, post-secondary, adult education), teacher demographics (i.e. gender, age, ethnicity, highest degree earned), or level of teacher experience with games and simulations. Additionally, these barriers may be similar to the adoption of any new technology or the barriers may be specific to the adoption of games and simulations.

Furthermore, there is no widely accepted valid and reliable instrument to measure the barriers that educators identify in the use of games and simulations in their classrooms. A comprehensive survey that distinguishes if barriers vary at different grade categories, teacher demographics, and teacher game and simulation inexperience and if the identified barriers are general to the adoption of any new technology or are specific to games and simulations may be more likely to become a widely accepted instrument that may discern the actual barriers to the adoption of games and simulations in education. This study is designed to provide this type of comprehensive instrument.

Purpose Statement

Because of the lack of a valid and reliable instrument to measure the barriers of the use of games and simulations in the classroom, and the lack of a cohesive study across grade categories, teacher demographic information, and teacher inexperience with games and simulations, the purpose of this study is to create a reliable comprehensive instrument to discover the barriers identified by educators in the use of games and simulations in their classrooms. More specifically, this survey is comprehensive in that the grade categories (i.e. elementary, pre-secondary, secondary, post-secondary, adult education), teacher demographic information (i.e. gender, age, ethnicity, highest degree earned), and teacher unfamiliarity with games and simulations are taken into consideration when identifying the perceived barriers of adoption of games and simulation in formal education.

Research Question

RQ1. What are the barriers to adopting games and simulations in education?

RQ1a. Are there any barriers related to the instructor's demographic (i.e. gender, age, ethnicity, highest degree earned) characteristics or the instructor's inexperience with games and simulations?

RQ1b. Is there a variation in the barriers between grade categories (i.e. elementary, pre-secondary, secondary, post-secondary, adult education)?

Significance of Study

Even after almost a decade of study to identify the barriers of game and simulation adoption in education, there is no widely accepted, valid, and reliable instrument to identify and measure the barriers to using games and simulations in formal education. Additionally, little research has been done to comprehensively identify barriers across grade categories, teacher demographics, and teacher inexperience with games and simulations. Nor has there been research to identify if the barriers are similar to the adoption of any new technology or are specific to games and simulations. This study will contribute to the development of a valid and reliable instrument of measurement as well as discover the reasons that games and simulations are not more widely used in classrooms, regardless of grade category, instructor demographics, and instructor unfamiliarity with games and simulations. This study can be used to help current and future educators who wish to incorporate games and simulations to sidestep or overcome potential barriers to adoption. Also, this study may help future researchers with the creation of a valid and reliable instrument to measure teacher perceptions of the barriers to the use of games and simulations in formal education. Lastly, this study may potentially be useful to game designers who wish to design games and simulations for educational purposes.

Definition of Terms

- ADOPTION. The decision to make full use of an innovation as the best course of action available (Rogers, 2003).

- BARRIER. Any issue and/or reason that prevents or limits the use of any technology in the classroom (Kotrlik & Redman, 2009).

- GAME. Competitive interactions bound by rules to achieve specified goals that depend on skill and often involve chance and an imaginary setting (Cameron & Dwyer, 2005; Randel, Morris, Wetzel, & Whitehill, 1992).

- GAME AND SIMULATION USE IN FORMAL EDUCATION. Any electronic game or simulation used to teach specific curriculum or as an example of existing relevant terms, concepts, and methods (Egenfledt-Nielsen, 2010). Additionally, this may include educators who have students create electronic games or simulations to demonstrate curricular knowledge.

- GRADE CATEGORIES. The grouping of school grades into five main categories: elementary, pre-secondary (i.e. middle school), secondary (i.e. high school), post-secondary (i.e. college/technical school), and adult education (i.e. ABE/GED, AHS, ESL).

- LEARNER LEVELS. The categorization of student learner levels into three main categories: low-level learners, general learners, and gifted learners.

- SIMULATION. An electronic model of a process or mechanism relating input changes to outcomes in a simplified reality that may not have a definite end point (Cameron & Dwyer, 2005; Randel et al., 1992).

Organization of Study

The remainder of the study is organized into four chapters and appendices including the survey and interviews used. Chapter 2 is the review of related literature regarding previously identified barriers of the adoption of games and simulations in education divided into relevant categories (i.e. Diffusion of Innovation (Conceptual Framework), Demographic Barriers, Inexperience with Games and Simulations Barriers, Grade Category Barriers, Student Learner-level Barriers, School-based Barriers, Technology-based Barriers, Game-specific Barriers). Chapter 3 includes the research design and methodology of the study. Chapter 4 introduces the results of the survey and data analysis and the findings based on this information. Chapter 5 contains the summary, discussions, and implications of the results, recommendations based on the results, and conclusions. Finally the study is concluded with a bibliography and appendices.

CHAPTER 2
REVIEW OF LITERATURE

Although there are many cited reasons to adopt games and simulations in education, and though technology has become more wide-spread and easier to access, currently game- and simulation-based learning does not seem widely adopted in formal education (Gee 2003; Gee & Levine, 2008; Kenny & Gunter, 2011; Prensky, 2001). This study aims to create a valid and reliable instrument to measure the teacher perceived barriers to the use of games and simulations in formal education. In order to do this, I incorporated the results from interviews of educators with information from published research to comprehensively identify the barriers to the incorporation of games and simulations into curriculum. To organize the previous investigations, I divided the research into eight main components: Diffusion of Innovation (Conceptual Framework), Demographic Barriers, Inexperience with Games and Simulations Barriers, Grade Category Barriers, Student Learner-level Barriers, School-based Barriers, Technology-based Barriers, and Game-specific Barriers. Each category begins with a list of definitions to help explain the category.

Conceptual Framework

Terminology

- DIFFUSION OF INNOVATION. A theory that attempts to explain how, why, and how quickly new ideas and technology (i.e. innovations) spread through a society (Rogers, 2003).

- RELATIVE ADVANTAGE. Describes the improvement of the new technology over the old technology because the innovation must be of some value to the innovator (Rogers, 2003).

- COMPATIBILITY. The extent to which the new approach is similar to the traditional practices with the new approach is important to the adoption of the innovation. The more compatible an innovation is, the more likely it will be adopted (Rogers, 2003).

- COMPLEXITY. Refers to how difficult the game or simulation is to learn and use. If the innovation is too complex or too difficult to use, then it is unlikely to be adopted (Rogers, 2003).

- TRIALABILITY. Refers to the ease with which a potential adoptee can tryout and experiment with an innovation. If an innovation is difficult to test in action, then it is less likely to be adopted (Rogers, 2003).

- OBSERVABILITY. Refers to the extent to which benefits of an innovation can be seen or observed by a potential user. When potential adoptees see the benefits that adopters have harnessed using the innovation, this encourages the potential adoptees to try the innovation as well. Therefore, sufficient observability is another characteristic in the potential diffusion of an innovation (Rogers, 2003).

Diffusion of Innovations

Electronic games and simulations are a newer technology, an innovation. Unfortunately, education has been especially resistant to change and this has become more obvious in the adoption, or lack of adoption, of instructional technology (Germanne & Sasse, 1997). Innovation causes change; resistance to change is a natural reaction to the uncertainty that any transformation creates (Rogers, 2003). One of the best known and well-respected attempts to describe the adoption of new ideas (or technology) through cultures is the theory of Diffusion of Innovation put forth by Everett Rogers (Rogers, 2003). The theory is complex and its full spectrum is beyond the scope of this chapter, but a brief synopsis of each characteristic, using the barriers of game and simulation adoption as the innovation is included to address this model.

Several researchers propose that adoption of a new technology is not a straightforward decision since adoptees go through several stages of internalization involving a complex process of emotional, cognitive, contextual, and social concerns, before fully embracing any type of technology (Straub, 2009; Taylor, 2008). Rogers

(2003) suggests that individuals follow a five-step process when deciding to adopt an innovation. The first step is *knowledge* or when the person first learns about the innovation. The second step is *persuasion* or when the person forms a favorable (if adopting) attitude about the innovation. The third step is *decision* or when the person makes the choice to adopt the innovation. The fourth step is *implementation* or when the person actively begins using the innovation. And the last step is *confirmation* or when the person gains positive (if adopting) reinforcement from the adoption process.

If using games and simulations in education as an example, the first step (i.e. *knowledge*) could be a teacher who learns about a game or simulation that is useful for a specific class from a colleague. As that colleague demonstrates the game or simulation, the teacher begins to like the game or simulation (i.e. *persuasion*), seeing a potential lesson. The teacher then makes the choice (i.e. *decision*) to use that game or simulation in his or her curriculum. The fourth step is when the teacher is planning and then using the game or simulation in class with his or her students (i.e. *implementation*). And finally, when the students successfully learn the intended lesson while enjoying the teaching process, the teacher is rewarded for the addition of the game or simulation (i.e. *confirmation*).

Once an individual adopts the innovation, there is no guarantee that the adoption will spread to others, diffusing throughout the society. Rogers (2003) suggests that the diffusion of any new idea or technology throughout a culture is influenced by the innovation itself (i.e. the idea or the technology), *communication channels* (i.e. the process through which the innovation is communicated between individuals), *time* (i.e.

the length of time for individuals to pass through the five-step adoption process), and a *social system* (i.e. a society with its own customs, beliefs, practices, and rules).

If using games and simulations as an example of the innovation, many teachers do not have an opportunity to communicate to each other their own teaching practices since many planning periods are asynchronous; therefore, a lack of communication may slow the overall adoption process of games and simulations in formal education. Additionally, the lack of parent, administrator, or community support may cause societal pressures (i.e. *social system*) which may also slow the diffusion of game and simulation use in formal education.

Moreover, within any society there are roles that individuals play in the adoption process (Rogers, 2003). For example, there are *opinion leaders*, highly esteemed individuals who have the ability to influence individuals toward adoption or rejection. Also, there are *change agents* who recognize the viewpoints of *opinion leaders* and help to mediate between these viewpoints and the *social system*. Finally, there are *change aides* who, although may have less credibility within the society, have more contact with the society and consequently can further the message of the *change agent*.

When using games and simulations in education as an example, a principal, who decides all the teachers of the school should incorporate a game or simulation into their curriculum, could be considered an *opinion leader*. Continuing this example, the instructional technologist who gives the trainings on the operation of the game or simulation could be considered a *change agent*. Lastly, the first few teachers who have successfully used the game or simulation could be *change aides* as they help non-adopters learn to use the game or simulation.

Continuing with the previous example, these first few teachers who successfully adopted the game or simulation could be thought of as either *innovators* or *early adopters* (Rogers, 2003). Rogers (2003) classified all adopters into five categories based on how quickly an individual adopts an innovation. These categories include: *innovators* (i.e. highly adventurous individuals that are the first to adopt (typically the first 5% of adopters)), *early adopters* (i.e. the second group of adopters who are usually more respected by their peers (typically the next 10% of adopters and usually contains the *opinion leaders*)), *early majority* (i.e. those individuals who interact with *opinion leaders* but taking longer to deliberate about the decision (typically the next 35% of adopters)), *late majority* (i.e. those individuals who are skeptical and cautious about new ideas (typically the next 35% of adopters)), and the *laggards* (i.e. those individuals who are very traditional and set in their ways (typically the last 15% to adopt)).

Additionally, Rogers (2003) identified several characteristics about the innovation itself that influences adoption and diffusion. These intrinsic characteristics include *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability* (see glossary above). Rogers (2003) claims that the probability of adoption of an innovation is likely to increase if the innovation is perceived to be advantageous; is compatible with existing norms, beliefs, and past experiences; has a relatively low level of *complexity*; can be experimented with or has a high rate of *trialability*; and use of the innovation has observable results, including being able to see others using the innovation.

Relative advantage refers to the “cost-benefits” analysis of the innovation or, in other words, the comparison of the relative benefits of using the innovation to any costs associated with the innovation. As with the adoption of any innovative technology, the new technology must be of some value to the innovator. With the addition of games and simulations, increased motivation, engagement, and active learning are often cited as benefits (Egenfeldt-Nielsen, 2010; Ke, 2008; Royle & Colfer, 2010; Torrente et al., 2010). Additionally, games and simulations can encourage active learning or learning by doing, can enhance learning of complex subject matter, can foster collaboration among learners, and can encourage systematic ordering and solving of problems (Gee, 2003; Ke, 2008; Royle & Colfer, 2010; Torrente, Moreno-Ger, Martinez-Ortiz, & Fernandez-Manjon, 2009). Conversely, some people see the costs of games and simulations outweighing the benefits. For example, parents and teachers fear that students will develop aggressive tendencies from the violence in games or may become addicted to playing these games (Koh et al., 2011).

Although Rogers (2003) found that *compatibility* is usually a smaller predictor of adoption than *relative advantage*, the educational system, which is an organization that changes quite slowly and appears inflexible, may see *compatibility* as a more important issue. The adoption of games and simulations in a classroom can be linked to the teachers' abilities to scaffold these new techniques to their own traditional pedagogical practices (Egenfeldt-Nielsen, 2004; Koh et al., 2011; Niederhauser & Stoddart, 2001; Ritzhaupt et al., 2010; Rosas et al., 2003; Royle & Colfer, 2010; Sanford et al., 2006; Taylor, 2008; Vos & Brennan, 2010). The *compatibility* of the old and new methodologies is important in educators' adoption of the use of games and simulations (Becker & Jacobsen, 2005; Simpson & Stansberry, 2008; Torrente et al., 2010).

The *complexity* of an innovation refers to how difficult it is to harness the *relative advantage* from the innovation. For instance, the *complexity* of games and simulations require extra time by instructors to incorporate into lessons and also the game *complexity* requires extended time to be played by students (Baek, 2008; Egenfeldt-Nielsen, 2004; Koh et al., 2011; Rice, 2007; Squire, 2006; Torrente et al., 2010). For these reasons, games and simulations may be considered complex by some potential adoptees.

As for *trialability*, games and simulations may not be very easy to experiment with in schools. Cost of the equipment, lack of specific methodologies, negative opinions about gaming, and cultural resistance lessen the *trialability* of games and simulations in education (Baek, 2008; Becker & Jacobsen, 2005; Kenny & Gunter 2011; Ritzhaupt et al., 2010; Royle & Colfer, 2010).

Finally, it is important for potential adoptees to see the benefits that adopters have using the innovation. This is quite difficult in public schools since, as Egenfeldt-Nielsen (2010) points out, many teachers essentially work in a vacuum and do not see what other teachers do in their own classrooms. The more research done on the adoption of games and simulations in education can be one way educators can see the benefits of adopting games and simulations in their own classrooms.

As research indicates, the adoption of any new technology is not an easy proposition for educators (Taylor, 2008). Identifying the barriers to adopting games and simulations will give insight into the adoption process, but also may assist teachers, administrators, and policy makers in understanding how to successfully adopt this instructional technology.

Demographic Barriers

Terminology:

- DEMOGRAPHIC BARRIER. For the purposes of this study, a demographic barrier

> is any barrier, originating from the teacher's demographic traits (i.e. gender, age, ethnicity, highest degree earned), which discourages the use of technology in the classroom. For example, a male teacher may have different perspectives about the introduction of a specific technology than a female teacher.

Demographic barriers

Do the demographic characteristics of a teacher (i.e. gender, age, ethnicity, highest degree earned) influence the decision to add games and simulations into the curriculum? Jensen and De Castell (2010) suggest that no technology should be assumed as value-neutral, or, in other words, no technology should be indiscriminately used regardless of identity factors like gender, race, nationality, or class. Also, research suggests that teaching level, years of experience, and teaching subject affected the potential adoption of games and simulations by a teacher (Kenny & McDaniel, 2011; Koh et al., 2011; Ritzhaupt et al., 2010).

Gender difference has been a focus of an array of research on technology integration in formal education (Annetta et al., 2009; Bourgonjon et al., 2011; Greenberg, Sherry, Lachlan, Lucas, & Holstrom, 2008; Hainey, Connolly, Stansfield, & Boyle, 2011; Jensen & De Castell, 2010; Joiner, Iacovides, Owen, Gavin, Clibbery, Darling, & Drew, 2011; Kenny & McDaniel, 2011; Robertson, 2012; Wilson, 2006). Technology has been stereotyped as a "male domain" or a "male norm and female deficit" since males, in general, showed more positive attitudes toward computers and other forms of digital media (Abbiss, 2008; Annetta et al., 2009; Cockburn, 1992; Jensen & De Castell, 2010). Additionally, supporting this idea that technology is gendered, both scientific and technological careers have more males enter and persist in these fields than do females (Annetta et al., 2009).

However, it may be that these gender-based differences are gradually disappearing as technology becomes more commonplace and mainstream. For example, one study suggests that girls may spend more time than boys using computers; however, males show a more positive attitude toward computers, are more self-confident in computer use, and use a computer out of school more frequently (Annetta et al.; 2009). Surprisingly, this study found that girls tended to maintain relationships by email, chat with friends online, and search information on the Internet more frequently than males. Studies of this nature suggest that technology is not really gendered, but that each gender is using the technology in different ways (Annetta et al., 2009; Jensen & De Castell, 2010; Joiner et al., 2011; Padilla-Walker, Nelson, Carroll, & Jensen, 2010; Wilson, 2006).

One of the ways that males use technology differently from females is playing computer and video games. Males tend to play games more frequently and for longer periods of time than females (Annetta et al., 2009; Hainey et al., 2011; Hamlen, 2010; Joiner et al., 2011; Padila-Walker et al., 2010; Roberts & Foehr, 2008; Robertson, 2012). Additionally, because boys tend to begin playing digital games at a younger age this gender gap tends to be magnified with age; therefore, by the time an average young male enrolls in college, he has accumulated many more hours of experience than an average young female of the same age (Hainey et al., 2011; Robertson, 2012).

The interesting question then becomes why – why is there such a difference in the amount of game play between males and females? Just as researchers identified that females and males use computers differently, other researchers have noticed that female and male game playing is also different. For example, research suggests that males and females prefer different types of games with females preferring more logic and puzzles for leisure and males preferring more competition/challenge and graphic sophistication for engagement (Annetta et al., 2009; Bourgonjon et al., 2011; Chen et al., 2010; Hainey et al., 2011; Lowrie & Jorgensen, 2011). Additionally, several researchers point out that many of the recent generation of games were created by males for males as evidenced by the lack of active female characters or, if a female character is present, the female character is highly sexualized (Greenberg et al., 2008; Hamlen, 2010; Jensen & De Castell, 2010). Because games often force players to engage in behaviors that are inherently masculine in nature, they may be less appealing to girls and women who are reluctant to cross gender barriers (Annetta et al., 2009; Greenberg et al., 2008; Jensen & De Castell, 2010). Both parental and peer support seem to be influential to girls' decisions to engage in such cross gender activities (Jensen & De Castell, 2010).

Another possible explanation for the gender difference is that girls may not have as much access to games in domestic spaces because parents do not purchase gaming systems as readily for daughters as for sons; therefore, girls may have to "wait in line" behind male relations to use technology at home and daughters' game choices are often more intensely regulated by parents than sons' game choices (Greenberg et al., 2008; Jensen & De Castell, 2010). Additionally, one study found that women have less free time, and that free time is in smaller chunks, than men, which may help explain a decreased amount of female game play (Joiner et al.; 2011).

Regardless of the cause for preventing girls from gaming in the past, recent research has suggested that girls are catching up with the boys (Annetta et al., 2009;

Bourgonjon et al., 2011). Because females are the highly sought market for the next generation of games, girls and women can be considered as the future central consumers of games (Greenberg et al., 2008; Jensen and De Castell, 2010; Joiner et al., 2011).

What do gender differences mean for using games and simulations as instructional tools? One study found no gender differences in learning outcomes, motivation, or self-efficacy when a simulation was introduced in a science lesson (Dede, Nelson, & Ketelhut, 2004). Another study suggests that female students will benefit as equally as male students regardless of the type and design of a digital game (Joiner et al., 2011). Nonetheless, researchers suggest that teachers should take into consideration the design of the lesson and the context of the game or simulation when integrating the two (Joiner et al., 2011; Robertson, 2012; Wilson, 2006). For example, one study suggests that when adding technology to a lesson, educators should give more attention and encouragement to female students to ensure a more positive learning experience (Chen et al., 2010).

Unlike gender, there has been little research on age or ethnicity with the use of instructional technology in respect to teachers. Interestingly, one study did find that older teachers have less confidence in technology and their ability to use that technology (Kotrlik & Redmann, 2009). Additionally, the “digital divide” is a term that has been bandied about to describe the generation gap between technology-savvy students versus the non-technology-savvy teachers (Buckingham, 2003; Tapscott, 1998). Tapscott (1998) focuses primarily on age as the main explanation for this digital divide; however, since Hamlen (2010) found a technology gap in school children, age may not be the only factor in differing technology abilities.

Aarsand (2007) suggests that socio-economic background, ethnicity, gender, geography as well as age are all of the social variables that explain this digital divide. Interestingly, African Americans reported spending more time on the Internet than any other ethnicity (Padilla-Walker et al., 2010). Roberts and Foehr (2008) found that African American youths reported playing games longer (40 minutes) per day than Hispanics (34 minutes) and Caucasians (30 minutes).

What do age and ethnicity differences mean for using games and simulations as instructional tools? In short, if a lesson successfully incorporates a game or simulation depends, ultimately, on the teacher. For instance, the teacher's type of learning and teaching systems and his or her pedagogical style is the driving influence on learning (Clark, 1983). For example, Kenny and McDaniel (2011) suggest that older people (40 years old and over) are playing more video games, which means that these older teachers may be more at ease to introduce a game or simulation into a lesson. Consequently gender, age, and/or ethnicity could lead to a lack of technology skills and/or game-playing skills. This type of deficiency may be a barrier to the introduction of a game or simulation in a lesson, but more research is merited to establish this concept and determine if this concept is actually correlated to gender, age, and/or ethnicity.

Inexperience with Games and Simulations Barriers

Terminology:

- INEXPERIENCE WITH GAMES AND SIMULATIONS BARRIER. For the purposes of this study, an inexperience with games and simulations barrier is any barrier, originating from the teacher's inexperience with games and simulations (i.e. the teacher does not frequently play games or simulations), which discourages the use of games and simulations in the classroom. For example, a teacher who frequently plays games and simulations may see more educational value in a game than a teacher who does not frequently play games and simulations.

Inexperience with games and simulations barriers

Does the frequency in which a teacher plays games and simulations influence the adoption of games and simulations into the curriculum? Does it increase or reduce any potential barriers in the addition of games and simulations into lessons? It makes sense that an instructor should know how to play a game or simulation before introducing it to students so that the instructor can teach students how to play and guide them to the true learning goals. For instance, the teacher's knowledge of the game or simulation can be instrumental in assisting students with learning to play the game, reducing frustration, and trouble-shooting sticking points (Charsky & Mims, 2008).

But if a teacher is inexperienced with games and simulations, would a teacher even want to incorporate one into a lesson? Research suggests that educators who play more games tend to be more empathetic toward this type of technology, thus being more motivated to adopt a game or simulation (Hamlen, 2010; Koh et al., 2011; Lim, 2008). De Aguilera and Mendiz (2003) suggest that teachers who denounce the use of games and simulations in education have no game-playing experience. They maintain that this lack of experience is a main contributor to the hostile criticism of all games, simulations, gaming technology, and players. Additionally, it has been suggested that to gain parental and community support for the use of games and simulations in education, those individuals should play games (Bourgonjon et al., 2011). This study goes on to hypothesize that experience with video games will lessen the perception that playing these games can have negative side-effects, like aggression.

Several researchers note that inexperience is a barrier to adoption and suggest that teachers increase their experience with games and simulations if they want to incorporate them into lessons (Kenny & McDaniel, 2011; Ritzhaupt et al., 2010; Schrader, Zheng, & Young, 2006). Interestingly, Kenny and McDaniel (2011) claim that although many people play games and simulations, and game time has been on a steady increase, teachers do not follow this gaming trend. They suggest that a particularly disproportionate percentage of preservice teachers either do not play games and simulations or do not play them as frequently as their non-teaching counterparts. Curiously, their study showed that many of these non-playing preservice teachers had a change of attitude, from negative to positive, about using games and simulations in curriculum after playing only one game. For these reasons, inexperience with games and simulations may be a potential barrier for educators in the adoption of games and simulations into his or her curriculum.

Grade Category Barriers

Terminology:

- GRADE CATEGORY BARRIER*.* For the purposes of this study, a grade category barrier is any barrier, stemming from the grade category (i.e. elementary, pre-secondary, secondary, adult education) of the students intended for the technology, which restrains a teacher from using that technology. For example, some educators may view games and simulations as ideal for younger students; whereas, other educators think that games and simulations should only be used with older students.

Grade category barriers

Does the category of education (i.e. elementary, pre-secondary, secondary, post-secondary, adult education) make a difference in the adoption of games and simulations in the classroom? It has been suggested that since playing games is a natural activity for children and an excellent example of learning through authentic situations, that game formats have a natural advantage in children's learning (Rosas et al., 2003). Niederhauser and Stoddart (2001) suggest that younger grades have more of a child-centered approach to learning and that teachers of this learner-centered pedagogy tend to choose different types of software to meet specific educational goals.

Conversely, in college, most classes are teacher-centered, where the professor transmits his or her knowledge to students who memorize the information and later reproduce it on an exam (King, 1993). This type of passive learning does not seem to correlate with the complex problem solving of games and simulations. One suggested reason for this outdated teaching method may be that many post-secondary educators have had little preparation to be educators (Schrum, Burbank, Engle, Chambers, & Glassett, 2005). These faculty members may have had little experience with newer educational technology tools and, with large teaching loads, have little time for professional development. Another challenge for post-secondary schools, community colleges in particular, is the diversity of the student population. The students have a wide range of skills and experiences with which they begin taking classes (Cox, 2003). This variety may make student-centered learning difficult. Alternatively, it has been suggested that it would be easier to incorporate games and simulations in the curriculum of secondary schools and community colleges, before students encounter the more specific, advanced curriculum of higher education (Koh et al., 2011). A survey done by Beggs, O'Neill, Virapen, and Alexander (2009) found that some of the disadvantages of using games and simulations in higher education were the lack of technology skills, the lack of resources, the lack of time, the lack of familiarity with games and simulations, and the uncertainty of how to use and where to begin using games and simulations. These are some of the same barriers found in elementary, middle (pre-secondary), and secondary schools. Rieber (1996) points out that some adult educational settings, such as corporate and military training environments, successfully incorporate games and simulations; however, due to the unfortunate misconceptions that reduce their learning potential, game use in education will have the greatest success in younger grades (i.e. elementary).

Student Learner-level Barriers

Terminology:

- STUDENT LEARNER-LEVEL BARRIER*.* For the purposes of this study, a student learner-level barrier is any barrier, originating from the learning level (i.e. low-level learners, general learners, gifted learners) of the students intended for the technology, which prevents the use of that technology in the classroom. For example, low-level learners may get too frustrated if the game is difficult and gifted students may get bored if the game is too easy.

Student learner-level barriers

Does the learning level (i.e. low-level learners, general learners, gifted learners) of the student make a difference in the addition of games and simulations in the curriculum? Squire (2005) suggests that game-based formats can make complex thinking accessible to a broader range of students, including those who are generally unsuccessful in school. Conversely, Villalta, Gajardo, Nussbaum, Andreu, Escheverria, and Plass (2011) cite information overload in games as confusing for student use in the classroom. This suggests that low-level learners may have trouble using games and simulations as educational tools. Mann (1994) suggests that the role of teacher and learner are often blurred in the new learning environments due to the advancement of multimedia and technology. She proposes that teachers often may learn only hours or minutes before students do and there are times when they learn together, which seems to happen frequently with gifted students. This role reversal of teacher and student is part of learning in technology-rich environments which may include games and simulations. As a final point, Winberg and Hedman (2008) argue that learning level is not an issue unless there is too large of a gap between the student and the game or simulation causing the student to be overwhelmed or, alternatively, not challenged enough to be engaged.

School-based Barriers

Terminology:

- SCHOOL-BASED BARRIER. For the purposes of this study, a school-based barrier is any barrier, caused by any employee or design of the school, which discourages the use of technology in the classroom. Examples of school-based barriers include, but are not limited to: class size (i.e. too large or too small), too much variation of student abilities, resistance to a shift in pedagogical practices, school culture (i.e. administrator, peer, and community support; standardized testing influence on teaching activities), and characteristics of the teacher (i.e. confidence with technology, how familiar the teacher is with games, belief games cause addiction/bad behavior, fear games will replace teachers).

School-based barriers

One example of a school-based barrier is class size since many teachers have no control over the number of students in their classrooms; however, class size can be a barrier for the introduction of any new technology. With the use of games and simulations in education, Egenfeldt-Nielsen (2004) cites larger class sizes as a barrier to adoption. Another school-based barrier that is not specific to games and simulations, but would be a school-based barrier for any new technology is the wide range of student skill and experience in the classroom (Schrum et al., 2005; Vos & Brennan, 2010). Variation in student abilities may make it difficult for an educator to keep all students on task because some may be familiar with the technology and become bored; whereas others will be lost and need extra help.

From an instructive point of view, many new technologies require a more learner-centered type of teaching which may require a major shift in pedagogical practices. Research has found that personal belief systems have a powerful influence on teachers' instructional practices (Niederhauser & Stoddart, 2001). For many schools, teaching with technology is so far outside traditional pedagogical practices, that computers are often banished to another room (Rosas et al., 2003).

School cultural resistance is also cited by several researchers as a barrier to the adoption of games and simulations in education (Koh et al., 2011; Royle & Colfer, 2010; Sliney et al. 2009). For example, in their survey, Becker and Jacobsen (2011) found that many teachers did not try to integrate games and simulations into their lessons because game integration was not considered a priority by the school's administration. Furthermore, administrators verbally supporting or making policies to support games and simulations is not enough to create a new culture. For instance, Niederhauser and Stoddart (2001) point out that often policy makers assume teachers will accept and implement any instructional methods mandated from the top down. If any instructional technology is to be incorporated in education, administrators should be encouraging and supportive of the incorporation and, perhaps, even offer incentives (Kotrlik & Redmann, 2009; Smarkola, 2007). If administration were to be more supportive with clear expectations and assessments, then there may be more adoption of instructional technologies, such as games and simulations (Koh et al., 2011; Kotrlik & Redmann, 2009; Royle & Colfer, 2010). For example, administrators could encourage a collaborative teaching environment with communities of practice around using games and simulations (Royle & Colfer, 2010; Sabin, 2011; Simpson & Stansberry, 2008).

Moreover, Simpson and Stansberry (2008) suggest that because the current political mandates for public schools require institutional accountability to be measured on mechanisms such as high-stakes testing, there is no room for instructional technologies that cannot prove higher test scores on these assessments. Educators have a huge influence on the culture of the school, including the community as well. Community support of the use of games and simulations in education could lead to the effective incorporation of this instructional technology (Koh et al., 2011).

One major barrier of adopting games and simulations in the classroom identified by researchers is the characteristics of the teacher (Egenfeldt-Nielsen, 2004; Niederhauser & Stoddart, 2001; Ritzhaupt et al., 2010; Rosas et al., 2003; Royle & Colfer, 2010; Simpson & Stansberry, 2008; Taylor, 2008; Virvou, Katsionis, & Manos, 2005). For example, Kotrlik and Redmann (2009) propose that older teachers have less confidence in technology and their ability to use that technology. Additionally they suggest that any technology adoption decreases as the age of the teacher increases which insinuates that more experienced teachers are less likely to utilize technology than less experienced teachers. Smarkola (2007) suggests that student teachers apply the instructional technology that they have learned from faculty when they begin teaching on their own. Simpson and Stansberry (2008) point out that preservice teachers do not identify themselves as gamers but, more importantly, are also not being taught to use games and simulations in their more traditional education classes. Several researchers imply that teachers are just not into gaming (Ritzhaupt et al., 2010; Rosas et al., 2003; Royle & Colfer, 2010). Although educators, as a whole, may have little experience with games, they must be willing to play them to become familiar with their learning potentials, which may help bridge the gap between the traditional teacher-centered classroom and the newer learner-centered classroom (Egenfeldt-Nielsen, 2004; Simpson & Stansberry, 2008). Many teachers may be unable to bridge this gap due to their own perception of gaming (Rice, 2007; Ritzhaupt et al., 2010). Kenny and Gunter (2011) go a step further and suggest that an antagonistic relationship has appeared between the proponents of educational games, who suggest that the use of video games is a cure to all that ails the educational system, and the teachers, parents, and administrators who are inexperienced with and reluctant to adopt video games.

Some teachers cannot bridge the gap because they are fearful that games will eventually replace them as instructors (Summers, 2004; Virvou et al., 2005). Researchers have tried to pointedly state that human teachers should never be replaced in the classroom (Virvou et al., 2005). As for video games in the classroom, it has been suggested that neither the game nor the teacher would be completely understood in isolation (Royle & Colfer, 2010).

These negative feelings and associations are indicative of second-order barriers (Ertmer, 1999). This concept suggests that first-order barriers are extrinsic (i.e. lack of access, insufficient time to plant, lack of support) and second-order barriers are intrinsic (i.e. teachers' belief system, teacher motivation). In other words, the intrinsic characteristics of the teacher, such as the teacher's beliefs about teaching, beliefs about games and simulations, established teaching practices, and willingness (or unwillingness) to change can be a barrier to the adoption of any technology. Ertmer (1999) goes a step further by suggesting that this belief system, which may not even be apparent to the teachers themselves, is what determines if a technology is successfully adopted.

Technology-based Barriers

Terminology:

- TECHNOLOGY-BASED BARRIER. For the purposes of this study, a technology-based barrier is any barrier, instigating from the technology in question, which discourages a teacher from using that technology. Examples of technology-based barriers include, but are not limited to: general fear of new technology (i.e. lack of confidence in individual technology skills), technology self-efficacy, technology training (i.e. lack of offered trainings, technical support, cost of trainings, ineffective trainings), lack of quality equipment, cost of new technology, and the extra time and effort needed to learn the technology and incorporate it into lesson plans.

Technology-based barriers

Redmann and Kotrlik (2009) propose that many educators face the following technology-based barriers: lack of self-confidence in using technology, lack of technology self-efficacy, lack of necessary knowledge about technology, lack of time to figure out how to use technology, and also the lack of access to resources such as institutional support, equipment, and state of the art software. Kotrlik and Redmann (2009) suggest that a lack of self-confidence and self-efficacy was linked to a deficiency in technology training and availability in the use of a new technology in curricula since hours of training and availability were significantly related to classroom usage of technology.

Researchers consistently identify training as a barrier to the adoption of any instructional technology (King, 2002; Kotrlik & Redmann, 2009; Smarkola, 2007). For instance, many teachers have increased technology anxiety since administrators equip educators with new technology but fail to provide adequate training on this technology. Several researchers find training to also be a significant barrier to the adoption of games and simulations in education (Koh et al., 2011; Niederhauser & Stoddart, 2001; Royle & Colfer, 2010; Simpson & Stansberry, 2008). For example, in 2005, Becker and Jacobsen discovered that surveyed teachers who had incorporated games and simulations in the classroom found professional development trainings were significantly helpful in the adoption process. For instance, those instructors who are inexperienced with this technology, but are willing to attempt a lesson that incorporates a game or simulation without proper training, may trigger a significant setback. Some inexperienced educators so poorly integrate the game or simulation in their lesson that neither the student nor the instructor wishes to use a game or simulation in class again (Egenfeldt-Nielsen, 2004; Koh et al., 2011; Sliney et al., 2009). To bypass a potential failing first attempt, Royle and Colfer (2010) suggest a more developed view of implementation is needed to account for all of the interlocking factors within the implementation of technology in formal education. Their suggestion also verifies the need for proper teacher training.

Administrators can show their support by providing technical assistance, purchasing up-to-date equipment and software, and by ensuring access to the necessary equipment (Redmann & Kotrlik, 2009; Smarkola, 2007). Researchers found that schools rarely have access to top quality equipment and software (Becker & Jacobsen, 2005; Egenfeldt-Nielsen, 2004; Rice, 2007). If schools did have up-to-date equipment and software, then staff and student accessibility to this equipment became an issue (Koh et al., 2011; Rosas et al., 2003; Royle & Colfer, 2010; Russell & Shepherd, 2010; Torrente et al., 2009). More specifically the lack of technical support is cited by several researchers as a barrier to the adoption of games and simulations in education (Becker & Jacobsen, 2005; Koh et al., 2011; Torrente et al., 2009).

Another technology-based barrier, which is outside of the school's control, is the cost and expense of adopting any new technology. One of the most argued barriers to introducing games and simulations in education is the cost (Koh et al., 2011; Royle & Colfer, 2010; Sliney et al., 2009; Torrente et al., 2010; Vos & Brennan, 2010). For instance, there is the price of equipment, such as computers or gaming systems, as well as licensing costs and agreements, if using a gaming subscription. Additionally, Summers (2004) points out that like many technology products, simulations are risky because customers cannot always try them without buying them. Although demo copies may partially relieve this problem, customers face a risk unless lead users can prove the new technology has value and show others how to incorporate this into curricula.

Many educators would be able to overcome their lack of training by teaching themselves a new technology, they may be able to correctly integrate this new technology without technical support, and perhaps they even could overcome the problems of cost and skill levels if these educators were given an appropriate amount of planning time. Lack of extra planning time has been identified as a major barrier to incorporating games and simulations in education by several researchers (Becker & Jacobsen, 2005; Koh et al., 2011; Ritzhaupt et al., 2010; Royle & Colfer, 2010; Simpson & Stansberry, 2008). This barrier is not specific to games and simulations; extra planning time is essential for any instructional technology to be successfully introduced in the classroom (Kotrlik & Redmann, 2009; Smarkola, 2007). Royle and Colfer (2010) warn that unless teachers are given extra time to correctly implement technology usage in the classroom, technology will continue to be underutilized in education. Becker and Jacobsen (2005) specifically suggest that teachers should be given extra planning time after any training to incorporate the concepts just learned into their classrooms. If incorporating games and simulations in a lesson, extra planning time is needed just for finding and evaluating the game and/or simulation to be used in class, just as with finding and evaluating any new technology before introducing it into a lesson (Koh et al., 2011; Vos & Brennan, 2010).

Game-specific Barriers

Terminology:

- GAME-SPECIFIC BARRIER. For the purpose of this study, a game-specific barrier is any barrier, specifically due to a game or simulation, which prevents an educator from using that game or simulation. Examples of game-specific barriers include, but are not limited to: negative connotations of the term "game," stigma of violence or overstimulation, game time incompatibility with class time, lack of adaptability, the lack of balance between entertainment and education, the ability to track and assess student progress within a game, lack of available lesson plans for games, game incompatibility with lesson objectives and state standards, and the cost to develop a game or simulation.

Game-specific barriers

Strangely, an unfortunate example of a game-specific barrier are the terms "game" and "video game," which sometimes have negative connotations attached. Furthermore, in 2007, Wexler, Aldrich, Johannigman, Oehlert, Quinn, and Van Barneveld found that the term game suggested play and not learning. They found that participants preferred the term "immersive learning" instead of game. Also, the term "video game" sometimes has a stigma of violence attached (Koh et al., 2011). Moreover, some educators and parents worry that children will become over stimulated by games or become addicted to games (Koh et al., 2011). Many researchers also suggest that teachers have negative perceptions of video games being used as educational components (Kenny & Gunter, 2011; Koh et al., 2011, Rice, 2007; Rosas et al., 2003). Koh, Kin, Wadhwa, and Lim (2011) suggest that perhaps teachers' lack of experience with video games may be the root cause for the opinion that video games should be used strictly for entertainment.

Another identified problem with using games and simulations in the classroom is the amount of class time needed for this complex software (Kebritchi, 2010; Koh et al., 2011; Royle & Colfer, 2010, Torrente et al., 2010). It is difficult to learn to play a game within one class period, and then continue that play a day or two later. Most students have little recollection and will essentially start from scratch each day (Egenfeldt-Nielsen, 2004; Squire, 2006). Consequently, a school day divided by short class periods is not conducive to the long-term engagement necessary with complex games and simulations (Rice, 2007).

Additionally, games and simulations tend to lack adaptability (i.e. cannot be customized). They are distributed as self-contained products with specific goals and uses that can rarely be adjusted to other contexts. Since instructors need to adapt, reuse, maintain, and share their materials, this lack of customizability, adaptability, and reusability increases costs and reduces the potential for video game use in the classroom (Beggs et al., 2009; Rice, 2007; Torrente et al., 2010).

Of those educators who want to use video games in the classroom, one of their main concerns is achieving an adequate balance between entertainment and educational value, both of which are indispensable for the successful incorporation of the game into the classroom (Torrente et al., 2010). For instance, if the students do not have some fun while they are playing the game, they will likely quit playing. Conversely, if fun becomes the main focus and the educational value is left out, the game would have little impact on learning outcomes.

This brings up the complexities of "edutainment," a moniker for games which may be entertaining, but lack the aspects that are attractive to children and the pedagogical tasks that are attractive to educators (Rosas et al., 2003). Furthermore, there is a fine line between students engaged in an activity and those immersed in learning (Kenny & Gunter, 2011). For example, students could be engaged in the non-relevant content of learning to play, rather than being immersed in learning the desired educational content.

Unfortunately, many researchers suggest that the development of video games is not currently compatible with formal education (Kenny & Gunter, 2011; Rice, 2007; Rosas et al., 2003; Royle & Colfer, 2010; Torrente et al., 2010). For instance, high profile commercial video games have budgets similar to movie productions with multiple people and millions of dollars. These game designers, who are under pressure for successful games, have little incentive to incorporate pedagogical components into the games they are constructing (Kenny & Gunter, 2011). Also, current game development has no room for instructors with little to no technical background. Unfortunately, that implies that if educators wish to see truly educational games balanced with the high graphics and entertainment of high profile games, then education must pay the multimillion dollar bill for their own production of a video game (Torrente et al., 2010).

If educators could create their own game, one suggested addition is the ability to track and assess student progress through the game. Several researchers have addressed the need to be able to monitor and evaluate each student's progression through the game or simulation (Russell & Shepherd, 2010; Sliney et al., 2009; Torrente et al., 2009; Torrente et al., 2010).

Using the immersive learning of games and simulations requires teachers to think outside of the traditional beliefs of teaching and learning that they have been using for years (Egenfeldt-Nielsen, 2010; Koh et al., 2011). By scaffolding new methodologies to older practices, teachers may be more comfortable to experiment with alternative methods of teaching, like using games and simulations as Rogers (2003) points out in the theory of Diffusion of Innovation. Consequently, if educators were given proven ways (i.e. specific lesson plans, established methods, best practices) and ideas of incorporating games and simulations into their curriculum, they may be more open to doing so. Thus, the avant-garde nature of games and simulations coupled with a lack of research and methodologies can be considered another barrier to the adoption of games and simulations in the classroom (Becker & Jacobsen, 2005; Ritzhaupt et al., 2010; Simpson & Stansberry, 2008; Torrente et al., 2010).

Nonetheless educators must be willing to take the first steps in adding games and simulations into their curriculum. Instructors may be more willing to take these steps if the rewards outweighed the risks. Unfortunately, many researchers cite that a major barrier to using games is that very few games match curricular activities and desired learning outcomes (Kenny & Gunter, 2011; Rice, 2007; Ritzhaupt et al., 2010; Royle & Colfer, 2010; Vos & Brennan, 2010). For example, typical commercial, off-the-shelf video games have learning outcomes more related to procedural knowledge rather than the complex conceptual knowledge of classroom lessons (Reese, 2007). Additionally, another major problem for administrators as well as instructors is that game and simulation learning outcomes usually lack alignment to state standards (Rice, 2007).

Synopsis of Reviewed Literature

The review of literature on the use of games and simulations in education demonstrates the benefits and difficulties associated with this form of educational technology. Unfortunately, even with current research, no specific reason can be indicated for the lack of adoption of games and simulations in curriculum. By incorporating research that suggests potential hindrances of game and simulation adoption and by reassessing the path of adoption through the theory Diffusion of Innovation, I better understood what is required to create a valid and reliable survey instrument. For instance, I had a clearer idea of what types of questions to ask in educator interviews. These questions reflected both the Diffusion of Innovations and previously cited barriers in recent studies. For example, I had not previously thought about how important it is to see the successful use of an innovation by peers (Rogers, 2003). Upon understanding this importance, I inserted a question in the educator interview that specifically asked how many colleagues were seen using games and simulations in their curriculum.

The literature on the potential barriers to the adoption of games and simulations was quite diverse. Dividing the potential barriers into categories helped to organize the information into manageable chunks. I was able to incorporate interview questions that broadly addressed some of these topics. For example, I asked each educator which grade category ((i.e. elementary, pre-secondary, secondary, adult education) or learner level that he or she thought would benefit from the addition of games and simulations in lessons. Additionally, I was able to ask some specific questions about a category. For instance I asked about the opinions of administrators, peers, and the surrounding community about the incorporation of games and simulations in education.

The problems associated with the Diffusion of Innovations and the research-identified barriers to the adoption of games and simulations were blended with the results from educator interviews to create a survey draft. This was a large step in my process of trying to identify why games and simulations are not widely adopted in formal education.

CHAPTER 3
METHODOLOGY

Although the adoption of game- and simulation-based learning may have positive results in education, and, moreover, the addition of instructional technology has been widely promoted in classrooms, the use of games and simulations has not been widely embraced in formal education (Gee 2003; Gee & Levine, 2008; Kenny & Gunter, 2011; Prensky, 2001). The need to understand why games and simulations are not commonly used in instruction is the driving force in the creation of a valid and reliable instrument to measure the teacher perceived barriers to the use of games and simulations in formal education.

Conception of the Instrument

To create this instrument, I incorporated the research already conducted, which is outlined in the previous chapter, with interviews from educators to design a comprehensive survey of the barriers to the adoption of games and simulations in curriculum. In particular, my focus was eight main components of the research: Diffusion of Innovation (Conceptual Framework), Demographic Barriers, Inexperience with Games and Simulations Barriers, Grade Category Barriers, Student Learner-level Barriers, School-based Barriers, Technology-based Barriers, and Game-specific Barriers. This research, divided into these eight categories, is detailed in Chapter 2. Using educator interviews and previously identified barriers from research, I created a draft of the instrument. I used a focus group, expert review, and think aloud protocol to increase the accuracy and efficacy of the survey instrument (AERA, APA, & NCME, 1999; Beatty, 2004; Chioncel, Van Der Veen, Wildemeersch, & Jarvis, 2003; Grant & Davis, 1997; Jones & Hunter, 1995; Rabiee, 2004; Van Someren, Barnard, & Sandberg, 1994; Vogt, King, & King, 2004). Upon the finalization of the survey, I tested the survey by distributing it to a group of educators. The results were analyzed to ensure that the data gathered corresponded to the intent for which the survey instrument was designed, to determine the teacher perceived barriers to the use of games and simulations in formal education.

Participants of the Interview

For the interviews, I spoke with educators to help develop an unbiased set of survey questions. Interview participants included educators from all grade categories (i.e. elementary, pre-secondary, secondary, post-secondary, adult education) and from all learner levels (i.e. low-level learners, general learners, gifted learners). Interviews were done in person or by phone, depending on the location and schedule of the interviewee.

All interviewees were either public or private school educators who were teaching during the 2011-2012 school year. I began with a few educators that were acquaintances who were interested in being interviewed. I then began the snowball or chain referral sampling technique where each interviewee was given an opportunity to suggest another educator to be interviewed (Biernacki & Waldorf, 1981). I completed 20 interviews, 17 females and 3 males, using this sampling technique (see Appendix A for a copy of the questions asked and Appendix B for a sample interview). Table 3-1 contains the demographic and teaching information of the interviewees.

Materials and Methods of the Interviews

The interviews contained questions to determine demographic information (i.e. age, gender, ethnicity, education). Additionally, educators were asked about their experience with and opinion of games and simulations since these characteristics may influence their opinions (Kenny & Gunter, 2011; Ritzhaupt et al., 2010). Given that a key component of the research is the conceptual framework of the theory of Diffusion of Innovation, I composed several interview questions with this in mind. For example, understanding the importance of seeing the benefits of adoption from other adopters in the Diffusion of Innovation, I asked, “Have you seen a co-worker successfully using games and simulations in his or her classes?” (Rogers, 2003). Also, I noted the characteristics of the educator being interviewed, paying particular attention to the grade category (i.e. elementary, pre-secondary, secondary, post-secondary, adult education) and the student learner level(s) (i.e. low-level learners, general learners, gifted learners) that the educator was currently teaching. In the interviews, I did not directly address specific technology-based barriers and game-specific barriers because I did not want to lead the interviewee’s answers. Instead, I asked generic barrier questions to determine if the interviewed educator would supply me with some specific barriers (Shafer & Lohse, 2006). For instance, I asked if the interviewee was concerned that his or her school does not have the equipment or resources to be able to use games and simulations in the classroom and then, based on the response, I asked for specific clarification.

Those interviews that were completed before March 9, 2012, were considered in the design of the survey. Furthermore, I included any interview for consideration in the construction of the survey instrument only if all of the interview questions were asked and answered (see Appendix A for a complete list of all questions).

Results of the Interviews

Upon completion, each interview was typed into a transcript. Then, I developed a list of barriers from the research and from the questions I asked (i.e. grade category and learner-level). After inserting this list into a spreadsheet, I used the interview transcripts to code (either numeric codes or lettered codes, depending on the information) the responses by the interviewees and, if necessary, added to the list of barriers (Beatty, 2004; Glaser, 1965). For example, I coded numerically when coding to a degree such as how much an interviewee thought class size was a barrier to the use of games and simulations in the classroom. The higher the number reflected the greater the concern of the interviewee. As another example, I used the lettered code "PB" when interviewees were offering what they thought could be potential barriers to the adoption of games and simulations in education. Once this information was entered, I averaged the numeric codes to identify which barriers were more of a concern by the interviewees because those items had a higher averaged number. I also could tally which barriers were suggested as potential barriers by multiple interviewees and also compare any other lettered codes such as perceived value of games and simulations.

Results of the interviews were grouped according to the type of questions asked. For example, questions dealing with Diffusion of Innovations (i.e. *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability*) were analyzed together. All interviewees agreed that student motivation and engagement were definite advantages adding games and simulations into education. Other *relative advantages* included: using different learning styles, reviewing material, increasing retention, immediate feedback, using varied learning, having real life connection, increasing recall of information, improving coordination, using self-correction, increasing use of problem-solving and critical thinking skills, and fostering good-natured competition. Other than one person, the interviewees listed multiple benefits for incorporating games and simulations in curriculum. The one exception stated that besides engagement/motivation and reviewing material, there was not much more use for games and simulations in education.

As for the rest of the Diffusion of Innovation categories, on average, the majority of interviewees said that they thought educational games and simulations were fairly compatible with their pedagogical practices. They also suggested that games and simulations were not too complex to harness the perceived values for a particular lesson, and that games and simulations would be fairly easy to experiment within a lesson. Although most interviewees have observed co-workers using games and simulations in their curriculum, they have not seen many co-workers doing this either because they do not get to regularly observe co-workers or that not many co-workers were currently using games and simulations in their classrooms.

When asked which grade category would benefit the most from the addition of games and simulations in education, eight respondents, the majority, said “all grade categories.” Seven respondents replied “elementary.” See Table 3-2 for all of the results from this question. Additionally, when asked which learner level would benefit the most from the addition of games and simulations in education, eleven respondents, the majority, said “all learner levels.” Eight respondents replied “low-level learners.” See Table 3-3 for all the results from this question. Interestingly, no respondents said specifically gifted learners would benefit the most from the addition of games and simulations into their curriculum. When asked if classes with mixed learner levels would present a problem, all of the respondents said “no.” Most cited that games and simulations easily lend themselves to peer learning or have differentiated learning and would therefore work much better in classes with multiple learner levels. See Appendix C for all of the data from these interviews.

Design and Implementation of the Survey Instrument

The results of the interviews, along with the corresponding research were the foundation in the design of the survey instrument. For example, by using the interview responses to generic barrier questions, along with researcher-suggested barriers, I was able to determine a more precise list of potential barriers. This list was included in the survey so that respondents could rank these potential barriers on a scale from zero (no barrier) to 4 (definite barrier) according to how much of a barrier the item is considered.

Verifying the Accuracy of the Survey Draft

A focus group, expert review, and the think aloud protocol were used to verify that the survey is accurately measuring what I intend it to measure, the teacher perceived barriers to using games and simulations in the classroom. These additional procedures helped to increase accuracy and efficacy before the survey draft was finalized (AERA et al., 1999; Beatty, 2004; Van Someren et al., 1994).

Focus group

After I compiled the information to help design a draft of the survey instrument, but before finalizing and distributing the survey, I gathered a focus group of educators to validate the content of the survey instrument draft (Chioncel et al., 2003; Grant & Davis, 1997; Rabiee, 2004; Vogt et al., 2004). Participants in the focus group were eight interviewed educators that were able to meet and discuss the survey at one time. The focus group consisted of 2 men and 6 women. All eight participants work for my college in some capacity. Other individuals were invited, but these participants were the only ones available to meet at the time and place arranged. The purpose of the focus group was to check the information, especially the list of potential barriers in the adoption of games and simulations, for accuracy and, also, to help clarify any information that I found confusing. Additionally, they offered insight to the survey by providing views that I had not previously considered.

Upon arrival to the meeting, participants were given a copy of the survey draft. Each question had a space allocated for participants to “grade” each survey question (Jones & Hunter, 1995). Since all participants were educators, they are very familiar with the traditional A to F grading scale. I asked them to read through the survey, independently, and grade each question. When everyone had completed the grading process, we then discussed any question that received a grade lower than an “A.” Participants were asked to grade questions based on grammar, clarity, and general opinion. When there was a question that received a lower grade, we discussed why it did not receive an “A” grade and what did the participant not like about the question. Other participants were encouraged to comment and discuss the question during this process.

For example, the first question that was discussed included the age categories. Several of the participants did not understand, nor like, the categories. They suggested that the first category should be anyone who was under the legally accepted “adult” age of 21 and that the categories build off of this number. I responded that this was fine, but that I needed to know if any survey participant was over 65. So, they suggested a split 60’s category of “61-65” and “over 65.” We followed this process with each question, including each sub-question (i.e. each potential barrier in the barrier question).

Additionally, I asked them that if I was asked to remove any questions, which questions or barriers they thought may be frivolous and therefore easy to remove. They did not want to remove any questions or barriers.

One problem that came to light during the focus group was the length of the survey. After ranking approximately 20-25 barriers, which is near the end of the survey, the participants seemed “burned out.” They started missing information and seemed to care less about the quality of the survey. I do not know if this “burn out” reflects the length of the survey or the length of the focus group discussion. Nevertheless, it was a concern I noted.

Input from the focus group resulted in a solid survey draft. Questions were corrected for grammar and also worded to reduce any potential confusion by a survey participant. However, since the group started to suffer from “burn out” at the length of the survey, I thought that perhaps the survey was too long. Thus I asked the focus group specifically to reduce the list of potential barriers to rank because I thought the list might be too long. Ironically, although the group poured over the list and discussed it thoroughly, the result was the addition of two more barriers to the list of barriers to rank.

Expert review

Following the incorporation of the comments of the focus group, the survey instrument was ready for an expert review. The expert review consisted of three educational technology professionals. These professionals each reviewed an electronic copy of the survey, separately, and returned their electronic edits and/or comments to me.

The expert review helped to further clarify the survey. The professionals’ comments helped to reduce potential confusion of survey respondents. Since these experts had not previously seen my survey, they had a fresh insight into each question. For instance, one professional suggested the addition of mobile devices to the question about use of technology in curriculum. Also, because of their expertise, these professionals could easily identify questions that were not worded thoroughly enough to capture the meaning of the question. For example, one professional suggested changing the “College/University/Technical” category to “Post-secondary” and to include examples for each category to eliminate confusion with the “Adult Education” category. Additionally, these experts could offer insight into how to better set up surveys in general since they had plenty of experience. Overall, this portion of the process helped immensely in solidifying the survey draft.

Think aloud protocol

After incorporating the suggestions from the expert review, the survey draft went under a think aloud protocol (Van Someren et al., 1994). I utilized this type of usability test to review the survey for clarity and intent. Three people agreed to perform the think aloud protocol, asynchronously. Two of the three were familiar with my project. For example, one participant was an interviewee and another participant was an interviewee that had also participated in the focus group. Conversely, the third participant had not participated in either the interviews or focus group.

The participants were instructed to say everything they were thinking out loud. I gave them an example by asking them to tell me their thought processes in answering how many windows that they have in their house. Frequently, during the process of answering the question, they would fall silent in thought. At that point, I would remind them that I needed to hear what they were thinking. A few times during each protocol, I would again remind them of this if they fell silent.

Although all three participants contributed something to improve the survey, the person who had not participated in either the focus group or the interviews had a fresh perspective that was immensely helpful. He helped with some wording of the questions, as did the others, but most importantly, he suggested a change in the order of the barriers to rank. For example, he suggested putting the longest worded barriers at the beginning and the shortest at the end since people would be more likely to read and rate a short barrier. He also assisted in getting questions in more layman terms since he did not understand several questions due to jargon.

Overall, this procedure helped me to understand if the potential participants of the survey would comprehend the survey instructions and/or questions as intended, or if any potential difficulties may be encountered. Consequently, several questions were re-written for clarification.

Participants of the Survey Instrument Trial

After using the focus group, the expert review, and the think aloud protocol techniques to increase the accuracy and efficacy of the survey draft, the survey was considered complete (AERA et al., 1999; Beatty, 2004; Van Someren et al., 1994). To test that the survey gathered the information for which it was designed, determining the teacher perceived barriers to the use of games and simulations in formal education, the survey instrument was distributed to a large number of educators so that a sufficient number of responses could be acquired and measured (Johanson & Brooks, 2010).

About the Survey

The survey consisted of 18 questions, two of which were open-ended, six of which had the option of writing in an answer for clarification, and one contained a list of 32 potential barriers for the respondent to rank. Respondents could rank these potential barriers on a scale from zero to four, where zero is “not a barrier,” two is “somewhat a barrier,” and four is “definite barrier.” If respondents cannot relate their experience to the potential barrier, instead of ranking from zero to four, they could mark “don’t know.” Respondents were also allowed the option of writing in a barrier to the adoption of games and simulations in the classroom in case their barrier(s) was not on the list to rank. Additionally, five questions were intentionally designed to have multiple responses. For example, respondents were asked their opinion about how games or simulations could be useful for educational purposes. The respondents were asked to mark all the answers that apply. Also, there was a space available for them to write in an option if they wanted to add anything. To review the full survey, see Appendix D.

Procedures for Survey Data Collection

The survey was open to educators who taught during the 2011-2012 school year. An invitation to participate, including a hyperlink to the survey, was sent out by the Chair of NCPN (National Career Pathways Network), a group of adult educators who are interested in the promotion of Career Pathways (an education plan that helps students determine a career and then plan their education to achieve the certificate or degree needed for that chosen career); the Chair of the ISTE (International Society for Technology in Education) special interest group for games and simulations; and the Chair of the RCCPN (Research Coast Career Pathways Network), the local chapter of the Career Pathways Network.

The survey was open to participants from May 3, 2012 to May 30, 2012. Educators from all grade categories (i.e. elementary, pre-secondary, secondary, post-secondary, adult education) and learning levels (i.e. low-level learners, general learners, gifted learners), world-wide, were eligible to participate in this study. The survey was made available in a web-based format using Survey Monkey. The survey was closed for participation on May 30, 2012.

Data Analysis of the Survey Instrument

There were 275 individuals that opened the instrument and at least answered the first question, the Informed Consent question. Since no question beyond the Informed Consent question was required, a different number of respondents (N) completed each portion of the survey. Consequently, each question had to be reviewed independently from the others by the number of individuals who responded to that specific question.

The completed survey instruments were sorted by demographic information (i.e. gender, ethnicity, age) to better understand the group of participants. To explore the underlying relationships between the barriers of the adoption of games and simulations, the demographic information, and the eight main research categories (i.e. Diffusion of Innovation (Conceptual Framework), Demographic Barriers, Inexperience with Games and Simulations Barriers, Grade Category Barriers, Student Learner-level Barriers, School-based Barriers, Technology-based Barriers, and Game-specific Barriers), I conducted an exploratory factor analysis. This procedure helped to reduce the data to a smaller set of variables that were easier to compare. To understand the statistical correlation between the reduced variables, a standard Multivariate Analysis of Variance (MANOVA) was used. If significance was detected, a follow-up one-way Analysis of Variance (ANOVA) was performed.

Table 3-1. Demographic information of interviewees

Interviewee	Sex (F/M)	Age	Ethnicity[1]	Highest degree	Grade level[2]	Learner level[3]	Class size
AKW2	F	56-65	White	M.S.	Post	M	26-30
BJ5	F	56-65	White	Ed.S.	Adult	M	21-25
BS13	F	56-65	White	M.S.	Post	M	>40
CORL8	F	56-65	White	B.S.	High	M, F	26-30
DAO14	F	56-65	White	M.S.	Middle	M	26-30
DDKD24	M	46-55	White	M.S.	High	M	21-25
JFL7	F	56-65	White	Ed.S.	Adult	M	10-15
JHKH7	F	56-65	White	A.S.	High	M	26-30
JM11	F	46-55	White	M.S.	Adult	G	10-15
JS4	F	26-35	Black	B.S.	Post	M	36-40
KJ10	F	56-65	White	B.S.	Adult	M	16-20
KK84	F	56-65	Hispanic	B.S.	Elem	M	16-20
LL7	F	56-65	White	B.S.	Middle	M	21-25
MA7	F	36-45	White	M.S.	Post	M	16-20
MAM9	M	46-55	White	M.S.	Post	G	16-20
MJ3	F	36-45	Hispanic	Ed.D.	Post	M	16-20
MT69	F	46-55	White	M.S.	Post	M	16-20
RCS16	F	26-35	White	B.S.	Middle	M	21-25
SHC2	F	26-35	White	B.S.	Adult	G	10-15
SPW5	M	26-35	White	M.S.	Adult	G	10-15

Ethnicity[1] – three categories were used: Black/African American, Hispanic/Latino, and White/Caucasian
Grade level[2] – five categories were used: Elementary, Middle School, High School, Post-secondary, and Adult Education
Learner Level[3] – three categories were used: G = general learners, F = gifted learners, and M = mixed (classes containing a mixture of low-level learners, general learners, and/or gifted learners)

Table 3-2. Interview responses to the question "Which grade category would benefit the most to the addition of games and simulations to their curriculum?"

Grade category	Number of responses[1] (out of 20 Interviewees)
Elementary	7
Pre-secondary (Middle School)	5
Secondary	5
Post-Secondary	2
All grade categories	8

Number of Responses[1] – interviewees could choose more than one grade category

Table 3-3. Interview responses to the question “Which learner level would benefit the most to the addition of games and simulations to their curriculum?”

Learner levels	Number of responses[1] (out of 20 Interviewees)
Low-level learners	8
General learners	3
Gifted learners	0
All learner levels	11

Number of Responses[1] – interviewees could choose more than one learner level

CHAPTER 4
RESULTS

As previously stated, the purpose of this study was to create a valid and reliable instrument to measure teacher perceived barriers to the use of games and simulations in formal education. To complete this task, I incorporated the research already conducted with interviews from educators to comprehensively identify the barriers to the incorporation of games and simulations in curriculum. From the collation of this information, I created a draft survey. A focus group, an expert review, and a think aloud protocol were used to improve the accuracy and efficacy of the survey. At this point, after the survey was finalized, it was then tested by a group of educators to determine if the information gathered corresponded to the purposes of this study, to identify the teacher perceived barriers to the use of games and simulations in the classroom.

Answering my Research Question

The initial intent of this study was to answer my research question, what are the barrier to adopting games and simulations in education? Unable to answer this question with only previous research, I designed a survey for educators to identify the barriers. In particular, I paid close attention to the demographic results (i.e. age, ethnicity, highest degree) to answer Part A of my question (*Are there any barriers related to the instructor's demographic characteristics?*). Additionally, as a portion of Part A (*Are there any barriers related to the instructor's inexperience with games and simulations?*), I noted the amount and frequency of game-playing by the respondents. All of these results can be found in the following subsections of this chapter: *Demographic Results*, *Demographic Results about Education and Teaching*, and *Results about Games and Simulations*.

After respondents rated potential barriers, a factor analysis could better describe what the barriers to game and simulation adoption are in education. These results can be found in the *Results about the Potential Barriers* subsection, below. Once the variables were reduced by the factor analysis and the barrier categories were identified, Part B of my research question (*Is there a variation in the barriers between grade categories?*) was also considered. These results can be found in the *Results about Games and Simulations* and the *Results about the Potential Barriers* subsections.

Demographic Results

Of the 255 individuals that responded to the gender question, 176 (69%) were female and 79 (31%) were male. The same number of individuals responded to the age and ethnicity questions. Seventy-eight percent of those respondents were between the ages of 31 and 60 (Table 4-1). Additionally, 87.1% of those respondents identified themselves as White/Caucasian (Table 4-2).

Demographic Results about Education and Teaching

The majority, 55.6%, of 261 respondents had Masters Degrees (Table 4-3). The grade categories that 264 respondents taught were fairly equally distributed except for adult education (only 3.8%). Elementary, middle, high, post-secondary, and “other” ranged between 16% and 21% (Table 4-4).

When asked how respondents use technology in their curriculum, 252 participants answered (Table 4-5, Figure 4-1). Over 90% of participants identified that they use electronic presentations (i.e. PowerPoint®, Prezi®, SlideRocket®) and Internet searches/research in their curriculum. Interestingly, only 10.3% of respondents identified that they use gaming platforms (i.e. Wii®, Xbox®, PlayStation®).

Results about Games and Simulations

Of the 243 participants who responded, 86% identified that they play some type of game on a weekly basis and 100% of them thought that games or simulations could be useful for educational purposes (Table 4-6, Table 4-7, and Figure 4-2, respectively). Of 240 respondents, 96.7% considered that games and simulations compatible with their teaching practices (Figure 4-3).

Out of 243 participants, 96.6% respondents supposed that games and simulations were not too complex for students to learn an intended lesson (Figure 4-4). Only 7.5% of 241 participants regarded games and simulations as difficult to experiment with in a lesson (Figure 4-5). Interestingly, 66.5% of 239 participants have either seen very few or no co-workers using games or simulations in their classroom, teaching practice, curriculum, or lesson plans (Figure 4-6).

When asked which grade levels would benefit from the addition of games and simulations, no respondents, out of the 241 that replied, answered "none" (Table 4-8). Elementary, Middle School, and High School had relatively similar responses with 88.8%, 94.2%, and 88.4% respectively. Interestingly, both Post-secondary (67.2%) and Adult Education (62.2%) had similar responses albeit considerably lower than K-12 categories. Two noteworthy open-ended responses suggested certificate programs and corporate trainings. Another respondent was unsure about adult education and wished to see research in this area.

Out of 239 respondents, all learning levels were perceived to benefit from the addition of games and simulations (Table 4-9). No one particular learning level seemed either preferred or not preferred: Low Level Learners (92.9%), General (intermediate)

Learners (93.3%), Gifted (high level) Learners (85.5%), and Mixed (two or more groups combined into one class) Learners (86.6%).

Results about the Potential Barriers

There were 32 potential barriers that respondents could rate from 0 (not a barrier) to 4 (definitely a barrier). Of those ratings, most respondents chose the 0 category (not a barrier) overall since it was chosen 2,225 times out of a total of 7,157 responses (Table 4-10). The least frequently chosen category was 4 (definitely a barrier) with 867 responses (Table 4-10). The overall average rating for all barriers was 1.59; since the 2 category was labeled as ‘somewhat a barrier,’ the average rating can be considered less than ‘somewhat a barrier.’ Together, these results suggest that most teachers may think these potential barriers are not definite obstacles to using games and simulations in their curriculum.

Interestingly, when each of the barriers’ rankings were averaged, some of the lowest ranked barriers included: the lack of student motivation to use games and simulations (0.61), the respondent’s own lack of technology abilities (0.63), the respondent’s own lack of motivation to use games and simulations (0.71), the perception that student aggression may result (0.85), the perception that student addiction may result (0.92), and the perception that student behavioral problems may result (1.01). These results suggest that students and teachers may be very motivated to use games and simulations in education. Additionally, some of the acknowledged concerns associated with games and simulations by researchers (i.e. aggression, addiction, behavioral problems) may not be perceived by respondents as likely impediments to the use of games and simulations.

Conversely, some of the higher rated barriers included: the cost of the equipment (2.62), the lack of time to plan and implement (2.52), the inability to try-out games and simulations before purchase (2.41), too much ‘edutainment’ or games and simulations that lack balance between entertainment and education (2.34), the lack of available lesson plans and examples (2.22), the lack of games and simulations that align to state standards or standardized testing (2.20), the inability to customize the game or simulation (2.18), and the inability to track student progress through the game or simulation (2.08). Many of these highly rated barriers are issues with the game or simulation itself. For example, tracking student abilities, customizability of the game or simulation, aligning to standards or standardized tests, and balancing entertainment and education are all issues that game or simulation designers would be able to address. Time to plan and implement and cost of the equipment may be more of a reflection of the teaching profession rather than a game or simulation. For instance, it seems that shrinking budgets and planning periods may be more of a problem than actually adding a game or simulation to curriculum.

Although many respondents attempted the question on ranking potential barriers to the addition of games and simulations in education, 184 participants fully completed the question by ranking all 32 potential barriers (Table 4-10 and Figure 4-7). An exploratory factor analysis was run using only the 184 fully completed rankings.

To examine the underlying structure of the data of the 32-item instrument, the researcher conducted exploratory factor analysis. Bartlett’s test of sphericity of these data had a $\chi^2 = 3573.77$ ($p < .001$). The Kaiser-Meyer-Olkin measure of sampling adequacy was .897, which was above the .5 recommended limit (Kaiser, 1974). The participant-to-item ratio was approximately 5:1, which is below the 10:1 ratio for factor analysis suggested by Kerlinger (1974) and above the thresholds described as more than adequate by some researchers in maintaining factor stability (Arrindell & Van der Ende, 1985; Guadagnoli & Velicer, 1988). Therefore, these data appeared to be well suited for exploratory factor analysis. All models were executed using principal component analysis and an oblique (promax) rotation, as the factors were anticipated to be related.

The initial unconstrained model resulted in seven factors explaining approximately 67% of the variability based on a Kaiser's criterion (i.e. eigenvalues greater than 1) and a review of the Scree plot (Figure 4-8). The model converged after 8 rotations. After reviewing the correlation matrix, it was determined that no unusual correlations were detected (e.g., negative correlations between items since all were positively stated). Further, the pattern matrix (Shown in Appendix E) coefficients exhibited a reasonably simple structure with each item loading on an associated item and very few cross-loadings. The Scree plot for the model is illustrated in Figure 4-8. As can be gleaned, the seven factor model appears to be a reasonable representation of these data.

Defining the Seven Factors

Each of the seven factors was identified by using the basis of barrier items correlated to the factor. Six of the seven groups had a Cronbach's Alpha between .95 and .70 (Table 4-11), which suggests the set of six items is closely related as a group (Nunnaly, 1978). The seventh group nears the .70 threshold at .65 and so could be fairly related to the others. The cumulative variance of these seven groups accounts for 67.36% of the data (Table 4-12). All factors are significantly correlated, from a mild to strong correlation, suggesting the barriers construct is cohesive (Table 4-13). Those seven factors were identified as: Iss*ues with Negative Potential Student Outcomes*, *Technology Issues*, *Issues Specific to Games and Simulations*, *Teacher Issues*, *Issues with Games and Simulations in Education*, *Incorporation Difficulties*, and *Student Ability*.

Issues with negative potential student outcomes

Issues with Negative Potential Student Outcomes was defined as a category of the barriers to the addition of games and simulations in education that addresses concerns about the effect the addition has on the student. This category contained six individual barriers: games and simulations can cause behavioral problems, the perception that they can cause aggression, the perception that they can cause addiction, students may not learn the intended lesson when using games and simulations, the opinion that students learn more from a teacher than from a game or simulation, and the opinion that other learning strategies are more effective than games or simulations. For example, some teachers are concerned that the outcome of using a game and simulation in a lesson is that it may cause behavioral problems or addiction. Additionally, another potential outcome of using a game or simulation in a lesson is that the students' level of education will be negatively affected (i.e. not learning the intended lesson or not learning as well from a game as from other educational resources).

This category had the highest Cronbach's Alpha (α = .93), which suggests a high internal consistency between six of the ranked barriers. Although this data appears normally distributed, with a mean of 1.12 and standard deviation of 1.08, the data appears moderately positively skewed and slightly leptokurtic (skewness = .97, Table 4-11). The highest ranked barrier in this category was the opinion that other learning strategies are more effective than games and simulations (average of 1.41). The lowest ranked barrier was the perception that games and simulations may cause student aggression (average of 0.85).

Technology issues

Technology Issues was defined as a category of the barriers to the addition of games and simulations in education that concerns problems with technology. This category includes difficulties with the technology itself, such as the cost, the inability to preview, and the lack of accessibility to disabled students. Additionally, this category also reflects the usage of the technology, for instance, the reliability of the technology, the amount of technical support available, and if the technology can be easily accessed outside of school.

This category had a Cronbach's Alpha of .80, which suggests a good relationship between the six barriers in this group. Although this data is also normally distributed, with a mean of 2.04 and standard deviation of .95, the data appears approximately symmetric (slight negative skew) and somewhat platykurtic (skewness = -22, Table 4-11). The highest rated barrier in this category was the inability to try-out a game or simulation before purchase (average of 2.62). The lowest rated barrier was the lack of game and simulation options for students with disabilities (average of 1.69).

Issues specific to games and simulations

Issues Specific to Games and Simulations was described as a category of the barriers to the addition of games and simulations in education that addresses concerns about games and simulations in general. Some examples include the lack of games and simulations that balance education and entertainment, the lack of customizability or adaptability, the lack of the ability to track student progress, and the lack of games and simulations that are not considered too easy and simplistic for students.

This category had a Cronbach's Alpha of .75, which suggests a good relationship between this set of four barriers. There is a normal distribution of data with a mean of 2.05, a standard deviation of .91, and approximate symmetry (slight negative skew) with slightly flattened curve (skewness = -.16, Table 4-11). The highest ranked barrier in this category is 'edutainment' or the lack of games with a balance between entertainment and education (average of 2.34). The lowest ranked barrier is the perception that games are too simple for students (average of 1.62).

Teacher issues

Teacher Issues was identified as a category of the barriers to the addition of games and simulations in education that concerns problems that teachers may face. Some of these barriers include time (i.e. to plan and implement the use of a game or simulation), finding games or simulations that match state standards or standardized testing, the lack of available lesson plans or examples of game and simulation incorporation, and characteristics of the teacher (i.e. not motivated to use games and simulations, not very tech savvy, lack of knowledge about games and simulations).

The *Teacher Issues* category had a Cronbach's Alpha of .79, suggesting good internal consistency between the six barriers in this group. The data is normally distributed with a mean of 1.65, a standard deviation of .87, and an approximate symmetry and a moderately flattened curve (skewness = -.67, Table 4-11). The highest ranked barrier in this category is time to plan and implement (average of 2.52). The lowest ranked barrier in this category is the respondent's own technology abilities (average of 0.63).

Issues with games and simulations in education

The *Issues with Games and Simulations in Education* category was defined as a group of barriers specific to using games and simulations in education. For example, teachers may feel more comfortable about using games and simulations if there were more evidence that they were helpful to student learning. Additionally, if there were clearly outlined expectations by administrators, it may be easier for teachers to add them. Also, teachers may feel that by using the term "game" in a lesson promotes the belief that students are playing and not learning. Furthermore, if parental and community support were openly displayed, teachers might also feel more inclined to incorporate games and simulations in their lessons.

This category had a Cronbach's Alpha of .87 which suggests a very close relationship between the 5 barriers in this group. Although this data is normally distributed with a mean of 1.55, a standard deviation of 1.10, and an approximate symmetry, the distribution curve appears quite flat (skewness = 1.00, Table 4-11). The highest rated barrier in this category is the lack of parental and/or community support (average of 1.58). The lowest rated barrier was the lack of evidence to support the use of games and simulations in education (average of 1.46).

Student issues

Student Issues was defined as a category of barriers to the adoption of games and simulations in education that are specific to students. For instance, students have a wide range of technical abilities, which makes it difficult for a teacher since some students may need extra help and other students may become bored while waiting for others to catch up. Additionally, some students may not be very motivated to use a game or simulation in class. For example, the student may have had a previous bad experience with a game or simulation and thus may have decided not to try any more games or simulations.

This category had a Cronbach's Alpha of .73, just above the .7 boundary of acceptable, which suggests a relationship between the two barriers in this group. As with the subsequent category, *Incorporation Issues*, this category, *Student Issues*, may have a low Cronbach's Alpha because there are only two barriers in this group. This data was normally distributed, with a mean of .83 and a standard deviation of .88, but moderately positively skewed and leptokurtic (skewness = 1.00, Table 4-11). Since there were only two barriers in this category, one is the highest (varying student abilities (i.e. technology skills, learning ability) – 1.05 average) and one is the lowest (lack of student motivation – 0.61 average).

Incorporation issues

Incorporation Issues was described as a category of barriers to the adoption of games and simulations in education that reflect some of the specific issues in the integration of this technology into the classroom. For example, many games and simulations are too complex to fit into one class period or there may be too many students in the class to help each student effectively.

The *Incorporation Issues* category had the lowest Cronbach's Alpha ($\alpha = .65$). Since the lowest acceptable range for Cronbach's is .7, this group of barriers may not be as closely related as the other barrier groups (Nunnaly, 1978). This may be a reflection that only three barriers make up this group. Interestingly, two of the barriers in this group, class period length and class size, are related to the class or school. Additionally, class period length and the third barrier, complexity of games and simulations, are related since class periods may be too short for a complex game or simulation. However, class size and complexity do not have an obvious connection, although one can suppose that a complex game or simulation may be more difficult if there is a large class. This unclear connection between these two individual barriers may also explain why this category is not as significant as the other groups. Nonetheless, this data showed a normal distribution with a mean of 1.75, a standard deviation of 1.03, and an approximate symmetry with moderate platykurtosis (skewness = .33, Table 4-11). The highest ranked barrier in this category is the length of the class period (average of 1.57). The lowest barrier in this category is the perception that games and simulations are too complex for students (average of 1.38).

MANOVA Results

A one-factor, between-subjects multivariate analysis of variance (MANOVA) was conducted for each of the demographic questions (i.e. gender, age, ethnicity, highest degree earned, grade category currently taught) and the question about the average amount of time the respondent spends gaming on the survey. Each of the seven categories of barriers determined by the exploratory factor analysis served as the dependent variables in each analysis. Each question on the survey comprised the independent variable for that particular MANOVA. Results from the MANOVA including those that were statistically significant and approaching significance at the *a priori* level of significance of .05 are found in Table 4-14. Four dependent variables (i.e. barrier categories) had a significant interaction, at the .05 level, with two independent variables (i.e. gender and respondent game playing frequency). Approaching significance was defined as any probability between .05 and .10. These results were interesting since they would have been significant if α was set at .10 (Table 4-14 for overall results).

Gender results

Gender, an independent variable, had a significant relationship with three dependent variables: *Issues with Negative Potential Student Outcomes* (Wilks' Λ (.835), F = 6.577, *p* = .011); *Technology Issues* (Wilks' Λ (.835), F = 8.050, *p* = .005); and, *Teacher Issues* (Wilks' Λ (.835), F = 4.293, *p* = .040). The other four dependent variables had no significance: *Issues Specific to Games and Simulations* (Wilks' Λ (.835), F = 0.017, *p* = .896); *Issues with Games and Simulations in Education* (Wilks' Λ (.835), F = 0.990, *p* = .321); *Incorporation Issues* (Wilks' Λ (.835), F = 0.644, *p* = .423); and, *Student Issues* (Wilks' Λ (.835), F = 0.007, *p* = .931). See Table 4-14 for overall results.

Age results

The independent variable, age, had no significant relationship at the .05 level with six dependent variables: *Issues with Negative Potential Student Outcomes* (Wilks' Λ (.835), F = 0.704, *p* = .647); *Technology Issues* (Wilks' Λ (.835), F = 0.414, *p* = .869); *Teacher Issues* (Wilks' Λ (.835), F = 0.291, *p* = .941); *Issues with Games and Simulations in Education* (Wilks' Λ (.835), F = 0.615, *p* = .718); *Incorporation Issues* (Wilks' Λ (.835), F = 0.694, *p* = .654); and, *Student Issues* (Wilks' Λ (.835), F = 1.314, *p* = .253). Interestingly, the dependent variable, *Issues Specific to Games and Simulations* (Wilks' Λ (.835), F = 2.106, *p* = .055) was approaching significance and would have been significant if α was set at .10 (Table 4-14 for overall results).

Ethnicity results

Ethnicity, an independent variable, had no significant relationship at the .05 level with six of the dependent variables: *Issues with Negative Potential Student Outcomes* (Wilks' Λ (.835), F = 0.896, *p* = .410); *Technology Issues* (Wilks' Λ (.835), F = 1.099, *p* =

.336); *Issues Specific to Games and Simulations* (Wilks' Λ (.835), F = 0.919, *p* = .401); *Teacher Issues* (Wilks' Λ (.835), F = 0.289, *p* = .749); *Incorporation Issues* (Wilks' Λ (.835), F = 1.346, *p* = .263); and, *Student Issues* (Wilks' Λ (.835), F = 1.743, *p* = .178). Interestingly, the dependent variable, *Issues with Games and Simulations in Education* (Wilks' Λ (.835), F = 2.351, *p* = .098) was approaching significance and would have been significant if α was set at .10 (Table 4-14 for overall results).

Highest degree earned by the respondent

The independent variable, highest degree earned by the respondent, had no significant relationship at the .05 or .10 level with any of the dependent variables: *Issues with Negative Potential Student Outcomes* (Wilks' Λ (.835), F = 1.461, *p* = .205); *Technology Issues* (Wilks' Λ (.835), F = 0.255, *p* = .937); *Issues Specific to Games and Simulations* (Wilks' Λ (.835), F = 0.792, *p* = .557); *Teacher Issues* (Wilks' Λ (.835), F = 1.137, *p* = .343); *Issues with Games and Simulations in Education* (Wilks' Λ (.835), F = 1.675, *p* = .143); *Incorporation Issues* (Wilks' Λ (.835), F = 0.565, *p* = .727); and, *Student Issues* (Wilks' Λ (.835), F = 0.347, *p* = .883). See Table 4-14 for overall results.

Grade category taught by the respondent

The independent variable, grade category taught by the respondent, had no significant relationship at the .05 level with five dependent variables: *Issues with Negative Potential Student Outcomes* (Wilks' Λ (.835), F = 1.214, *p* = .305); *Issues Specific to Games and Simulations* (Wilks' Λ (.835), F = 0.979, *p* = .432) *Issues with Games and Simulations in Education* (Wilks' Λ (.835), F = 1.493, *p* = .194); *Incorporation Issues* (Wilks' Λ (.835), F = 1.181, *p* = .320); and, *Student Issues* (Wilks' Λ (.835), F = 1.420, *p* = .219). Interestingly, two dependent variables, *Technology Issues* (Wilks' Λ (.835), F = 2.157, *p* = .061) and *Teacher Issues* (Wilks' Λ (.835), F = 2.183, *p*

= .058), were approaching significance and would have been significant if α was set at .10 (Table 4-14 for overall results).

Respondents' game play frequency

The respondents' game play frequency, an independent variable, had a significant relationship with one dependent variable. *Technology Issues*, according to Wilks' Λ (.787), F = 3.163, p = .009 was significant at the .05 level. Interestingly, the dependent variable, *Teacher Issues* (Wilks' Λ (.835), F = 2.159, p = .061) was approaching significance and would have been significant if α was set at .10 (Table 4-14 for overall results). The other five dependent variables had no significance: *Issues with Negative Potential Student Outcomes* (Wilks' Λ (.835), F = 1.002, p = .418); *Issues Specific to Games and Simulations* (Wilks' Λ (.835), F = 0.549, p = .739) *Issues with Games and Simulations in Education* (Wilks' Λ (.835), F = 0.583, p = .713); *Incorporation Issues* (Wilks' Λ (.835), F = 1.317, p = .259); and, *Student Issues* (Wilks' Λ (.835), F = 0.741, p = .594).

ANOVA Results

Univariate analyses of variance (ANOVA) for each dependent variable were conducted as follow-up tests to the MANOVA results that were significant at the .05 level. The four follow-up analyses included two independent variables, gender and frequency of game play.

Gender and issues with negative potential student outcomes

The ANOVA using gender and *Issues with Negative Potential Student Outcomes* resulted in a significant difference between males and females (F = 3.286, p = .030; Table 4-15). Females had a mean of 0.9954 (SD = 0.96963, N = 145; Table 4-16) and males had a mean of 1.3819 (SD = 1.25860, N = 72; Table 4-16). These results suggest that, on average, males thought that this barrier, *Issues with Negative Potential Student Outcomes*, was more of a barrier than females.

Gender and technology issues

Also, the ANOVA using gender and *Technology Issues* resulted in a significant difference between males and females (F = 6.164, *p* = .032; Table 4-15). Females had a mean of 2.1598 (SD = 0.92928, N = 146; Table 4-16) and males had a mean of 1.7971 (SD = 0.96333, N = 69; Table 4-16). These results suggest that *Technology Issues* were, on average, more of a barrier for females than for males.

Gender and teacher issues

An additional significant difference between genders surfaced in the ANOVA examining gender and *Teacher Issues* (F = 3.393, *p* = .031; Table 4-15). Females had a mean of 1.7483 (SD = 0.84964, N = 145; Table 4-16) and males had a mean of 1.4718 (SD = 0.86968, N = 71; Table 4-16). These results suggest that *Teacher Issues* were, on average, more of a barrier for females than for males.

Game play frequency and technology issues

A follow-up ANOVA between the independent variable of respondents' game play frequency and the dependent variable of *Technology Issues* yielded results that were not significant at the .05 level (F = 2.030, *p* = 0.076; Table 4-15). However, by using the definition previously applied, these results are approaching significance since the results would be considered significant at the .10 level.

Game play frequency was based on the average amount of time the respondent played games in one week. There were six categories: 0 hours per week (Mean = 2.2759, SD = 0.95460, N = 29), 0-2 hours per week (Mean = 2.1556, SD = 0.92063, N = 90), 2-5 hours per week (Mean = 1.9340, SD = 0.92412, N = 53), 5-10 hours per week

(Mean = 1.9710, SD = 1.04767, N = 23), 10-25 hours per week (Mean = 1.6765, SD = 0.97088, N = 17), and >25 hours per week (Mean = 1.0000, SD = 0.66667, N = 3). See Table 4-17 for these overall results.

Interestingly, the means decrease as the frequency of game playing increases. This suggests that respondents who play games more frequently do not view technology as much of a barrier as those respondents who play games less frequently.

Summary of Statistical Analyses

Three statistical analyses were used on the survey data: an exploratory factor analysis, a MANOVA, and an ANOVA. Each of the statistical analyses had significant results.

The exploratory factor analysis on the 32 potential barriers to using games and simulations in education found that seven factors explained 67% of the variance in the data. By identifying the barriers in each of the seven factors, the barrier categories could be identified and defined. Six of the seven groups had a Cronbach's Alpha between .95 and .70, which suggests the set of six items is closely related as a group (Nunnaly, 1978). These seven categories include: *Issues with Negative Potential Student Outcomes* (α = .93), *Technology Issues* (α = .80), *Issues Specific to Games and Simulations* (α = .75), *Teacher Issues* (α=.79), *Issues with Games and Simulations in Education* (α = .87), *Student Issues* (α = .73), and *Incorporation Issues* (α = .65).

By using the seven barrier categories as dependent variables, I could use demographic information (i.e. age, ethnicity, gender, highest degree earned, grade category taught) and the amount of time the respondent spent playing games as independent variables for MANOVA analyses. Out of these analyses, only four interactions were significant: *Gender and Issues with Negative Potential Student*

Outcomes (p = .011), *Gender and Technology Issues* (p = .005), *Gender and Teacher Issues* (p = .040), and *Respondent's Game Play Frequency and Technology Issues* (p = .009).

To understand how each variable in the significant MANOVA analyses was related to each other, I did a follow-up ANOVA analysis. For example, the ANOVA for *Gender and Issues with Negative Potential Student Outcomes* was significant (p = .030) with a male mean of 1.3819 and a female mean of 0.9954. This suggests that, on average, males ranked this category as more of a barrier than females.

The *Gender and Technology Issues* ANOVA was significant (p = .032) with a female mean of 2.1598 and a male mean of 1.7971. This suggests that, on average, women rated *Technology Issues* as more of a barrier than men did.

The *Gender and Teacher Issues* ANOVA was also significant (p = .031) with a female mean of 1.7483 and a male mean of 1.4718. These results imply that, on average, females ranked barriers in this category as stronger barriers than males.

The ANOVA using *Respondent's Game Play Frequency and Technology Issues* (p = .076) was not significant at the .05 level. However, it is interesting to note that the means for each category of game play (i.e. 0 hours per week, 0-2 hours per week, 2-5 hours per week, 5-10 hours per week, 10-25 hours per week, more than 25 hours per week) decreased as the amount of time per week the respondent played a game increased. This suggests that those who play games more frequently do not think that those potential barriers in the *Technology Issues* category are as much of a barrier as compared to those who play games less frequently.

Chapter 5 discusses the significance of these findings and how they relate to the study as a whole. Also, I consider data from questions for the theory of Diffusion of Innovations, grade categories, and learner levels, along with the potential barriers to determine if the survey instrument corresponded to the intent for which the survey was designed, to determine the teacher perceived barriers to the use of games and simulations in formal education.

Table 4-1. Age of the survey respondents

Answer options	Response percent	Response count
0-20	0.0%	0
21-30	9.8%	25
31-40	22.7%	58
41-50	28.2%	72
51-60	27.1%	69
61-65	7.5%	19
Older than 65	4.7%	12
	Answered question	255

Table 4-2. Ethnicity of the survey respondents

Answer options	Response percent	Response count[1]
Asian	2.4%	6
Black/African American	3.1%	8
Hawaiian/Pacific Islander	0.8%	2
Hispanic/Latino/Caribbean Islander	7.1%	18
White/Caucasian	87.1%	222
Native American	0.4%	1
Other	3.1%	8
	Answered question	255

Response count[1] – respondents could choose more than one answer option

Table 4-3. Highest degree earned by survey respondents

Answer options	Response percent	Response count
Associates	1.2%	3
Bachelors	17.6%	46
Masters	55.6%	145
Specialist	5.7%	15
Doctorate	16.1%	42
Other (please specify)	3.8%	10
	Answered question	261

Table 4-4. Grade category survey respondents teach

Answer options	Response percent	Response count
Elementary	20.0%	53
Middle School	16.3%	43
High School	20.8%	55
Post-secondary (i.e. college, university, technical)	18.6%	49
Adult Education (i.e. ABE/GED, ESL/ESOL, Adult High School)	3.8%	10
Other (please specify)	20.5%	54
	Answered question	264

Table 4-5. How survey respondents use technology in their curriculum

Answer options	Response percent	Response count[1]
Electronic presentations (i.e. PowerPoint®, Prezi®, SlideRocket®, and so on)	92.9%	234
Digital Programs included with textbooks	44.8%	113
District programs (i.e. Discovery Education®, Standardized Test Prep programs, and so on)	40.1%	101
Learning/Course Management Systems (i.e. BlackBoard®, Angel®, WebCT® and so on)	54.8%	138
Mobile Digital Devices	42.5%	107
Internet Searches/Research	90.5%	228
Internet/Specific Websites	88.9%	224
Electronic meeting place (i.e. Elluminate®, Wimba®, and so on)	28.6%	72
Gaming Platforms (i.e. Wii®, Xbox®, PlayStation®, and so on)	10.3%	26
Computer games/simulations (i.e. software, internet, mobile application)	56.0%	141
Teacher-created digital media for lesson	73.4%	185
Students create digital media	63.9%	161
Other (please explain)	12.7%	32
	Answered question	252

Response count[1] – respondents could choose more than one answer option

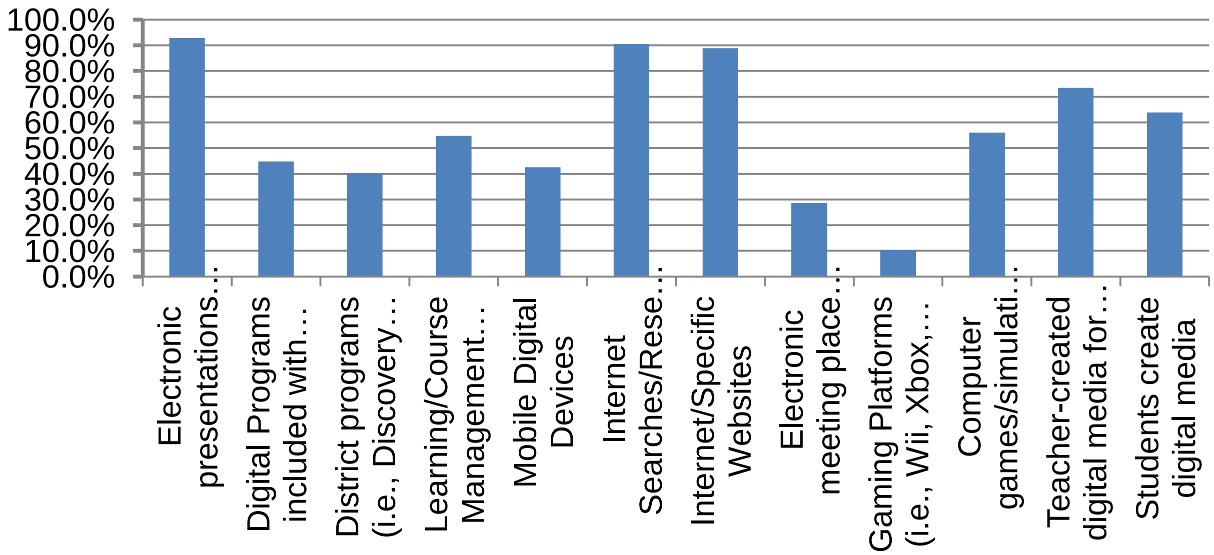

Figure 4-1. How survey respondents use technology in their curriculum

Table 4-6. How often do survey respondents play games (board, card, Internet, software, gaming platform, mobile application, etc.)

Answer options	Response percent	Response count
0 hours per week	14.0%	34
0-2 hours per week	42.0%	102
2-5 hours per week	24.3%	59
5-10 hours per week	11.1%	27
10-25 hours per week	7.0%	17
More than 25 hours per week	1.6%	4
	Answered question	243

Table 4-7. How survey respondents thought games or simulations could be useful for educational purposes.

Answer options	Response percent	Response count[1]
Games are NOT useful for education	0.0%	0
Review of material	75.3%	183
Motivating & engaging students	94.7%	230
Applying learning styles & varied learning	82.3%	200
Immediate feedback & self-correction	86.4%	210
Building hand-eye coordination	54.7%	133
Problem solving and critical thinking	89.3%	217
Differentiated (personalized) learning	81.5%	198
Peer learning opportunities	64.6%	157
Pre-test for current skills to assign lessons	58.8%	143
Post-test for learned skills	56.8%	138
Foster good-natured competition among students	59.7%	145
Approximate real-life situations	73.3%	178
As a reward for students	46.5%	113
Other (please explain)	7.8%	19
	Answered question	243

Response count[1] – respondents could choose more than one answer option

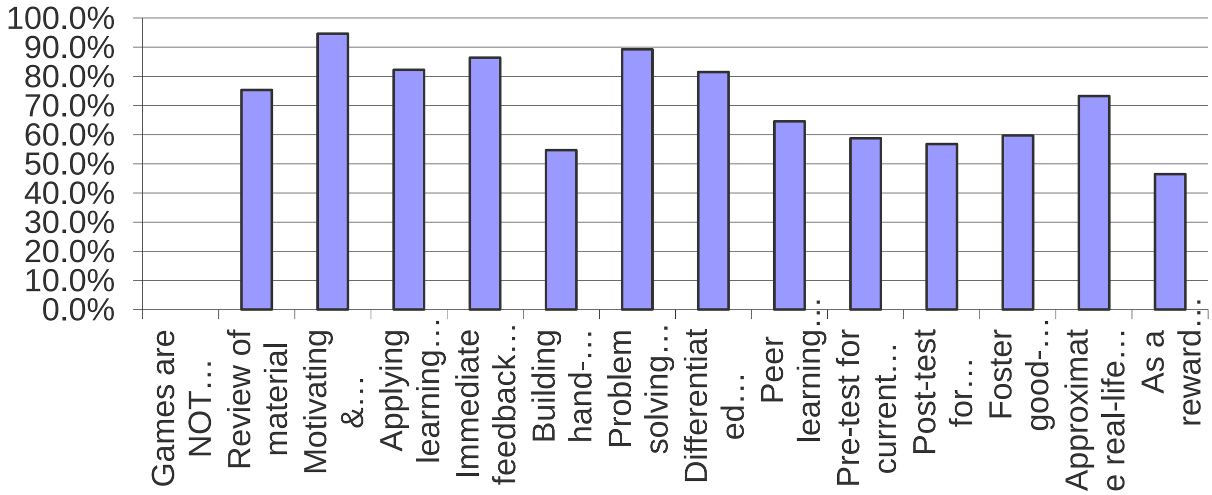

Figure 4-2. How survey respondents thought games or simulations could be useful for educational purposes

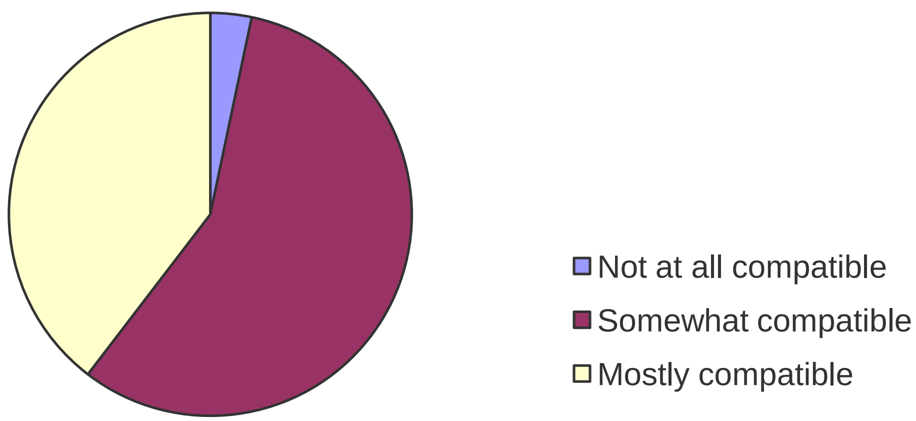

Figure 4-3. Survey respondents who thought games and simulations are compatible with their own teaching practices.

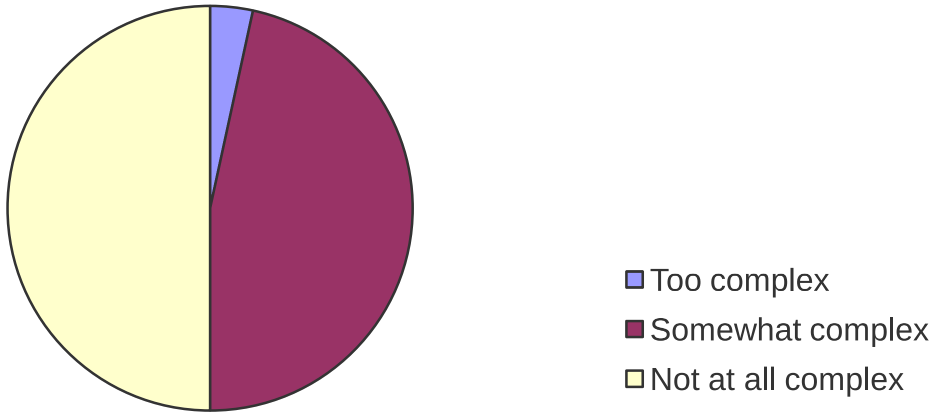

Figure 4-4. Survey respondents who thought games or simulations were too complex for their students to learn the intended lesson

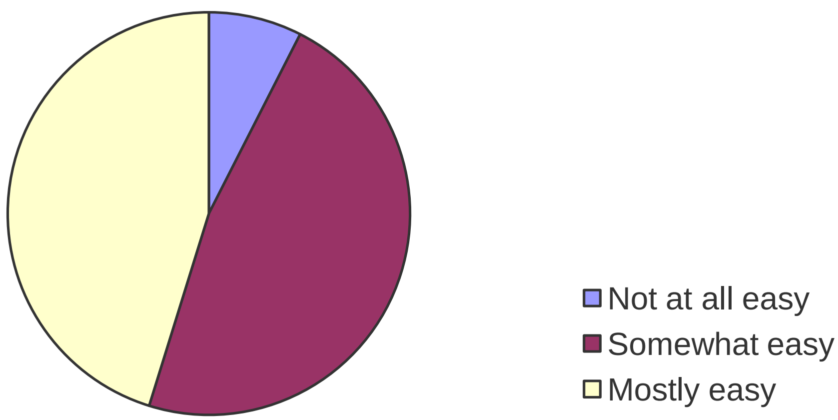

Figure 4-5. Survey respondents who thought that it would be easy to experiment with an educational game or simulation for one of their lessons

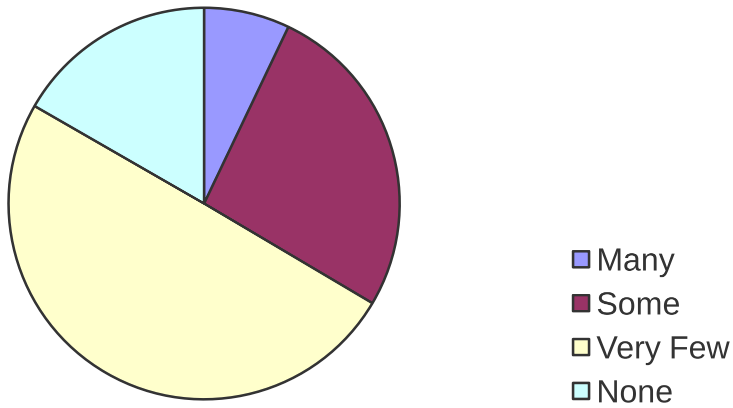

Figure 4-6. Survey respondents who have seen co-workers using games or simulations in their classroom, teaching practices, curriculum, or lesson plans

Table 4-8. Grade category(s) survey respondents thought would benefit from the addition of educational games and simulations.

Answer options	Response percent	Response count[1]
None	0.0%	0
Elementary	88.8%	214
Middle School	94.2%	227
High School	88.4%	213
Post-secondary (i.e. college, university, technical)	67.2%	162
Adult Education (i.e. ABE/GED, ESL/ESOL, Adult High School)	62.2%	150
Other (please explain)	5.4%	13
	Answered question	241

Response count[1] – respondents could choose more than one answer option

Table 4-9. Learner level(s) survey respondents thought would benefit from the addition of educational games and simulations.

Answer options	Response percent	Response count[1]
None	0.0%	0
Low-level learners	92.9%	222
General (intermediate) learners	93.3%	223
Gifted (high-level) learners	85.8%	205
Mixed learners (two or more groups combined in one class)	86.6%	207
Other (please explain)	5.0%	12
	Answered question	239

Response count[1] – respondents could choose more than one answer option

Table 4-10. Survey respondents rank how much each of these potential barriers prevent them from using games and simulations

Answer options	0 - Not a barrier	1	2 – Somewhat a barrier	3	4 – Definitely a barrier	Rating average	Response count
1) Lack of time (i.e. find a game or simulation, learn the game or simulation, incorporate a game or simulation into the lesson)	27	18	66	41	74	2.52	226
2) Lack of games and simulations for disabled students (i.e. access, equip-ment, game/sim. options)	60	34	72	26	30	1.69	222
3) Lack of games and simulations with a good balance between education and entertainment (i.e. game/simulation is entertain-ing but with little learning, or it has enough learning but has little entertainment)	19	26	86	50	45	2.34	226
4) Complexity (too difficult) of games and simulations for my students	65	59	65	25	12	1.38	226
5) Simplicity (too easy) of games and simulations for my students	49	56	62	39	15	1.62	221
6) Lack of customizability or adaptability in a game or simulation (i.e. inability to modify game/simulation subjects, goals, or objectives)	23	38	73	56	34	2.18	224
7) Lack of the ability to track and/or assess student progress within a game/simulation	31	33	73	54	29	2.08	220
8) Lack of knowledge about how to use games and simulations appropriately	63	52	42	47	21	1.60	225
9) The opinion that games and simulations cause problems with classroom management and/or in-class student behavior	115	47	26	19	18	1.01	225

Table 4-10. Continued

Answer options	0 - Not a barrier	1	2 – Somewhat a barrier	3	4 – Definitely a barrier	Rating average	Response count
10) The perception that games may cause student behavioral problems (i.e. violence or aggression)	127	46	22	15	14	0.85	224
11) The perception that games may cause student obsession or addiction	113	59	23	12	16	0.92	223
12) The concern that students will not learn the intended lesson using the game/simulation	77	58	43	27	20	1.36	225
13) The opinion that students learn more from a teacher than from a game or simulation	93	53	36	27	14	1.17	223
14) The opinion that other learning strategies are more effective than using games or simulations	74	50	50	31	18	1.41	223
15) Lack of games/simulations that are aligned to state standards or standardized testing	38	31	47	67	42	2.20	225
16) Lack of examples and available lesson plans using games and simulations	36	29	57	56	47	2.22	225
17) The perception of the term “game” (rather than the term “educational simulation,” for example)	81	34	42	38	29	1.55	224
18) Lack of evidence to support the use of games and simulations in education	67	48	56	39	12	1.46	222
19) Lack of parental and/or community support for the use of games and simulations in classrooms/lessons	70	42	45	46	21	1.58	224
20) Lack of your own motivation to use games and simulations in lessons	125	54	32	10	3	0.71	224

Table 4-10. Continued

Answer options	0 - Not a barrier	1	2 – Somewhat a barrier	3	4 – Definitely a barrier	Rating average	Response count
21) Lack of student motivation to use games and simulations in lessons (i.e. students do not seem interested in games/simulations)	143	38	30	10	2	0.61	223
22) Varying student abilities (i.e. technology skills, learning ability)	84	71	49	16	5	1.05	225
23) Lack of clear expectations, by administrators, for teacher usage	67	44	57	34	22	1.55	224
24) Cost/expense of games/simulations/equipment	18	21	59	58	69	2.62	225
25) Inability to try a game or simulation before purchase	28	23	62	47	61	2.41	221
26) Lack of access to games and simulations outside of school	53	38	59	40	35	1.85	225
27) Lack of technical support (for teachers and/or students)	54	32	53	45	40	1.93	224
28) Lack of technology reliability	60	42	53	40	29	1.71	224
29) Lack of my own technology abilities	140	41	21	13	4	0.63	219
30) Lack of administrative support	72	47	40	33	31	1.57	223
31) Length of class period	76	41	41	38	29	1.57	225
32) Class size	77	45	39	35	26	1.50	222
Category totals	2225	1350	1581	1134	867	--------	7157
Average rating						1.59	
Total respondents							226

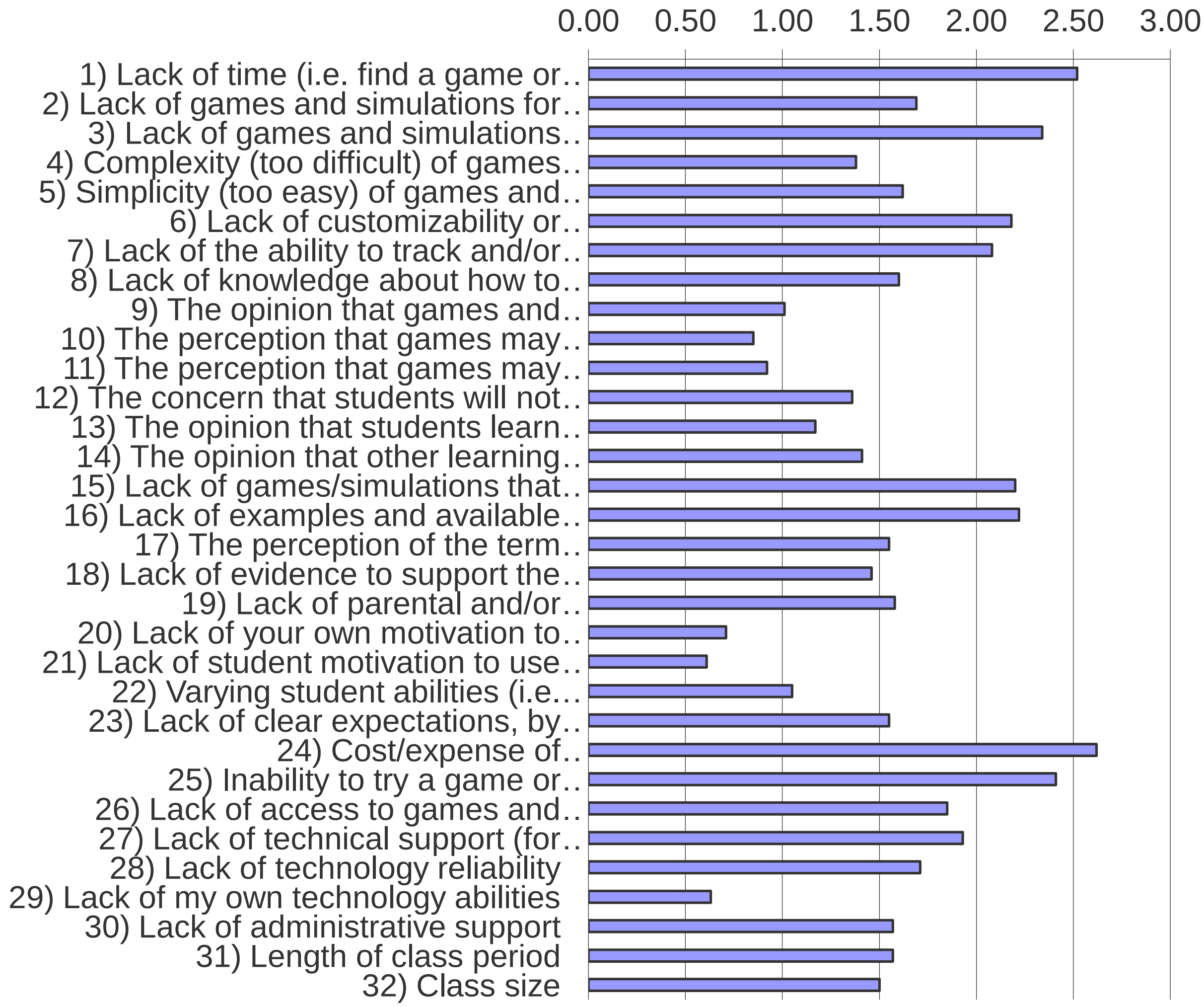

Figure 4-7. Survey respondents rank (0= no barrier to 4= definite barrier) how much each of these potential barriers prevent them from using games and simulations

Table 4-11. The seven identified factors from the model

Factor	M	SD	Skewness	Kurtosis	α	Items
Issues with Negative Potential Student Outcomes	1.12	1.08	0.97	0.18	.93	6
Technology Issues	2.04	0.95	-0.22	-0.61	.80	6
Issues Specific to Games & Simulations	2.05	0.91	-0.16	-0.32	.75	4
Teacher Issues	1.65	0.87	0.05	-0.67	.79	6
Issues with Games & Simulations in Education	1.55	1.10	0.23	-0.95	.87	5
Student Issues	0.83	0.88	1.00	0.36	.73	2
Incorporation Issues	1.75	1.03	0.33	-0.76	.65	3

Table 4-12. Eigenvalues and cumulative variance explained by the model

Factors	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Eigenvalues	11.19	2.88	1.94	1.61	1.55	1.24	1.14
Variance (%)	34.98	9.01	6.06	5.03	4.84	3.87	3.56
Cumulative Variance (%)	34.98	43.99	50.05	55.08	59.93	63.80	67.36

Table 4-13. Correlation matrix for the model

	1	**2**	**3**	**4**	**5**	**6**	**7**
1	1						
2	.364**	1					
3	.293**	.474**	1				
4	.482**	.582**	.458**	1			
5	.675**	.543**	.389**	.508**	1		
6	.429**	.480**	.523**	.500**	.504**	1	
7	.400**	.408**	.292**	.470**	.415**	.388**	1

**. Correlation is significant at the .01 level (2-tailed).

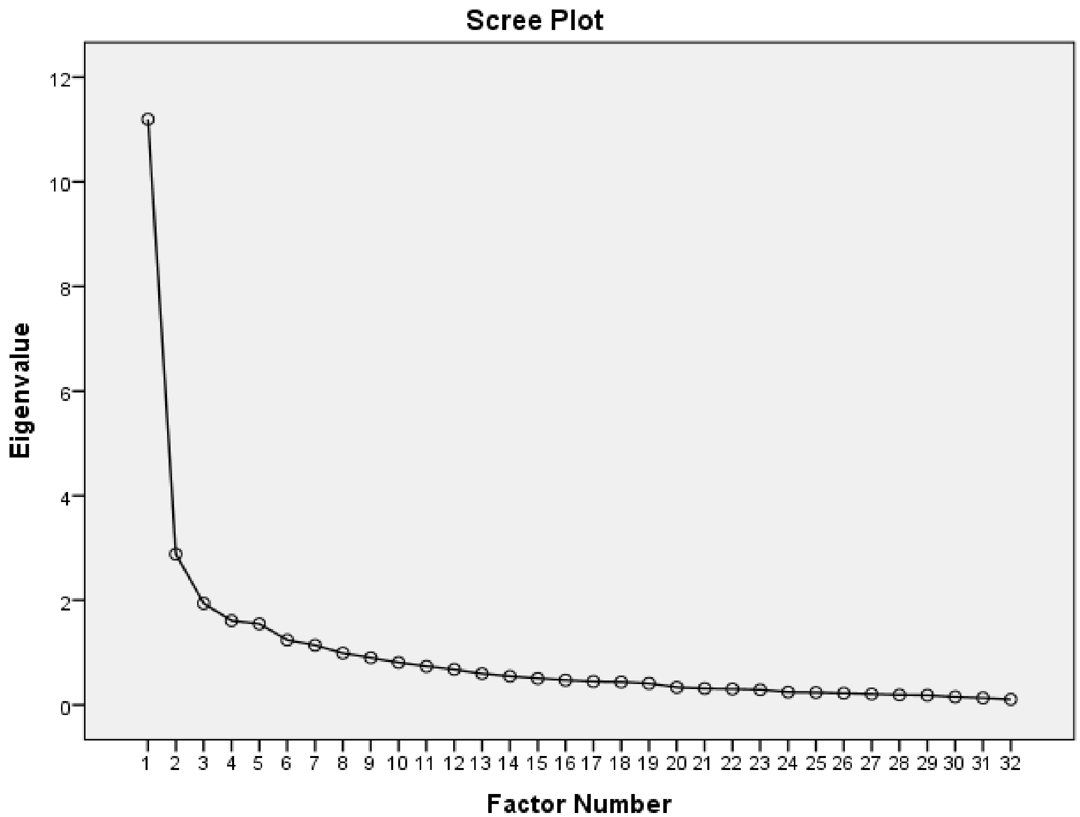

Figure 4-8. Scree plot for 32-item instrument.

Table 4-14. MANOVA results for the demographic and game frequency survey questions

Independent variable	Wilks' Lambda	Dependent variable	F	Significance
Gender	0.835	Issues with Negative Potential Student Outcomes	6.577	0.011**
Gender	0.835	Technology Issues	8.050	0.005**
Gender	0.835	Issues Specific to Games & Simulations	0.017	0.896
Gender	0.835	Teacher Issues	4.293	0.040**
Gender	0.835	Issues with Games and Simulations in Education	0.990	0.321
Gender	0.835	Incorporation Issues	0.644	0.423
Gender	0.835	Student Issues	0.007	0.931
Age	0.770	Issues with Negative Potential Student Outcomes	0.704	0.647
Age	0.770	Technology Issues	0.414	0.869
Age	0.770	Issues Specific to Games & Simulations	2.106	0.055*
Age	0.770	Teacher Issues	0.291	0.941
Age	0.770	Issues with Games and Simulations in Education	0.615	0.718
Age	0.770	Incorporation Issues	0.694	0.654
Age	0.770	Student Issues	1.314	0.253
Ethnicity	0.892	Issues with Negative Potential Student Outcomes	0.896	0.410
Ethnicity	0.892	Technology Issues	1.099	0.336

Table 4-14. Continued

Independent variable	Wilks' Lambda	Dependent variable	F	Significance
Ethnicity	0.892	Issues Specific to Games & Simulations	0.919	0.401
Ethnicity	0.892	Teacher Issues	0.289	0.749
Ethnicity	0.892	Issues with Games and Simulations in Education	2.351	0.098*
Ethnicity	0.892	Incorporation Issues	1.346	0.263
Ethnicity	0.892	Student Issues	1.743	0.178
Highest Degree Earned	0.806	Issues with Negative Potential Student Outcomes	1.461	0.205
Highest Degree Earned	0.806	Technology Issues	0.255	0.937
Highest Degree Earned	0.806	Issues Specific to Games & Simulations	0.792	0.557
Highest Degree Earned	0.806	Teacher Issues	1.137	0.343
Highest Degree Earned	0.806	Issues with Games and Simulations in Education	1.675	0.143
Highest Degree Earned	0.806	Incorporation Issues	0.565	0.727
Highest Degree Earned	0.806	Student Issues	0.347	0.883
Grade Cat. Taught	0.729	Issues with Negative Potential Student Outcomes	1.214	0.305
Grade Cat. Taught	0.729	Technology Issues	2.157	0.061*
Grade Cat. Taught	0.729	Issues Specific to Games & Simulations	0.979	0.432

Table 4-14. Continued

Independent variable	Wilks' Lambda	Dependent variable	F	Significance
Grade Cat. Taught	0.729	Teacher Issues	2.183	0.058*
Grade Cat. Taught	0.729	Issues with Games and Simulations in Education	1.493	0.194
Grade Cat. Taught	0.729	Incorporation Issues	1.181	0.320
Grade Cat. Taught	0.729	Student Issues	1.420	0.219
Respondents' Game Play Frequency	0.787	Issues with Negative Potential Student Outcomes	1.002	0.418
Respondents' Game Play Frequency	0.787	Technology Issues	3.163	0.009**
Respondents' Game Play Frequency	0.787	Issues Specific to Games & Simulations	0.549	0.739
Respondents' Game Play Frequency	0.787	Teacher Issues	2.159	0.061*
Respondents' Game Play Frequency	0.787	Issues with Games and Simulations in Education	0.583	0.713
Respondents' Game Play Frequency	0.787	Incorporation Issues	1.317	0.259
Respondents' Game Play Frequency	0.787	Student Issues	0.741	0.594

** Correlation is significant at the 0.05 level
* Correlation is significant at the 0.10 level

Table 4-15. Follow-up ANOVA results on significant (at the .05 level) MANOVA's

Independent variable	Dependent variable	F	Significance
Gender	Result to student	3.286	.030
Gender	Tech issues	6.164	.032
Gender	Teacher issues	3.393	.031
Game Play Frequency	Tech issues	2.030	.076

Table 4-16. Descriptive statistics for the ANOVA's involving gender

Dependent variable	Gender	Mean	Standard deviation	N
Result to Student	Female	0.9954	0.96963	145
	Male	1.3819	1.25860	72
Tech issues	Female	2.1598	0.92928	146
	Male	1.7971	0.96333	69
Teacher Issues	Female	1.7483	0.84964	145
	Male	1.4718	0.86968	71

Table 4-17. Descriptive statistics for the ANOVA for game play frequency

Game play frequency	Mean	Standard deviation	N
0 hours per week	2.2759	0.95460	29
0-2 hours per week	2.1556	0.92063	90
2-5 hours per week	1.9340	0.92412	53
5-10 hours per week	1.9710	1.04767	23
10-25 hours per week	1.6765	0.97088	17
>25 hours per week	1.0000	0.66667	3

CHAPTER 5
DISCUSSION AND IMPLICATIONS

Summary of the Study

Many researchers have identified electronic games and simulations as a potential teaching tool with a degree of interactivity that can cause intense engagement and deep, meaningful learning experiences (Aldrich, 2005; Annetta, 2008; Annetta et al., 2009; Cameron & Dwyer, 2005; Coller & Scott, 2009; Gee, 2003; Halverson, 2005; Hamlen, 2010; Prensky, 2001; Rieber, 1996; Shaffer, 2006; Shaffer et al., 2005; Squire, 2006). Although the potential benefits of incorporating games and simulations in education have been identified and supported and there seems to be interest in incorporating games and simulations by educators, some researchers have noticed that game and simulation integration into education has been slow (Gee 2003; Gee & Levine, 2008; Kenny & Gunter, 2011; Koh et al., 2011; Prensky, 2001). Consequently, researchers have tried to identify the barriers to the adoption of games and simulations in education (Baek, 2008; Becker & Jacobsen, 2005; Boyle et al., 2012; Egenfeldt-Nielsen, 2004; KeBritchi, 2010; Kenny & Gunter, 2011; Rice, 2007; Ritzhaupt et al., 2010; Simpson & Stansberry, 2008). Furthermore, Bourgonjon (2011) questions whether current research is taking a broad enough approach when studying these key issues.

Because, at present, very few, if any, studies take a broad, comprehensive look at potential barriers to the adoption of games and simulations in formal education, the purpose of this study was to create an all-inclusive survey to discern these barriers. For example, there is a definite lack of research in barriers across grade categories (i.e. elementary, pre-secondary, secondary, post-secondary, adult education), teacher demographics (i.e. gender, age, ethnicity, highest degree earned), and teacher inexperience with games and simulations. Also, consideration should be given that the barriers to adoption may be similar in nature to the adoption of any new technology (i.e. the theory of Diffusions of Innovations) or specific to the adoption of games and simulations. A comprehensive survey that distinguishes if teacher perceived barriers vary at different grade categories, teacher demographics, teacher game and simulation inexperience, and if the identified barriers are general to the adoption of any new technology or are specific to games and simulations may be more likely to become a widely accepted, valid and reliable instrument in ascertaining the barriers to the adoption of games and simulations in formal education.

To achieve this goal, I incorporated research already conducted (detailed in Chapter 2) with interviews from educators to design a draft of a survey of the potential barriers to the adoption of games and simulations in curriculum. I used a focus group, expert review, and think aloud protocol to increase the accuracy and efficacy of the survey instrument (AERA et al., 1999; Beatty, 2004; Chioncel et al., 2003; Grant & Davis, 1997; Rabiee, 2004; Van Someren et al., 1994; Vogt et al., 2004). By incorporating the comments and suggestions of the focus group, the expert panel, and think aloud protocol, I was able to finalize the survey. Then I transferred the survey onto the Internet, so that I could test the survey by distributing it to a group of educators. Finally, I analyzed the results to ensure that the data gathered corresponded to the intent for which the survey instrument was designed, to determine the teacher perceived barriers to the use of games and simulations in formal education.

Summary of the Findings

This section of Chapter 5 is divided into sections based on my research questions and research components of the literature reviewed in Chapter 2. This summary of findings includes the following sections: *Perceived Barriers to the Adoption of Games and Simulations in Education* (further divided into the seven barrier categories), *Grade Category*, *Learner Level*, *Diffusion of Innovations*, and *Teacher Inexperience with Games and Simulations*.

Perceived Barriers to the Adoption of Games and Simulations in Education

Please recall my research question: what are the barriers to adopting games and simulations in education? Because the barriers were the central focus of my research, they are the focus of my findings.

A large portion of the survey included 32 potential barriers that respondents rated according to how much (or how little) the respondent perceived the item as a barrier to the adoption of games and simulations into his or her curriculum. An exploratory factor analysis helped to understand the underlying structure by identifying seven factors that accounted for most of the variability in the respondents' rankings. These seven categories of barriers were: *Issues with Negative Potential Student Outcomes*, *Technology Issues*, *Issues Specific to Games and Simulations*, *Teacher Issues*, *Issues with Games and Simulations in Education*, *Incorporation Issues*, and *Student Issues*.

When each of the barriers' rankings were averaged, some of the lowest ranked barriers included: the lack of student motivation to use games and simulations (0.61), the respondent's own lack of technology abilities (0.63), the respondent's own lack of motivation to use games and simulations (0.71), the perception that student aggression may result (0.85), the perception that student addiction may result (0.92), and the perception that student behavioral problems may result (1.01). Alternatively, some of the higher rated barriers included: the cost of the equipment (2.62), the lack of time to plan and implement (2.52), the inability to try-out games and simulations before purchase (2.41), too much ‘edutainment’ or games and simulations that lack balance between entertainment and education (2.34), the lack of available lesson plans and examples (2.22), the lack of games and simulations that align to state standards or standardized testing (2.20), the inability to customize the game or simulation (2.18), and the inability to track student progress through the game or simulation (2.08).

Some of these categories had no significant or only approaching significant interactions with specific demographic information. For this study, approaching significance was defined as having a p-value between .05 and .10. For instance, *Issues with Negative Potential Student Outcomes* included six individual barriers and had one significant interaction, where $p < .05$, one approaching significant interaction, where $.05 < p < .10$, and four no significant interactions, where $p > .10$.

Issues with negative potential student outcomes

This category contained six individual barriers that concerned possible behavioral problems (i.e. addiction, aggression, classroom behavioral problems) and negative educational outcomes (i.e. not learning intended lessons, better learning from other strategies or from the teacher). Interestingly, this category’s average ranking ranged from 0.85 to 1.41 (recall that 0 is no barrier and 2 is somewhat a barrier), which is low. Three of the six barriers in this category were identified as the lowest overall (i.e. class behavioral problems, aggression, and addiction). This suggests that, on the whole, this category was not considered as much of an obstacle for the addition of games and simulations into the classroom.

Another interesting point is that all six of these barriers have been identified and previously discussed as game-specific barriers (Chapter 2). For example, over-stimulation, aggression, and addiction have been identified as concerns by some educators and parents who worry about games and simulations being used as educational components (Kenny & Gunter, 2011; Koh et al., 2011; Rice, 2007; Rosas et al., 2003). Additionally, several researchers suggest that the development of video games is not currently compatible with formal education since there is little incentive to incorporate pedagogical components to guarantee learning outcomes into the high profile, multimillion dollar games they are constructing (Kenny & Gunter, 2011; Rice, 2007; Rosas et al., 2003; Royle & Colfer, 2010; Torrente et al., 2010). Because all six of these barriers are teacher concerns that are specific to games and simulations, it is reasonable that they are contained within one barrier category.

Gender was the only demographic characteristic that had significant interactions with this barrier category. Thus, gender was a significant (p = .030) factor in ranking the individual barriers in the *Issues with Negative Potential Student Outcomes* category. On average, male educators had a tendency to rank these individual barriers as more of a barrier than did female educators. This is very interesting since much of the research shows that males tend to enjoy playing games and simulations more and prefer learning by the use of games and simulations more than females (Greenberg et al., 2010; Hainey et al., 2011; Hamlen, 2010; Robertson, 2012). One could speculate that perhaps the supposed male affinity for games and simulations enables a sympathy and understanding for addiction or aggression as potential outcomes of games and simulations. Moreover, the supposed female distain for games and simulations could explain the lack of understanding of how a game or simulation could cause addiction or aggression. However, one study hypothesizes that experience with video games lessens perceived negative effects, like aggression, of playing these games (Bourgonjon et al., 2011). This suggests that if males are truly playing so much more than females, they would be less concerned about behavioral outcomes like aggression.

Interestingly, more recent statistics show that males and females play games just as frequently and in a similar amount of time, but, each gender plays different types of games (Annetta et al., 2009; Bourgonjon et al., 2011; Chen et al., 2010; Hainey et al., 2011; Lowrie & Jorgensen, 2011). Also, Wilson (2006) suggests that females prefer to learn by case study and practical application. If this female preference is true, one would expect increased rankings of individual negative learning outcome barriers in this category by females; however, that did not seem to happen. In summary, these confusing results are very interesting and merit a more in depth study.

Technology issues

The six individual barriers in this category include: cost of this technology, access to this technology outside of school, technical support, technology reliability, inability to try the technology before buying, and technology availability for students with disabilities. Interestingly, on the whole, this category was rated fairly high in comparison to other categories. The range of average ratings was between 1.69 and 2.62. This category contained two of the highest overall ranked barriers (i.e., cost of the equipment (2.62) and the inability to try-out a game or simulation before purchase (2.41)). The higher ratings for this whole category suggest that perhaps these individual barriers are thought to be more of a challenge in the adoption of games and simulations in education.

Similarly, all but one of these individual barriers were previously identified and discussed as technology-based barriers (Chapter 2). For example, researchers identified some serious problems with top quality equipment and software in schools: cost of the technology, availability, as well as accessibility, to staff and students, and the inability to try-out products, like simulations, before buying (Becker & Jacobsen, 2005; Egenfeldt-Nielsen, 2004; Koh et al., 2011; Rice, 2007; Rosas et al., 2003; Royle & Colfer, 2010; Russell & Shepherd, 2010; Summers, 2004; Torrente et al., 2009). The one barrier that was not previously identified in this category was accessibility to disabled students. This barrier was suggested from several educators during interviews.

The gender of the respondent also significantly (p = .032) influenced how the individual barriers in the *Technology Issues* category were ranked. In general, female educators ranked individual technology items as more of a barrier than male educators. Given some of the research on females and technology, this result is provocative. For example, one study suggests that technology is a male domain since males have positive attitudes toward technology, report less problems with technology, and can integrate technology smoothly into lessons (Bourgonjon et al., 2011). Additionally, Abbiss (2008) broadly characterized technology as a male domain and a female deficit. Conversely many researchers claim that females use technology just as much as males or that females use technology in different ways in males; therefore their motivations and level of confidence may not be the same as males (Annetta et al., 2009; Jensen & De Castell, 2010; Joiner et al., 2011; Padilla-Walker et al., 2010; Wilson, 2006). These starkly opposing sides to the question of gender and technology, along with this study's significant results, indicates this subject this deserves a closer look. Further study is recommended.

Teacher issues

This category included six individual barriers: time (for implementation and planning), finding games to match standards and testing, lack of available lesson plans and examples, and teacher characteristics (i.e. self-motivation, knowledge about games and simulations, technology abilities). Interestingly, this category had a wide range (0.63 – 2.52) of average ratings of individual barriers. Three of the barriers were identified as the overall highest (i.e. time to plan and implement (2.52), alignment to state standards and standardized testing (2.20), and the lack of available lesson plans and examples (2.22)). Two barriers were identified as the overall lowest (i.e. the respondent's own lack of motivation (0.71) and the respondent's own lack of technology abilities (0.63)). These results suggest that some of these individual barriers are much more of a concern to educators than other individual barriers in this category.

Like the previous two categories, this category contains individual barriers that were previously identified and discussed (Chapter 2); however, unlike the previous two categories, this category contains barriers that were identified in multiple sections (i.e. technology-based, game-specific, and school-based barriers) of the literature review. This suggests that although each of these barriers originate from different places (i.e. administrator pressure, state standardization, understanding complicated technology) all of these problems ultimately cause a perceived barrier to the teacher. Although many researchers claim that a major barrier of adopting games and simulations in the classroom is the characteristics of the teacher, perhaps, at least in this study, it is more a case of the beliefs and/or perceptions of the teacher, rather than the characteristics of the teacher (Egenfeldt-Nielsen, 2004; Niederhauser & Stoddart, 2001; Ritzhaupt et al., 2010; Rosas et al., 2003; Royle & Colfer, 2010; Simpson & Stansberry, 2008; Taylor, 2008; Virvou et al., 2005). For example, Simpson and Stansberry (2008) suggest that political mechanisms, such as high-stakes testing, cause pressure on teachers to improve their students' test scores. Unless a technology is perceived as a guaranteed improvement of students' scores, teachers may not risk an unknown technology, like games and simulations, which could take time away from technologies and lessons that have been proven to increase test scores. Another example is the teacher perceived confidence in their knowledge of games and simulations. Since researchers consistently identify training as a barrier to the adoption of any instructional technology, this could be a perceived problem to teachers who have had little to no training in the use of games and simulations (King, 2002; Koh et al., 2011; Kotrlik & Redmann, 2009; Niederhauser & Stoddart, 2001; Royle & Colfer, 2010; Simpson & Stansberry, 2008; Smarkola, 2007).

Again, gender was a significant (p = .031) factor in ranking these individual barriers. In this study, female educators ranked these items as more of a barrier than their male counterparts. Some recent research may help explain these results. For instance, Hamlen (2010) concluded that although females initially have the same ability as males, their lack of motivation about using technology leads to less overall experience and thereby lowering their confidence. In other words, because females do not receive the same feelings of reward for using technology that males do, females may not be motivated to continue using technology. Interestingly, Lim (2008) suggested that a major barrier to designing successful learning environments was a lack of motivation by teachers coupled with an induced emphasis on standards, grades, and measured outcomes. Unfortunately, gender difference was not a focus of Lim's (2008) study, but these results are very interesting when coupled with Hamlen's (2010) results. In general, to understand how these individual barriers are specifically associated with gender, more research is required.

Issues specific to games and simulations

The four individual barriers in this barrier category included: the inability to track student progress, the inability to customize a game/simulation, the belief that games are too simple for students, and the lack of games/simulations with a good balance between education and entertainment. Three out of the four barriers in this category were rated as the highest barriers (i.e. edutainment or the lack of balance between entertainment and education (2.34), the inability to customize the game or simulation (2.18), and the inability to track student progress within the game or simulation (2.08)). The fourth barrier was also ranked fairly high (i.e. the perception that games and simulations are too simple for students (1.62)). Taken together, this suggests that this category of barriers was viewed by respondents as substantial barriers to the adoption of games and simulations in education.

All of these individual barriers were previously identified and discussed (Chapter 2) as game-specific barriers. These barriers are not related to the outcome of the student as with the category *Issues with Negative Potential Student Outcomes*. These barriers seem to be problems with the construct of the game or simulation itself. For instance, many educators, who are not opposed to using games and simulations in class, cite the problem of "edutainment" (i.e. a game that does not balance entertainment and education) in finding a game to use in a lesson (Rosas et al., 2003;

Torrente et al., 2010). Another example is the inability to monitor and evaluate each student's progression through the game or simulation (Russell & Shepherd, 2010; Sliney et al., 2009; Torrente et al., 2009; Torrente et al., 2010). Without this ability, it becomes almost impossible for teachers to assign a grade, based on progress or improvement, to a student.

There were no significant interactions with this barrier category. Age was approaching a significant (p = .055) interaction with *Issues Specific to Games and Simulations*. Unfortunately, not much research has been done in regards to age and game and simulation usage. Kotrlik and Redman (2009) did find that older teachers have less confidence in technology and their ability to use that technology, but this is not specific to games and simulations. The main concern between age and technology use is the generation gap (i.e. digital divide) between technology-savvy users and those who are not very savvy with technology (Buckingham, 2003; Tapscott, 1998). Perhaps there is a difference in the understanding and use of game and simulation technology between younger teachers, who are familiar with game and simulation technology, and older teachers, who are not familiar with game and simulation technology, as they "stand" on either side of the digital divide. Clearly, without further research, this is just speculation.

Issues with games and simulations in education

This barrier category contained five individual barriers: the perception of the term "game," the lack of evidence to support use, the lack of administrative support, the lack of parental/community support, and the lack of clear expectations by administrators. The average rating of barriers in this category ranged from 1.46 to 1.58. This is a very close range, which suggests that respondents viewed the barriers in this category almost equally as obstacles to game and simulation adoption in their curriculum. Also, these ratings are about the middle of the total range (0.61 – 2.62) which insinuates that overall these barriers are not the most nor the least problematic of the potential barriers to the adoption of games and simulations.

This is another category with individual barriers that were previously identified and discussed from two different sections of the literature review (Chapter 2). For example, two of the individual barriers, were cited as specific to games. The term "game," which is sometimes associated with playing rather than learning, and other negative perceptions of games and simulations may cause the need for extra evidence to justify use in education (Kenny & Gunter, 2011; Koh et al., 2011; Rice, 2007; Rosas et al., 2003; Wexler et al., 2007). The other three individual barriers were discussed as school-based barriers. School cultural resistance, especially support from administrators, parents, and community, has been cited by several researchers as a barrier to the adoption of games and simulations in education (Koh et al., 2011; Royle & Colfer, 2010; Sliney et al. 2009). For example, administrators often make policies and assume teachers will accept and implement them without any provisions or assistance (Niederhauser & Stoddart, 2001).

This barrier had no significant interactions. Ethnicity had an approaching significant (p = .098) interaction with this category. As with age, there has been little research in the differences between ethnicities in regards to game and simulation usage. Although Roberts and Foehr (2008) found that African American males played games longer than other ethnicities, it is interesting that most video games today offer very few characters of ethnicities other than Caucasian. Some of those video games that do offer minority characters may not have the most positive character roles or those games may be strictly for entertainment purposes. For example, if a person of a minority ethnicity plays a game with a character of the same ethnicity and this game has the character stealing cars, selling drugs, or talking to prostitutes, then it might be difficult for this game player to see any educational potential in this type of game. Perhaps as game designers create more positive character roles of ethnicities other than Caucasian, the possible interaction between ethnicity and *Issues with Games and Simulations in Education* will decrease. Of course, without further study, this is just conjecture.

Student issues

This barrier category contained two individual barriers: the lack of student motivation and the variation in student abilities (i.e. technology skills, learning abilities). The barrier about student motivation was proposed in the interview process. The variation in student abilities was previously discussed in the school-based barriers section (Chapter 2). Neither of these barriers is specific to games and simulations, but could potentially be a barrier for any new technology. Both, lack of student motivation and a wide range of student skill and experience, would make it difficult for an educator to keep all students on task because some may be disinterested or familiar with the technology and become bored; whereas others will be lost and need extra help (Schrum et al., 2005; Vos & Brennan, 2010). Interestingly, there were no significant or approaching significant interactions with this barrier category. One barrier did have the lowest averaged ranking (i.e. the lack of student motivation to use games and simulations (0.61)). The other barrier was not rated very highly either (i.e. varying student abilities (1.05)), which suggests that perhaps this category is not much of a perceived barrier overall to the adoption of games and simulations in education.

Incorporation issues

This category contained three individual barriers: the length of class period, the size of the class, and the belief that games are too complex for students. This barrier category had a very small range of average rankings (1.38 – 1.57), which suggests that the individual barriers in this category may be viewed as comparable impediments to using games and simulations in curriculum. Also, since most of these barriers' average ratings fall toward the lower half of the overall range (0.61 – 2.62), then perhaps these barriers are somewhat perceived as inconsequential hindrances to the use of games and simulations in the classroom.

These individual barriers were previously discussed in Chapter 2. Class size was discussed as school-based barrier, since many teachers have no control over the number of students in their classrooms. Complexity of games and simulations was discussed as a game-specific barrier since they are difficult to play in one day; consequently, most students will have little recollection from the previous day and will essentially start from scratch each day the game or simulation is played (Egenfeldt-Nielsen, 2004; Squire, 2006). Interestingly, the length of the class period could be considered both school-based and game-specific barriers. For example, the length of a class period is not controlled by the teacher, but is dictated by the school; thus it could be considered a school-based barrier. Additionally, because of the way games and simulations are constructed, a typical game or simulation cannot be completed within one day despite one class period. Hence it could be considered a game-specific barrier.

Another identified problem with using games and simulations in the classroom is the amount of class time needed for this complex software (Kebritchi, 2010; Koh et al., 2011; Royle & Colfer, 2010; Torrente et al., 2010). It is difficult to learn to play a game within one class period, and then continue that play a day or two later. Additionally, class size can be a barrier for the introduction of any new technology. With the use of games and simulations in education, Egenfeldt-Nielsen (2004) cites larger class sizes as a barrier to adoption.

Incorporation Issues had no significant or approaching significant interactions. All interactions were considered not significant.

Grade Category

A question on the survey asked the opinion of the respondent to which grades would benefit by the adoption of games and simulations. It is noteworthy that not one single person responded “none,” which suggests that all respondents thought that games and simulations would benefit some part of a student’s educational career. Middle school grades (94.2%) were thought the grade category to benefit most, while Elementary (88.8%) and High School (88.4%) closely followed. Post-secondary (67.2%) and Adult Education (62.2%) were also thought to be a benefit by more than half of the people who responded to this question.

Additionally, the grade-level the respondent taught had an approaching significant interaction with *Teacher Issues* (p = .058) and *Technology Issues* (p = .061). The differences in the requirements for teachers in different grade-levels can be extreme. For example, if asked about various items within the *Teacher Issues* category, I believe many teachers would say there are varying amounts of planning time, consequences of standardized testing, technology usage, availability of lesson plans and so on, when contrasting high school with elementary. The same could be said for items within the *Technology Issues* category, which includes individual barriers like access to technology outside of school, cost, technology reliability, technical support, and accessibility for disabled students. For instance, technology usage may not be as frequent or intricate in a first grade classroom as in an eleventh grade classroom; therefore, technology costs and technical support may be more of a problem in high school than elementary. Because neither *Teacher Issues* nor *Technology Issues* are standardized across grade categories, this might explain an approaching significant interaction between grade categories and *Teacher Issues* and grade categories and *Technology Issues*. Without further research though, this is just a supposition.

Learner Level

Another question on the survey instrument regarded learner levels of students. Respondents were asked which learner levels they thought would benefit from the addition of games and simulations to the curriculum. Again, it is noteworthy that no respondent answered “none” to this question. This implies that all respondents thought that all learner levels would benefit in some way by the addition of games and simulations. *General/intermediate learners* (93.3%) were thought to benefit the most while *Low level* (92.9%) and *Gifted/high level* (85.8%) learners followed closely. Interestingly, when asked about *Mixed learners* (i.e. when two or more groups of learners are combined), 86.6% of respondents thought this category would benefit from the addition of games and simulations.

On a side note, during the interview process, several interviewees responded that *Mixed learners* would benefit because those students who understood could help those students who did not understand. This form of peer learning may have led to the higher response in this category.

Diffusion of Innovations

A portion of the survey dealt with questions that involved the theory of Diffusion of Innovations. Those questions that related to *relative advantage*, *compatibility*, *complexity*, and *trialability* had positive responses. For instance, out of 243 respondents, 100% thought games and simulations could be useful (i.e. *relative advantage*) and 96.6% thought games and simulations were compatible (i.e. *compatibility*) with their teaching practices. Additionally, only 7.5% of 241 respondents thought games would be too difficult to experiment with in a lesson (i.e. *complexity* and *trialability*).

Interestingly, 66.5% of 239 respondents have seen very few or no co-workers using games and simulations in their teaching practices (i.e. *observability*). This makes sense since many teachers rarely get to observe their peers teach because, for the most part, everyone is teaching at the same time in separate classrooms. The theory of Diffusion of Innovations states that it is essential for potential adopters to observe the success of those who have successfully adopted the innovation (Rogers, 2003). Consequently, this lack of observed peers who have successfully adopted games and simulations may contribute to the slow overall adoption of games and simulations in education.

Teacher Inexperience with Games and Simulations

Interestingly, although the MANOVA had a significant (p = .009) interaction between *Respondent Game Play Frequency and Technology Issues*, the follow-up ANOVA had an approaching significant (p = .076) interaction between the factors. On closer inspection of the means for each category of frequency of game play by the respondent, a general trend appeared. It seems that those respondents that played games less frequently ranked technology barriers higher than those respondents that played games more frequently. One study, that cited some the differences between genders in regards to technology, suggests that females have less experience with technology and therefore have more problems with technology (Bourgonjon et al., 2011). On the surface, it makes sense that those individuals who use one specific technology more frequently would be more comfortable with technology in general; however, this result merits further study.

Limitations and Delimitations

Several of the limitations of this study center on the respondents. For example, since the survey was sent via the Internet, it is assumable that the respondents are comfortable with using technology. Additionally, the respondents may not represent a random sample of the whole population of educators since the invitations to the internet survey were sent to two groups of educators: members of a special interest group of ISTE (International Society for Technology in Education) that is a proponent of the use of games and simulations in classrooms and members of two different subgroups of a career pathway organization that is primarily composed of various types of educators from Adult Education (i.e. ESL, ABE/GED, AHS). As a result, most of the ISTE respondents can be considered bias in that they are comfortable with technology, and that these educators approve of the use of technology, games and simulations in particular, in formal education. As for those respondents in Adult Education, they may be biased toward issues within their own educational level. Additionally, another respondent limitation was the assumption that all respondents were proficient enough with the English language to understand the terminology and questions in the survey.

Another limitation is the researcher's bias and its impact on the interpretation of the data collected, especially the interpretation of interviewed individuals and the definition of the seven categories of barriers created by the exploratory factor analysis, during this study. An additional limitation of this study was not discovered until the analysis of the data. A few of the questions were not placed correctly into the Internet survey host to permit their use in the data analyses. For example, the question about which grade categories would benefit from the addition of games and simulations included an option for the respondent to choose more than one grade category. The option for multiple answers made this question ineligible for statistical analysis. This same problem occurred for the question that asked what learner level would benefit from the addition of games and simulations and the question that involved the amount and types of technology used by the respondent. If this data would have been correctly collected, this information could have been included in the statistical analyses, which would have led to a broader approach to identifying the barriers to the adoption of games and simulations in education.

A delimitation of this study is that the survey results may not be generalized to all learning with games and simulations. For example, the results of this study may not be applicable to a company that trains their employees through the use of computer simulations or a branch of military that trains their soldiers with computer simulations. Also, the results of this study may not be completely generalizable to online educational programs, since those barriers (i.e. access to the Internet) may be quite different from brick and mortar schools. Since the respondents were comfortable with technology, those schools that have little technology may have more severe technology problems (i.e. access, comfort with technology) than what is reflected in this study. Finally since the ISTE group respondents were more than likely proponents of the use of games and simulations in education, those results that show teacher bias with games (i.e. game experience/self-confidence with games, games not appropriate for learning), may not accurately reflect educators as a whole.

Recommendations

This section of Chapter 5 is divided into three subsections: recommendations for future research, recommendations for educators, and recommendations for administrators. All sections contain suggestions that may be helpful to those individuals who wish to study games and simulations in education or those individuals who wish use games and simulations in their curriculum.

Interestingly, three categories, *Teacher Issues*, *Issues with Negative Potential Student Outcomes*, and *Technology Issues*, had the largest number of individual barriers (six in each category) and contained significant interactions with gender and/or respondent game playing frequency. Because these categories contain the most individual barriers and significant interactions, these categories may explain a lot of the problems associated with the introduction of games and simulations in education. Given their significant and approaching significant interactions and their large amount of individual barriers, researchers as well as educators may want to pay particular attention to these three identified barrier categories and their individual barriers.

Recommendations for Future Research

The purpose for this study was to design a valid and reliable survey instrument that could help discern the teacher perceived barriers to the adoption of games and simulations in formal education. With a few modifications (i.e. making all questions single response only, see limitations section), I believe the survey instrument to be valid, reliable for the data it obtains, and able to capture the data for which it was intended, the teacher perceived barriers to using games and simulations in formal education. This survey was tested on a sample of educators to ensure that it collected the information corresponded to the intent for which the survey instrument was designed. One of the limitations in this study was the nonrandom groups of educators surveyed. By using a more random sample of educators, future researchers may have more valid results.

In this study, the data from the survey gave insight to the complicated question of what are the barriers to game and simulation adoption in education. A larger, more random population and a corrected survey instrument (i.e. broader scope) may provide new interactions and/or more understanding about those interactions that this study found significant and approaching significant. Future study is imperative to understanding the teacher perceived barriers so that these barriers may be overcome and, subsequently, that games and simulations are successfully introduced into formal education.

Because of the limitation of the technology question, this data could not be used in the statistical analysis; however, I believe it would have been interesting to compare the amount of technology a respondent used to the ranking of barriers. For example, if a respondent used a lot of technology, he or she may have ranked the individual barriers in the *Technology Issues* category lower. It would also have been interesting to look more in depth at the particular technologies used and barrier rankings.

In the Summary of Findings section, I suggested several topics for more research, especially when the results and research differed. For example, the confusing results of males rating barriers higher in *Issues with Negative Potential Student Outcomes*, do not correspond with some of the research suggesting that players who play more are desensitized to some of the negative behavioral outcomes, like aggression (Bourgonjon et al., 2011; Greenberg et al., 2010; Hainey et al., 2011; Hamlen, 2010; Robertson, 2012;). Additionally, females tend to like learning with practical applications more than games, which suggests that they would be more concerned about negative learning outcomes (Wilson, 2006). Due to these contradictory results and research, I suggest further study is necessary concerning gender and student, both behavioral and learning, outcomes.

I proposed another possible study due to the difference in gender ratings of the barriers in *Technology Issues*. Please recall that barriers in this category were rated higher by females than males. This was a confusing result given recent research that suggests females and males use technology in similar amounts but may have different motivations and confidence levels (Annetta et al., 2009; Jensen & De Castell, 2010; Joiner et al., 2011; Padilla-walker et al., 2010; Wilson, 2006). How do these differing motivations and confidence levels result when frequency of use is similar? Is technology male dominated as some research suggests (Abbiss, 2008; Bourgonjon et al., 2011)? Further study is recommended to answer these questions.

Another potential study including gender is the perceived pressures of the teacher (i.e. administrator pressure, state standardization, understanding complicated technology) that deal with barriers in the *Teacher Issues* category. Hamlen (2010) suggested that, although females and males initially have the same ability, female lack of motivation about using technology leads to less overall experience which lowers their confidence. This is interesting when coupled with Lim's (2008) suggestion that a lack of motivation by teachers coupled with a focus on standards, grades, and measured outcomes is a major barrier to designing successful learning environments. Further research into these perceived pressures along with gender and, possibly, technology use, such as games and simulations, is recommended.

Age, ethnicity, and grade-level taught did have approaching significant ($.05 > p > .10$) interactions with four of the barrier categories. All of these demographic interactions, both significant and/or approaching significant, were very interesting and give insight on some of the problems of introducing games and simulations into curriculum. These demographic characteristics are points to consider for future research, especially since there is a definite lack of research on these demographics and games and simulations in education.

Interestingly, two categories, *Technology Issues* and *Issues Specific to Games and Simulations*, had some of the highest rated barrier averages. This suggests that perhaps these two categories may contain the foremost hindrances to the adoption of games and simulations in education. Further, in depth study should look into the individual barriers in this category. Perhaps resolving these obstacles will lead to better chances for successful game and simulation adoption into curriculum. Another point of interest is that two categories, *Student Issues* (two individual barriers) and *Incorporation Issues* (three individual barriers) had no significant interactions. What does that mean? Is it because these are the two smallest categories of barriers? Are the individual barriers in these categories equally perceived as barriers by all educators? Perhaps these barriers are remnants of 20th century classrooms and are diminishing as 21st century classrooms are becoming established. No hypothesis can be given at this time; however, future research may hold the explanation for no significant interactions from these two barrier categories.

Gender of the respondent was a very significant factor when rating individual barriers in three categories: *Issues with Negative Potential Student Outcomes*, *Teacher Issues*, and *Technology Issues*. Interestingly, it was not one particular gender that was ranking these items as more of a barrier. Male educators ranked those items in *Issues with Negative Potential Student Outcomes* as more of a barrier than female educators; whereas, female educators ranked items in *Teacher Issues* and *Technology Issues* as more of a barrier than male educators. By reviewing gender differences in playing games and simulations to investigate these results, I found that many researchers suggest that females either do not play or do not enjoy playing games and simulations as much as males do (Greenberg et al., 2010; Hainey et al., 2011; Hamlen, 2010; Robertson, 2012). Furthermore, research suggests that, although females may play games just as frequently and in a similar amount of time as males, each gender plays different types of games (Annetta et al., 2009; Bourgonjon et al., 2011; Chen et al., 2010; Hainey et al., 2011; Lowrie & Jorgensen, 2011). Given these obvious gender differences in recent research, the question then becomes why gender was not significant when rating the barriers in *Issues Specific to Games and Simulations* (four individual barriers) and *Issues with Games and Simulations in Education* (five individual barriers). Both of these categories have barriers that would seemingly fluctuate in rank depending on a respondent's opinion of games and simulations. For example, the balance between education and entertainment may not be as much of a barrier with those individuals who like games and can see educational value in them. Consequently, it is very interesting that gender made no difference in these two barrier categories and so further research is recommended.

Recommendations for Educators

Teachers should consider adding games and simulations to their curriculum given the positive research on the subject, as previously stated in the Chapter 1. For instance, there is a large amount of research that suggests that games and simulations are a beneficial, engaging, motivational educational tool that promotes deep meaningful learning (Aldrich, 2005; Annetta, 2008; Annetta et al., 2009; Cameron & Dwyer, 2005; Coller & Scott, 2009; Gee, 2003; Halverson, 2005; Hamlen, 2010; Prensky, 2001; Rieber, 1996; Shaffer, 2006; Shaffer et al., 2005; Squire, 2006). Additionally, many groups of students (i.e. gender, physical disability, lower socio-economic, hyperactivity) are being underserved since they cannot perform the lesson to the degree for which it was intended. Many of these neglected groups do better when games and simulations are added to the curriculum (Angelone, 2010; Chen et al., 2010; Squire 2005).

One suggested barrier was that educators are not exposed to good research and practices (Grimley, Green, Nilsen, Thompson, & Tomes, 2011; Kenny & Gunter, 2011; Schrader et al., 2006). Grimley, Green, Nilsen, Thompson, and Tomes (2011) remind educators that it is the perception of the student, not the actual instruction, which determines learning; therefore, it is not the instructional technique but how the student perceives the technique that inspires learning. Additionally, it has been suggested that not only do educators not incorporate enough technology into our classrooms; educators have not yet moved away from the 18th century definition of what it is to be educated (Schrader et al., 2006). If educators had more access to good research and proven teaching practices, games and simulations may be more widely accepted and implemented in formal education.

Additionally, by being aware of the identified barriers in this study, it may be easier for educators to be able to incorporate games and simulations into their own curriculum. For example, by knowing that inexperience with game playing is related to educators regarding technology issues as more of a barrier, an interested educator could increase his or her game playing to potentially reduce these barriers. Consequently, educators should pay attention to the individual barriers in the two highest rated categories, *Technology Issues* and *Issues Specific to Games and Simulations*. Because these two categories had the highest average rankings, being aware of the individual barriers in these categories may help a teacher be able to resolve these problems before they become major obstacles. For example, by knowing that the inability to customize or track student progress in a game or simulation was a problem for other educators, a teacher may better informed about which games or simulations to choose to incorporate into his or her own lessons.

On a more practical note, educators should understand that it is not necessary to be a gaming guru to introduce games and simulations into the classroom. Although a few students may not know much about gaming technology and some students may have more experience than the instructor, there is no cause for concern since these conditions set up an opportunity for a peer learning situation. Adams (2009) points out that grouping older students with younger students to improve their skills is not a new concept, but the benefits are still present regardless if the skill is reading or technology. Those students who know more about games and simulations will be able to help those students, and possibly instructors, who do not know very much about the technology. Nonetheless, given the results of this study, the more the instructor plays games, the less the instructor struggles with technology. Considering this result, my recommendation is for teachers to play games and simulations in class and out of class. This experience, given these results, will help build technology skills, but, in my opinion, will also aid the teacher in helping the students grasp the intended lesson of the game without getting caught up in learning game playing skills (i.e. the unintended lesson of the game). Also, the more students play games and simulations, the more they may improve their technology skills as well. So the addition of games and simulations into curriculum may improve both the teacher's and the students' technology abilities. However, given the gender results of this study, perhaps educators should be sensitive to the unusual relationship that females have with games and simulations. Perhaps educators could be more encouraging and understanding with their female students when assigning lessons with games and simulations.

Additionally, a new trend in education is differentiated learning, and despite the push for it, grading students can pose ethical problems for instructors when a grade represents different sets of skills for different students (Jackson, 2009). Games and simulations may be more adaptable for differentiated learning since these are actually forms of assessment (Gee, 2003). As students devote more time to the game or simulation, they build their skills, thereby passing the assessment by moving on to the next level.

Moreover, it is a common fear of educators that if they do not do what is necessary to adjust to the cognitive structures of digital natives, technology may replace them (Adams, 2009; Annetta et al., 2009). Several researchers have tried to allay these fears by establishing reasons that students will always need a human teacher to be able to interact and learn (Grimley et al., 2011; Jackson, 2009). At any rate, educators should not let this unsubstantiated fear be a barrier to the adoption of a teaching tool with so much potential.

Recommendations for School Administrators

As for school administrators, I recommend that they study the identified teacher-perceived barriers of the adoption of games and simulations into curriculum. Several individual barriers should be corrected at the administrator level.

For example, one of the ranked barriers dealt with technical support. When given the opportunity to write in barriers on the survey, many respondents acknowledge the “arrogant” and non-supportive attitude of their school’s Instructional Technologists. Additionally, the amount of *Technology Issues* with web filters, fire walls, restricted technology access, and lack of updated technology were cited as definite barriers. All of these issues cannot be solved by individual teachers; however, an administrator could address most of these problems.

Another example deals with this study’s finding that the more a teacher played games, the less the teacher thought technology was a challenge. Several researchers have also suggested that teachers who play games are more likely to view them as useful teaching tools (De Aguilera & Mendiz, 2003; Kenny & McDaniel, 2011; Koh et al., 2011; Lee & Hoadley, 2007; Ritzhaupt et al., 2010; Schrader et al., 2006). For these reasons, administrators should encourage their teachers to play games and simulations. They could do this by offering trainings that expose teachers to games and simulations or by setting aside professional development time for research and practice of games and simulations. Administrators could also create their own form of peer learning by pairing experienced game-playing teachers with non-playing teachers or create some other form of professional development activities with players and non-players.

Moreover, recall that the theory of Diffusion of Innovations states that it is essential for potential adopters to observe the success of those who have already adopted the innovation (Rogers, 2003). Since many teachers rarely get to observe their peers teach because usually everyone is teaching at the same time in separate classrooms, this lack of observed peers who have successfully adopted games and simulations may contribute to the slow overall adoption of this type of technology. Administrators, however, could allow peer observation of successful adopters of games and simulations. Additionally, administrators could, as previously stated, create groups of peers who can learn from each other about game and simulation adoption. Both of these recommendations may increase the rate of game and simulation adoption by teachers as they would see the benefits of adding games and simulations first hand.

Conclusions

My research helped to create a valid and reliable survey instrument to discern teacher perceived barriers to the adoption of games and simulations in formal education. This survey instrument, with slight improvements (i.e. changing the multiple response questions cited in the limitations section to single response), can be used on a larger scale with a more random set of educators to definitively ascertain the barriers that teachers identify as preventing them from using games and simulations in their curriculum.

This research has led to the identification of some of these barriers. An exploratory factor analysis led to the discovery of seven barrier categories: *Issues with Negative Potential Student Outcomes*, *Technology Issues*, *Issues Specific to Games and Simulations*, *Teacher Issues*, *Issues with Games and Simulations in Education*, *Incorporation Issues*, and *Student Issues*. These categories accounted for approximately 67% of the variance in the results. By using a MANOVA and then a follow-up ANOVA on significant results, I found that gender had a significant interaction with three barrier categories: *Issues with Negative Potential Student Outcomes*, *Technology Issues*, and *Teacher Issues*. Upon reviewing the means, it appears that males are more concerned with individual barriers, like negative student behavioral outcomes and negative student learning outcomes, in the *Issues with Negative Potential Student Outcomes* category. Female educators ranked individual barriers in the *Technology Issues* category (i.e. technical support, technology reliability, accessibility outside of school) as more of a barrier to the adoption of games and simulations in their curriculum than male educators. And finally, female educators thought that individual barriers in the *Teacher Issues* category (i.e. time to plan and implement, matching to standards or standardized testing) were more of a barrier than male educators. Another significant interaction was *Respondent Game Play Frequency and Technology Issues*. After reviewing the means, it appears that those individuals who are inexperienced with playing games and simulations ranked the individual barriers in the *Technology Issues* (i.e. technical support, technology reliability, accessibility outside of school) category as more of a barrier.

As for my own current professional practices, this research has given me a great insight as to why I have trouble persuading my peer teachers to use games and simulations in their curriculum. Now that I have a better understanding of the perceived barriers, I can better support my peers and ask my administrators for specific help. For instance, I can ask my administrators for professional enhancement with games and simulations and I can ask that my peer teachers be able to observe my class as the students successfully use games and simulations in a lesson. I can also understand that if my peer teacher is female, she may need more support and encouragement with technology and teacher issues. Or, if my peer teacher is male, he may need to completely understand the potential outcomes, both behavioral and learning, to the student.

For my potential future professional practice, I found this research a wealth of information. All of these barrier categories will help me to present the individual barriers to my future students who are studying to become teachers. By breaking these barriers into categories and recognizing the impact demographic information and game inexperience can have on the adoption of this technology, I hope to eliminate the potential barriers that these future teachers would face when they want to introduce games and simulations into their own curriculum. This subject is quite complex so these categories and interactions coupled with some pertinent research will help these students to understand how and why to introduce games and simulations into their curriculum.

APPENDIX A
INTERVIEW QUESTIONS

1) What is your gender?
    - Male/Female

2) What is your age?
    - 0-25, 26-35, 36-45, 46-55, 56-65, >65

3) What is your ethnicity?
    - Asian, Black/African American, Hawaiian/Pacific Islander, Hispanic/Latino, White/Caucasian, Other

4) Highest Degree Earned
    - Associates, Bachelors, Masters, Specialist, Doctorate/PhD

5) What grade(s) do you currently teach?
    - Kindergarten, first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, eleventh, twelfth, post-secondary, adult education, other

6) Are your current students considered low-level learners, general learners, or gifted learners?
    - Low-level
    - General
    - Gifted
    - Mixed levels – all two or more in the same classroom

7) What subjects do you currently teach?
    - Elementary, Language Arts, Social Studies, Science, Math, Computers, Second Languages, Music, fine Arts, Health/Physical Education, Other

8) On average, how many students do you have in a class?
    - <10, 10-15, 16-20, 21-25, 26-30, 31-35, 36-40, >40

9) Do you currently use technology in your classes?

    - If so, can you explain a little of how you use this technology?

10) Do you play games for entertainment?

    - If so, roughly how many hours per week do you play games?
        - 0-1, 1-3, 3-5, 5-10, 10-25, 25-40, >40

    - What kind of games (i.e. computer, video, board, cards, etc)?

(Appendix A – continued)

11) Do you play games or simulations for any reason other than entertainment?

- If so, can you share why?

12) Have you played a gaming system (i.e. Xbox®, Wii®, PlayStation®)?

- Do you or someone in your household own one?
- If yes, how frequently do you play?

13) Have you ever played computer games (i.e. software and/or internet)?

- If so, how frequently?

14) How do you think games could be useful for educational purposes?

15) Do you think games and simulations could be beneficial to your curriculum?

- If so, do you think the benefits outweigh the costs? Can you explain your thoughts?

16) Do you think it would be easy to try-out a game or simulation in one of your lessons?

- Can you please explain?

17) Have you seen a co-worker or co-workers successfully using games and simulations in their classes?

- How frequently?

18) Do you think your administrators would support your use of a game and/or simulation?

- Why or why not?

19) Do you think the school culture (i.e. class sizes, class periods, peer opinions) would support the addition of games and simulations in your classroom?

- Why or why not?

(Appendix A – continued)

20) What are your foremost concerns about adding a game or simulation into your curriculum?

- Are you concerned because games and simulations are not appropriate for school (i.e. strictly entertainment)?
    - Can you please explain?
- Are you concerned because games and simulations are not appropriate for students (i.e. may be bad (i.e. behavior, health) or addictive for students)?
    - Can you please explain?
- Are you concerned about using games and simulations because you are not familiar with them (i.e. you'd want training)?
    - Can you please explain?
- Are you concerned because your school will not have the resources to purchase this type of equipment?
    - Can you please explain?
- Are you concerned about using games and simulations because you don't know how to incorporate it into your lessons (i.e. you want lesson plans or examples)?
    - Can you please explain?

21) Which grade categories (i.e. elementary, pre-secondary, secondary, post-secondary) do you think would benefit the most from the addition of games and simulations in the curriculum?

- Can you please tell me more about why you think this?

22) Which learner levels (i.e. low-level learners, general learners, gifted learners) do you think would benefit the most from the addition of games and simulations in the curriculum?

- Can you please explain?
- What about classes with mixed learner levels (two or more)?

(Appendix A – continued)

23) In your opinion, how would the following feel about having games and simulations added into the curriculum?
    - Students
    - Parents
    - Teachers
    - Administrators
    - The majority of the community around your school

24) Think of someone who does NOT want games and simulations added into the curriculum. Why do you think this person thinks this way?

25) Do you have any final comments or questions?

APPENDIX B
SAMPLE INTERVIEW

Interviewee: AKW2

Date: 03/02/2012

Gender: **Female** Male

Age:
0-25 26-35 36-45 46-55 **56-65** >65

Ethnicity:
Asian | Black/African-American | Hawaiian/Pacific Islander | Hispanic/Latino | **White/Caucasian** | Other:

Highest Degree Earned:
Bachelors **Masters** Specialist Doctorate

What grade(s) do you currently teach?
Kindergarten 1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th
Post-secondary Adult Education Other:

Are your current students considered low-level learners, general learners, or gifted learners?
low-level general gifted **mixed** – two or more in the same classroom

What subject(s) do you currently teach?
Elementary **Language Arts** Social Studies Science
Math Computers Second Languages Music
Fine Arts Health/Physical Education Other:

On average, how many students do you have in a class?
<10 10-15 16-20 21-25 **26-30** 31-35 36-40 >40

Do you currently use technology in your classes? **yes** no

If so, can you explain a little of how you use this technology?

My students have a website that is associated with their textbook that they have to watch speeches on and answer questions. They are also assigned to watch certain TED videos and answer questions about them. They also take some online quizzes associated with the textbook website. And in addition I have my Angel® website (LMS) and on Angel® I also have some links to websites so they don't have to find TED, it links to it and takes them to the 10 best graduation speeches in history or something like those. They also have the link to great American speeches and they watch some speeches in there plus I sometimes I show them in class. I don't assess or evaluate online – I wish I did, but I don't.

(Appendix B – continued)

Do you play games for entertainment? yes no

If so, roughly how many hours per week do you play games?

0-1 1-3 3-5 5-10 10-25 25-40 >40

What kind of games (i.e. computer, video, board, cards, etc)?

Mostly board games and card games.

Do you play games for any reason other than entertainment? yes no

If so, can you share why?

Have you played a gaming system (i.e. Xbox®, Wii®, PlayStation®)? yes no

Do you or someone in your household own one? yes no

If yes, how frequently do you play?

Do you play computer games (i.e. software and/or internet)? yes no

If yes, how frequently do you play?

A couple times a month

How do you think games could be useful for educational purposes?

I use them some. I have my students play Jeopardy. I use it primarily as review before tests. I also have what I call "Quiz Bowl" and I break them into groups and their teams. I give them true or false – I call them "thumbs up" and "thumbs down." They also have fill-ins and they have to help study for the test. The first team that answers all the questions correctly gets points towards their test. So I use it primarily as a review and to prepare for tests. I've found that if I just start reading over stuff to prepare for the test, I found that I'm just wasting my time. When we play this, all my athletes and everybody who really doesn't like to study, they all have a good day when we do this.

Do think games and simulations could be beneficial to your curriculum? yes no

If so, do you think the benefits outweigh the costs? Can you explain your thoughts?

I think they would because I have a lot of students who are poor attention students, especially some of my lower…I have a couple of kids who are basketball players who came up to me the semester after this was over and said "I want to come back to your class the day before the test when you play those games." And I thought that was all that they remembered. But, clearly they were engaged and they were not easy to engage. And I think it helps engage them.

Do think it would be easy to try-out a game or simulation in one of your lessons? yes no

Can you please explain?

I think I could incorporate it fairly easily as long as it matched my content. And it could somehow help explain or help review, I think it helps them remember better. I've always said that the true art of retention is attention, and if you never got their attention than retention is out of the question.

(Appendix B – continued)

Have you seen a co-worker or co-workers successfully using games and simulations in their classes? **yes** no

How frequently?

Some of them showed me the Jeopardy game – two or three.

Do you think your administrators would support your use of a game and/or simulation? **yes** no

Why or why not?

Because whenever I tried to ask to do something, even if it's a little off-the-grid, so to speak, if I think it can have tangible benefits then they've been really supportive of that.

Do you think the school culture (i.e. class size, class periods, peer opinions) would support the addition of games and simulations? yes no

Why or why not?

I think the size of my class doesn't help it particularly because, when you have 30, you have a lot of people playing at one time. A smaller size would be better. I find I'm not doing it as much because I'm finding it longer to get through the class and since it is a performance class and they all have to give speeches, I am finding that I have less time and this is one of the things I do less because of it.

Since I just read that the average attention span of a 16 year old is 8 seconds, then the night class, which is 2.5 hours long is probably a little much. The hour and 15 minute classes would probably be better. So the night classes may be harder for attention, but may lend themselves to be better for gaming, just for a break, to get them back engaged again.

What are your foremost concerns about adding a game or simulation into your curriculum?

Obviously creating the technology online, because I'm not terrible tech-savvy. And the couple of times that I tried to mess with templates – you know if I could have somebody help me create them, the first time especially, I mean if you show me once I can get it. But just to give me instructions, some support in creating the initial template would be all I would need to administer the game.

Are you concerned because, in your opinion, games and simulations are not appropriate for school (i.e. strictly entertainment)?

Can you please explain?

No. They are not just for entertainment.

Are you concerned because, in your opinion, games and simulations are not appropriate for students (i.e. may be bad (i.e. behavior, health) or addictive for students)?

Can you please elaborate?

No, I'm absolutely convinced. I have tons of boys who are all violent game players, including my own, and they turn out to be nice adults. I don't see that link. I know there are some kids, but I think they have some other issues than just playing Mortal Kombat when they were 7 or something.

(Appendix B – continued)

Are you concerned about using games and simulations because you are not familiar with them (i.e. you'd want training)?

Can you please explain?

Yes I would need more training because I know there are a lot more games online that I don't know about.

Are you concerned because your school will not have the resources to purchase this type of equipment?

Why or why not?

I usually get most things I want when it comes to resources as long as they deem it usable. And a lot of them are available online so I don't think they would be too, too costly.

Are you concerned about using games and simulations because you don't know how to incorporate it into your lessons (i.e. you want lesson plans or examples)?

Can you please elaborate?

I think I could figure it out, how to do that, as long as I was shown some of the different games you could play. I think I could figure where to put them in my lessons.

Which grade categories (i.e. elementary, pre-secondary, secondary, post-secondary) do you think would benefit the most from the addition of games and simulations in the curriculum?

Can you please tell me more about why you think this?

Maybe secondary. It's probably the hardest to do because they are so crazy, but it would engage them more because they are so dis-engaged. When I go to observe they are like a bunch of zombies.

Which learner levels (i.e. low-level learners, general learners, gifted learners) do you think would benefit the most from the addition of games and simulations in the curriculum?

Can you please explain?

More low and general. I think the gifted ones would figure it out and create their own ones. But they tend to find ways to engage themselves. Both the low and the general could use games. I think it would gain attention, keep them involved, they like to win.

And what do you think about classes with mixed learner levels (two or more)?

When I have, some kids like it more than others, but I haven't had anyone say this didn't help them to prepare. And of course the next day, when I tell them you have 5 points extra credit, then they really liked it. So, I think if you make it rewarding for all of them then I think that's not an issue.

(Appendix B – continued)

In your opinion, how would the following feel about having games and simulations added into the curriculum?

Students:

I think they'd like it.

Parents:

I think it would be varying . I think some would think we are trying to dummy things down and have them play games and they're not going to learn. But I think that's because they don't really understand the way this works. Some of the see games as not really involving education.

Teachers:

I think most teachers – I mean I'm pretty old teacher and I think – I've seen how unengaged students have become. So, I think they would be ok with it.

Administrators:

I think that would be mixed also. If they see it as kind of a means to an end they could kind of be ok with it. I suspect some are going to think, you know old conservative institutions might think that that doesn't have a place.

The majority of the community around your school:

I think they would be mixed as well. I think their education level and their knowledge of what's going on in schools would be a factor. If they knew a lot of what was going on, saw how unengaged kids are, I don't think they would think that anything wouldn't be worth a try.

Think of someone who does NOT want games and simulations added into the curriculum. Why do you think this person thinks this way?

One person I chatted with about it. He said it was just one more gimmick to try to get kids to learn and kids have to want to learn or not and that this is just a gimmick. And that it's going to make it "fun" but they are still not going to learn anything. They don't see it as a means to learning or having an end goal of learning.

I think some people would think it would take away from other things, but I think again that that's not valid because you could be teaching those other things through the game and they don't understand, they think that if you are playing games then you're not learning who the presidents are or where the countries are or whatever. Instead of think that through this game they could learn where all these countries are because they are going to have to mark it on something here. So I think they object because they see it as a substitute for "real" learning. They ask "When do you have time for that?" And they are acting like by doing that you are not doing something else and it doesn't have to be that way. I could take a class hour where I review and I'm just you know "study this, study this, study this" and nobody is listening because I'm giving it to them on a sheet of paper so why is anybody going to listen when it's right there. But when I had them play the games and going over the questions and it also forces them to study a little sooner because I do it the Wednesday before the next Monday so that way they also have some ideas of what they do know and what they don't know and what areas they need to study more. So I don't think it necessarily one or the other, which is what I think some of the people who object to it think.

Final comment – I know how busy you are, but I would like to know of some places I could go on the web to find some interesting games or templates or whatever.

APPENDIX C
INTERVIEW DATA

Appendix C-1. Demographics, grade category, and learner level of interviewees

Interviewee	Sex (F/M)	Age	Ethni-city[1]	Highest Degree	Grade Level[2]	Learner Level[3]	Class Size	Suggested Grades	Suggested Learners	Mixed Classes
AKW2	F	56-65	W	M.S.	Post	M	26-30	High	L & G	0
BJ5	F	56-65	W	Ed.S.	Adult	M	21-25	Middle	All	1, peer
BS13	F	56-65	W	M.S.	Post	M	>40	All	All	1, diff.
CORL8	F	56-65	W	B.S.	High	M, F	26-30	Middle, High	All	0, peer
DAO14	F	56-65	W	M.S.	Middle	M	26-30	Elem	All	0, peer
DDKD24	M	46-55	W	M.S.	High	M	21-25	All	L	0, diff.
JFL7	F	56-65	W	Ed.S.	Adult	M	10-15	All	All	0
JHKH7	F	56-65	W	A.S.	High	M	26-30	All	All	0, peer
JM11	F	46-55	W	M.S.	Adult	G	10-15	High, Post	All	0
JS4	F	26-35	B	B.S.	Post	M	36-40	Elem	All	0, diff.
KJ10	F	56-65	W	B.S.	Adult	M	16-20	All	All	0, peer
KK84	F	56-65	H	B.S.	Elem	M	16-20	Elem, High	L	0, peer
LL7	F	56-65	W	B.S.	Middle	M	21-25	Elem, Middle	All	0
MA7	F	36-45	W	M.S.	Post	M	16-20	Elem, Post	L, G	0, peer
MAM9	M	46-55	W	M.S.	Post	G	16-20	All	All	1, peer
MJ3	F	36-45	H	Ed.D.	Post	M	16-20	Middle	L	0, peer
MT69	F	46-55	W	M.S.	Post	M	16-20	All	L	0, diff.
RCS16	F	26-35	W	B.S.	Middle	M	21-25	Elem, Middle	G	1
SHC2	F	26-35	W	B.S.	Adult	G	10-15	All	All, L	0, diff.
SPW5	M	26-35	W	M.S.	Adult	G	10-15	Elem, High	L	0, diff.

Appendix C-2. Interviewee responses to Diffusion of Innovation questions

Interviewee	Perceived Value	Compatibility	Complexity	Trialability	Observability
AKW2	R,E,M	1	*	*	1
BJ5	E,LS,I,M	3, PB	3	3	0
BS13	N, R, M	2	2	2	2
CORL8	M, E, LS	1	1	1	1
DAO14	E, M, LS, V, RL	0	1	1	5
DDKD24	E, M, RC, LS	0	0	0	5
JFL7	E, M, LS, RL	1	1	1	2
JHKH7	R, E, M, LS	0	2	2	1
JM11	E, M	0	1	0	1
JS4	LS, E, M	2	2	2	1
KJ10	C, M, E, LS	0	1	0	2
KK84	E, M, SC	0	0	0	5
LL7	R, E, M, LS	3	3	3	1
MA7	PS, R, RL, E, M, LS, SC, PT	0	0	0	5
MAM9	PS, CT, M, E	3	3	3	0
MJ3	E, M	0	1	1	0
MT69	E, M, CT, PS, FC, LS	0	1	1	2
RCS16	R, E, M	1	1	1	5
SHC2	E, M, R	3	3	3	1
SPW5	E, M, R, RL, LS, C	2	2	2	2

Appendix C-3. Interviewee responses to potential school-based barriers

Interviewee	Time to plan	Class Size	Class Period	Student Skills	Shift in Pedag.	Admin. Support	Peer Support	Parent Support	Comm. Support	Teacher's Confid-ence	Teacher's Experi-ence	Too much work for teacher	Class Manage
AKW2	3	2	2	*	*	2	0	2	2	2	2	*	*
BJ5	*	*	3	2	PB	2	0	1	0	0	0	*	*
BS13	2	3	*	*	*	0	0	1	0	1	1	*	*
CORL8	3	1	*	*	PB	0	2	1	2	3	3	*	*
DAO14	2	1	*	*	PB	3, PB	0	1	1	1	1	*	*
DDKD24	3	0	*	*	PB	1	1	2	0	0	0	*	*
JFL7	*	0	*	*	PB	3	2	2	3	0	0	*	*
JHKH7	3	2	1	*	PB	0	0	1	1	3	3	PB	*
JM11	3	1	*	*	PB	0	0	1	2	1	1	*	*
JS4	PB	0	0	*	PB	0	1	0	0	PB	PB	*	*
KJ10	1	0	0	*	PB	1	1	2	1	1, PB	1, PB	*	*
KK84	*	0	*	*	0	1	1	1	1	*	*	*	3, PB
LL7	*	*	*	*	PB	1	1	0	0	*	*	*	*
MA7	1	0	0	*	PB	1	0	1	2	0	0	*	*
MAM9	PB	1	0	*	0	1	1	2	2	*	*	*	*
MJ3	*	0	0	*	PB	1	1	1	3	PB	PB	*	PB
MT69	3	0	0	*	PB	0	2	1	1	0, PB	0, PB	*	PB
RCS16	1	*	*	*	*	3	1	0	2	*	*	*	2
SHC2	3	3	3	*	PB	3	3	2	2	*	*	*	*
SPW5	*	1	1	*	PB	1	2	1	2	PB	PB	*	PB

Appendix C-4. Interviewee responses to potential technology-based barriers

Interviewee	Tech Training	Quality/Cost of Equipment	Tech support (teachers/ student)	Tech Resistant
AKW2	2	1	*	*
BJ5	0	3	3	*
BS13	1	2	*	*
CORL8	2, PB	3	*	*
DAO14	0	2	*	PB
DDKD24	1	3, PB	3, PB	PB
JFL7	2	0	2	3, PB
JHKH7	3	3	*	*
JM11	2	2	2	PB
JS4	2	3	*	*
KJ10	1	1	*	*
KK84	0	0	*	*
LL7	2	0	*	*
MA7	1	1	*	*
MAM9	0	1	*	*
MJ3	1, PB	1	*	PB
MT69	1, PB	0	*	PB
RCS16	1	3	*	*
SHC2	3	3	*	PB
SPW5	0	1	*	PB

Appendix C-5. Interviewee responses to potential game-specific barriers

Interviewee	Games only Entertain	Violence/ Addiction	Time incompat-ibility	Balance of Enter. & Ed.	Tracking Ability	Available Lesson Plans	Standards & Testing	Gimmick/ Frivolous	Time away from lesson	Term "game"	Disabled Students
AKW2	0	0	*	PB	*	0	1, PB	PB	PB	*	*
BJ5	0	0	3	*	*	0	3	*	*	PB	*
BS13	0	0, PB	*	2	*	0	3	*	*	*	2
CORL8	0	0	*	*	*	0, PB	*	PB	*	*	*
DAO14	1, PB	0	*	PB	*	0	3, PB	*	*	*	*
DDKD24	0, PB	0	*	*	*	1	*	*	*	*	*
JFL7	0	0	*	*	3	0	3	*	*	*	*
JHKH7	0	0	*	*	*	2	*	*	*	*	*
JM11	0	0	*	*	*	2	*	*	*	PB	*
JS4	0	0	3	2	*	3	*	*	3	3	3
KJ10	0	0	*	1	*	1	*	PB	*	*	*
KK84	0	0	*	*	*	0	*	*	PB	*	1
LL7	0	0	*	*	*	3	*	PB	3, PB	*	*
MA7	0	0, PB	*	*	*	0	*	PB	2, PB	*	*
MAM9	0	3	*	*	*	0	PB	2, PB	2, PB	*	*
MJ3	0	0	*	*	*	0	*	PB	PB	*	*
MT69	0	0	*	*	*	0	*	*	*	*	*
RCS16	0	1	*	2	*	1	3	PB	3, PB	*	*
SHC2	0	1	*	3	*	3	3, PB	PB	3	*	*
SPW5	0	0	*	*	*	2	2	*	3	*	*

APPENDIX D
SURVEY INSTRUMENT

Informed Consent

Protocol Title: Identifying the Barriers to Using Games and Simulations in Education: Creating a Valid and Reliable Survey Instrument

Please read this consent document carefully before you decide to participate in this study.

Purpose of the research study:
The purpose of this study is to create a valid and reliable survey, using information from research and education practitioners (i.e. instructors, teachers, professors), to determine why games and simulations are not more commonly used in formal education.

What you will be asked to do in the study:
You will be asked to complete an electronic survey. At the conclusion of the survey, your information will be submitted electronically. No personal data will be shared with anyone and will be removed from the data before it is analyzed (see the confidentiality section for more information).

Time required:
A maximum of 30 minutes

Risks and Benefits:
There is minimal risk since this survey is a standard electronic survey. You may not personally benefit from this survey. However, educators who wish to incorporate games and simulations in their curricula may find the results of this research beneficial to their cause.

Compensation:
There will be no compensation for participating in this research.

Confidentiality:
Your identity will be kept confidential to the extent provided by law. Your information will be assigned a code number. To ensure your confidentiality, your name will not be tied to this information. Additionally, your name will not be used in any report or publication.

Voluntary participation:
Your participation in this study is completely voluntary. There is no penalty for not participating.

Right to withdraw from the study:
You have the right to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study:

Jeannie Justice, University of Florida Graduate Student, PO Box 7863, Port St. Lucie, FL 34985, 772-341-1394.

Albert Ritzhaupt, University of Florida Research Advisor, PhD, College of Education, 2423 Norman Hall, PO Box 117048, Gainesville, Fl 32611, 352-273-4180.

Whom to contact about your rights as a research participant in the study:

IRB02 Office, Box 112250, University of Florida, Gainesville, FL 32611-2250; phone 392-0433.

1) By participating in this survey, you show your consent as a participant in the study described above. In other words, you are demonstrating that you have read the procedure described above and are voluntarily agreeing to participate in the procedure. (Please note - if you wish, you may print this page to keep a copy of this document for your records.)

If you choose NOT to participate, please exit this survey by clicking on the "Exit this survey" button at the top right corner of this page or by closing this website.

If you choose to participate, please check the “Participate” option below and then click next to begin the survey.

2) Gender
- Female
- Male

3) Age
- 0-20
- 21-30
- 31-40
- 41-50
- 51-60
- 61-65
- Older than 65

4) Ethnicity (please check all that apply)
- Asian
- Black/African American
- Hawaiian/Pacific Islander
- Hispanic/Latino/Caribbean Islander
- White/Caucasian
- Native American
- Other

5) Highest Degree Earned
- Associates
- Bachelors
- Masters
- Specialist
- Doctorate
- Other (please specify)

6) What grade category do you currently teach?
- Elementary
- Middle School
- High School
- Post-secondary (i.e. college, university, technical)
- Adult Education (i.e. ABE/GED, ESL/ESOL, Adult High School)
- Other (please specify)

7) How do you use technology in your curriculum? Please check all that apply.
- Electronic presentations (i.e. PowerPoint®, Prezi®, SlideRocket®, and so on)
- Digital Programs included with textbooks
- District programs (i.e. Discovery Education®, Standardized Test Prep programs, and so on)
- Learning/Course Management Systems (i.e. BlackBoard®, Angel®, WebCT® and so on)
- Mobile Digital Devices
- Internet Searches/Research
- Internet/Specific Websites
- Electronic meeting place (i.e. Elluminate®, Wimba®, and so on)
- Gaming Platforms (i.e. Wii®, Xbox®, PlayStation®, and so on)
- Computer games/simulations (i.e. software, internet, mobile application)
- Teacher-created digital media for lesson
- Students create digital media
- Other (please explain)

8) How often do you play games (board, card, Internet, software, gaming platform, mobile application, etc.)? Please check the box next to the number of hours per week you play games.
- 0 hours per week
- 0-2 hours per week
- 2-5 hours per week
- 5-10 hours per week
- 10-25 hours per week
- More than 25 hours per week

9) How do you think games or simulations could be useful for educational purposes? Please check all that apply.

Games are NOT useful for education
Review of material
Motivating & engaging students
Applying learning styles & varied learning
Immediate feedback & self-correction
Building hand-eye coordination
Problem solving and critical thinking
Differentiated (personalized) learning
Peer learning opportunities
Pre-test for current skills to assign lessons
Post-test for learned skills
Foster good-natured competition among students
Approximate real-life situations
As a reward for students
Other (please explain)

10) In general, how compatible (complimentary/well-suited) are educational games and simulations with your own teaching practices?
Not at all compatible
Somewhat compatible
Mostly compatible

11) In general, are educational games or simulations too complex (challenging/time consuming) for your students to learn the intended lesson?
Too complex
Somewhat complex
Not at all complex

12) In general, how easy do you think it would be to experiment with an educational game or simulation for one of your lessons?
Not at all easy
Somewhat easy
Mostly easy

13) How many co-workers have you seen using games or simulations in their classroom, teaching practices, curriculum, or lesson plans?
Many
Some
Very Few
None

14) Which grade category(s) do you think would benefit from the addition of educational games and simulations? Please check all that apply.
None
Elementary
Middle School

High School
Post-secondary (i.e. college, university, technical)
Adult Education (i.e. ABE/GED, ESL/ESOL, Adult High School)
Other (please explain)

15) What learner level(s) do you think would benefit from the addition of educational games and simulations? Please check all that apply.
None
Low-level learners
General (intermediate) learners
Gifted (high-level) learners
Mixed learners (two or more groups combined in one class)
Other (please explain)

16) Please rate each potential barrier according to your opinion of how much the item may be an obstacle to your use of educational games and simulations in your classroom, teaching practices, lesson plans, or curriculum.

In other words, how much does each of these potential barriers prevent you from using games and simulations?

Scale: 0 (not a barrier), 1, 2 (Somewhat a barrier), 3, 4 (Definitely a barrier)

1) Lack of time (i.e. find a game or simulation, learn the game or simulation, incorporate a game or simulation into the lesson)

2) Lack of games and simulations for disabled students (i.e. access, equipment, game/simulation options)

3) Lack of games and simulations with a good balance between education and entertainment (i.e. game/simulation is entertaining but with little learning, or it has enough learning but has little entertainment)

4) Complexity (too difficult) of games and simulations for my students

5) Simplicity (too easy) of games and simulations for my students

6) Lack of customizability or adaptability in a game or simulation (i.e. inability to modify game/simulation subjects, goals, or objectives)

7) Lack of the ability to track and/or assess student progress within a game/simulation

8) Lack of knowledge about how to use games and simulations appropriately

9) The opinion that games and simulations cause problems with classroom management and/or in-class student behavior

10) The perception that games may cause student behavioral problems (i.e. violence or aggression)

11) The perception that games may cause student obsession or addiction

12) The concern that students will not learn the intended lesson using the game/simulation

13) The opinion that students learn more from a teacher than from a game or simulation

14) The opinion that other learning strategies are more effective than using games or simulations

15) Lack of games/simulations that are aligned to state standards or standardized testing

16) Lack of examples and available lesson plans using games and simulations

17) The perception of the term “game” (rather than the term “educational simulation,” for example)

18) Lack of evidence to support the use of games and simulations in education

19) Lack of parental and/or community support for the use of games and simulations in classrooms/lessons

20) Lack of your own motivation to use games and simulations in lessons

21) Lack of student motivation to use games and simulations in lessons (i.e. students do not seem interested in games/simulations)

22) Varying student abilities (i.e. technology skills, learning ability)

23) Lack of clear expectations, by administrators, for teacher usage

24) Cost/expense of games/simulations/equipment

25) Inability to try a game or simulation before purchase

26) Lack of access to games and simulations outside of school

27) Lack of technical support (for teachers and/or students)

28) Lack of technology reliability

29) Lack of my own technology abilities

30) Lack of administrative support

31) Length of class period

32) Class size

17) Are there any barriers missing from the list on the previous page?

In other words, is there something not previously listed that is preventing you from using educational games and simulations in your lessons, curriculum, teaching practices, or classroom?

18) Do you have any general comments or concerns about this survey and/or study?

APPENDIX E
PATTERN MATRIX

Pattern Matrix[a]

	Component						
	1	2	3	4	5	6	7
Barrier1	-.199	-.009	.326	.383	.072	.110	.185
Barrier2	.320	.415	.274	-.146	-.405	.162	.083
Barrier3	.102	.076	.693	.107	-.070	-.057	-.147
Barrier4	-.017	-.092	.308	.106	-.150	.581	.271
Barrier5	.165	-.094	.846	-.170	-.062	-.100	-.026
Barrier6	-.052	-.019	.857	-.031	-.028	-.035	.097
Barrier7	-.170	.038	.617	.085	.124	-.036	.079
Barrier8	.145	-.056	.068	.778	-.059	.013	-.005
Barrier9	.832	-.096	-.039	.075	.064	.033	.058
Barrier10	.916	.020	-.059	-.005	-.065	.039	.047
Barrier11	.859	.012	.022	-.073	-.062	.143	-.008
Barrier12	.651	-.034	.155	.096	.157	.003	-.018
Barrier13	.810	.017	-.012	.010	.227	-.239	.049
Barrier14	.756	-.012	.026	.107	.185	-.108	-.009
Barrier15	-.009	.210	.225	.459	.027	.104	-.128
Barrier16	-.049	.067	.282	.615	.109	.113	-.162
Barrier17	.362	-.006	.042	.185	.507	.011	-.133
Barrier18	.160	-.068	.050	.136	.662	.059	-.046
Barrier19	.268	-.007	-.013	-.035	.670	.099	.030
Barrier20	.026	-.034	-.242	.647	.072	-.133	.541
Barrier21	.079	-.005	-.038	.116	.050	-.029	.842
Barrier22	-.006	-.072	.216	-.026	.168	.144	.673
Barrier23	.028	.131	.026	-.114	.710	.058	.201
Barrier24	-.048	.747	.150	-.115	.204	-.236	.021
Barrier25	-.149	.589	.239	.000	.246	-.202	.131
Barrier26	.023	.750	-.104	.122	-.068	.124	.004
Barrier27	-.055	.754	-.128	.295	-.001	.051	-.132
Barrier28	.046	.614	-.105	.045	.124	.149	-.080
Barrier29	.076	.206	-.258	.724	-.321	-.084	.229
Barrier30	.054	.281	-.159	-.359	.722	.175	.094
Barrier31	-.035	-.037	-.161	-.004	.257	.892	-.015
Barrier32	-.026	.032	-.114	-.025	.121	.898	-.043

Extraction Method: Principal Component Analysis. Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

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BIOGRAPHICAL SKETCH

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