T & R Project Revision Summary Sheet

Stephanie Green

Focus and Rationale

In the focus and rationale section for my project, I logically tried to connect the need for using computer-based programs in the classroom in order to promote student achievement. I did this by making a case for the use of computer games and focused on the call to implement them in traditional classrooms as a support method of instruction. I also focused my investigation on two mathematical games that I evaluated and choose based on a rubric that I found by John Rice to implement higher-learning educational games within the classroom. I also state how I will implement the games as a support to the regular curriculum mandated by state standards and will research improved test scores based on that implementation. Then I revised what I meant by student achievement by defining what exactly I mean by having students achieve, more specifically that students will (or will not) receive higher test scores after playing computer-based educational games.

Literary Review and Annotations

For this section of my project, I looked at the APA guidelines of how to cite specific entries within the paper and corrected those areas that I had not cited correctly. In order to address the question of "how come proponents always argue that video games teach kids only the good stuff (higher order reasoning, literacy skill, etc.), but not the bad stuff (violence, anti-social behavior, misogyny, etc), I expanded my research and included my idea of the answer as proposed by Kurt Squire (2003) in the Perspectives section. To elicit specific ways to implement video games into the classrooms, I followed a step-by-step process recommended by Marc Prensky (2001) in his Digital Natives Digital Immigrants article, to describe ways mathematical games might be used to teach specific content. I also included results of empirical studies in other sections of the paper (introduction, pedagogy, assessment). In order to account for how researchers assessed the use of video games in math class and its impact on students' learning math I described and included a study from California about the effects of using ST Math, a series of mathematical games, and how it affected standardized math scores and student achievement.

Research Design

Upon revising the design in my project, I decided not to include regular unit testing as an assessment tool because the goal of my research was to study student achievement on standardized tests. It is widely known that the language of the questions and the thinking skills need to pass standardized test is very different from classroom tests since many teachers write and use their own tests based on the ability level of their students. In order to promote an even playing field for my study, I decided to use just

the MEAP test to determine student achievement. While I know there are several different ways to assess student achievement other than standardized tests, I chose this as the focus of my study. Within my design, I described how I will observe my students through monitoring and circulating in the lab in order to assess engagement and motivational levels. I also described the participants in the study and how I would group them. I believe my plan is detailed enough so that someone could easily replicate my design for further studies. In looking at these revisions, I believe I have conducted my research appropriately and have communicated my intent so that other researchers may learn from my study.

Envisioning the Future in Education: An Investigation in Mathematical Educational Games and Student Achievement on Standardized Tests

Stephanie Green

Focus and Rationale

We live in an ever-changing technological world where computers and the Internet are becoming front runners in educational policy. Since computers first entered the classroom, an ongoing debate of whether or not technology belongs in the educational process has ensued. Some educators believe that it is imperative to engage students in technological skills, while others contend that technology is best left out of the classroom. When I look at the future of education, I see a vibrant, technology rich environment, with students well-prepared for whatever lies ahead of them. It is my belief that technology plays a vital role in educating 21st Century students who are equipped with the skills necessary to compete in an increasingly technical world. Encompassing these beliefs is the use of computer-based educational games within the classroom.

To objectively meet my students' needs, it is important to give attention to both sides of the technology issue in education. The question I intend to seek is "Does playing computer-based mathematical games increase students scores on standardized tests?" Students in today's society are growing up with technology all around them. They are multi-taskers and have grown up in the digital age that allows them to socialize, play and learn through the Internet and computer-based software. Technology is ever present in the student's life. Understanding this permits teachers to use technology as a vehicle for student instruction. In order to implement this technology into the classroom, I choose two educational mathematical games, **Zoombini's Logical Journey** and **Cyberchase Carnival Chaos**, to guide my students in preparing for high stakes tests.

When students enter a classroom, they are traditionally expected to listen to the teacher lecture, and in many classrooms, the lecture still seems to be the centerpiece of instruction, where students passively absorb pre-processed information and then regurgitate it in response to periodic multiple-choice exams. While teachers try to make essay examinations and engaging discussions possible, rarely do these discussions effect significant change in the passive nature of the learning experience for these classes. A classroom set up with playing educational games changes the way a student views the classroom environment. These innovations grab their attention and allow them to experience learning in a format that they are already used to. "Video games also reinforce self-confidence and compel children to focus attention on an activity. Used properly in the classroom, video games have the power to keep students engaged in learning" (Visscher, 2007).

One way to implement the use of video games in the classroom is to use a constructivist approach to enable students to scaffold their learning. Along with traditional approaches to teaching, such as lectures, PowerPoint presentations, modeling, and offering practice, playing video games supports the knowledge that students seek when preparing for standardized tests. It has become increasingly crucial for students to score well on standardized tests based on the No Child Left Behind Act (NCLB, 2002), and implementing standards-based computer games to support higher level thinking addressed on these tests increases student achievement (Rice, 2007).

This growing concern for student achievement is defined by Martinez (2010) as "Improved scores on standardized tests, increased application and production of knowledge for the real world, increased ability for students to manage learning, and improved access to information that increases knowledge, inquiry and depth of investigation". According to this definition, video games can increase all areas of student achievement based on the nature of playing the games. In playing computer-based educational games, students are presented with simulated worlds: "worlds which, if well constructed, are not just about facts or isolated skills, but embody particular social practices" (Shaffer, Squire, Halverson, Gee, 2004). Video games thus make it possible for players to participate in valued communities of practice and as a result develop the ways of thinking that organize those practices (Gee, 2003). In this proposal, I call for an opportunity of a change in practice to support learners to be successful in mathematical achievement through the implementation of educational computer games.

Introduction

Why do students spend hours playing video games and significantly less time on homework and other educational material? When giving students opportunities for powerful learning experiences, it is important for them to be active participants so they can instill a memory of learning and reactivate that memory in future experiences with the concept learned. As teachers, we can give students cues of important information, vary the pace of instruction through multiple strategies, and design lessons that encourage students to apply the knowledge using real-world examples to foster the learning process. Games exemplify this structure and can be used as a vehicle for student achievement.

In this research paper, I intend to answer the question, "Does playing computer-based mathematical games increase students scores on standardized tests?" Students are willing to work hard to beat a game, but those same students do not appear to have the same motivation to work hard at school. By adopting the gaming systems within the school setting, educators can tap into this motivation to engage students in learning the concepts we teach. Gaming is an inquiry based learning tool that allows students to discover the concepts needed to complete the game, extracting the fundamental ideas of Constructivism and giving students the opportunity to take this approach to learning mathematics. The embodiment of this approach is unveiled in the Oxford Study where children were asked to create their

own games, set-up their own clues and forecast the experience other gamers might have in playing their game. The thinking and learning skills developed within this game creation lesson far outplay those found in many traditional lessons (Briggs-Hale, Judd, Martindill, & Parsley, 2006).

Perspectives

The role of educational games has been widely viewed as vital to 21st century learners. Gee (2005) points out the divide between school systems that teach using the basic skill and drill practice, and video games that offer the application process that students need to distinctly remember the process. According to Gee (2005), schools actually "violate" what cutting edge research has taught us about the way children learn and disregard the notion that video games have brought about the "death of reading". He ascertains that not only are children reading and writing while playing a video game, much of what they are reading and writing are done at higher levels than what they are introduced to at school. Researcher Kate Salen (Ellis, 2009) goes on to point out the need for students to view their lives as relevant both in and out of school, and not as two separate entities. Playing video games within the school curriculum closes in on what students are already doing outside of school.

"Play is, of course, one of the best ways to learn, especially for children" (Pittman, 2008). Marc Prensky (2001) feels even more strongly. "Kids are really learning a lot when they play these games, and they're learning things that are not taught in school. They learn to solve problems, take risks and evaluate outcomes, and work with others to accomplish a goal. And they learn these things in a way that's interesting and painless." Wilson (2007) agrees with Prensky's assessment of video games and learning by suggesting that "games are ... complex problem-solving systems that develop logical thinking, decision making, and encourage a scientific approach to the unknown." When using these ideas and connecting them to mathematics, Briggs-Hale, et al (2006) found that "mathematical games have repeatedly been proven to increase student understanding and achievement in mathematics…math games are fun activities that develop targeted math strategies and skills by leveraging students' natural inclination to play."

Rice (2007) describes the importance of heightening students reasoning skills through the implementation computer-based mathematical games. He concluded that video games "facilitated positive attitudes toward math learning significantly more than paper drilling." He goes further to suggest that using computer-based drills and practices are "significantly more effective in facilitating math learning motivation; whereas individualistic goal structure was significantly more effective …in promoting math test performance." (2007) Papanastasiou, & Ferdig explore the relationship between math literacy and technology use and contend that students "mechanical use of playing online mathematical games alone does not highly correlate with increased academic growth, specifically in mathematical literacy acquisition" (2006) and call for more research in this area to be completed. Along those lines, Kimble looks at both the pros and cons of educational research that focuses on the use of technology and

learning. She found that drill and practice software has a positive effect on mathematical learning, while playing mathematical video games had no effect at all (1999).

Aligned with Kimble's findings, many educators and researchers have negative attitudes toward the use of playing video games in a school setting. Many educators insist that games do not belong in the educational system because they are a waste of time, students do not learn anything from a game except violence and sex, and playing games do not promote higher level thinking skills (Pittman, 2008). Van Puymbroeck (2006) suggests that children have become more defiant, are more likely to commit violent crimes when they get older and become physically unfit because they are constantly sitting while playing these games. He goes on to point out that children who play some games become socially inept. "Social skill deficiency can cause emotional, cognitive and behavioral problems with high levels of anxiety or anger. Animosity, which was found to be detrimental to social skills, was also a significant outcome of video gaming." (2006).

In an effort to analyze the effectiveness of computer-based educational games, Squire (2007) offers that while drill and kill video games do not offer the higher-order thinking skills any better than traditional paper and pencil methods, "a well designed video game will produce results which are substantially different from non-computer based games" especially those that offer simulations and strategy skills in order to complete the game. He contends that "using video games to support student exploration of microworlds or as a construction tool is more consistent with the emerging paradigm of instruction." Teachers are then held responsible to evaluate and observe the games themselves, as well as their educational value in order to promote student achievement. In completing his study, Squire (2007) found that "research on video game violence has failed to show that video games cause violent, anti-social, or aggressive behavior or poor school performance."

Prensky (2005) also exposes these accepted myths that video games are harmful for children. In contrast, he asserts that games teach a multitude of skills including problem solving, language and cognitive skills, strategic thinking, multitasking and parallel processing. He calls for a movement in education to introduce gaming in education, as children are already playing and learning from them on their own. Lee Wilson (2007) approves of this call and notes that "not all video games are rife with violence; instead, many games challenge players to utilize high-order thinking and problem-solving skills." He also asserts that there are "several popular games focus on history, economics, mathematics, and other subjects that make them useful additions to classroom education."

Pedagogy

Educational games naturally enact the Constructivist approach to learning. At the root of this approach is inquiry based instruction that provides scaffolding as the student moves on in a lesson. A constructivist approach to learning is one where learners construct knowledge out of their experiences.

This type of active learning takes place when students are engaged in video game playing. “How to employ games for constructivist learning and teaching has become an attention in the field of education and game design in recent years.” (Jong, Shang, Lee, & Lee, 2008) The development of new cognitive tools for helping learners share and construct knowledge within their own communities can and should be taking place within our schools (Salomon & Perkins).

In order to elicit and draw out successful mathematical learners, teachers need to facilitate the use of educational video games within the classroom. “Only leaving learners to float amidst rich experiences but without teachers' guidance in the process of game-based learning does not work” (Gee, 2005). Educators cannot simply put students in front of a game and direct them to play it; instead teachers should model game playing for the student and teach the expectations within the game itself (Tyre, 2007). “We believe a learning game by itself may unlikely facilitate effective learning, unless opportunities of initial enablement, reflection and generalization of abstraction are embedded therein.” (Jong, et al, 2008) Such a model could allow for “a systematic approach to the development of educational games that will allow for the easy identification of appropriate game elements underpinned by sound pedagogical arguments.” (Amory, et al, 1999).

As leaders in education, teachers must not only guide students through the educational process, but also evaluate the tools they need to implement the use of video games in the classroom. “Our students will learn from video games. The questions we must ask and answer are: Who will create these games, and will they be based on sound theories of learning and socially conscious educational practices?” (Shaffer, Squire, Halverson, & Gee, 2004). Game designers are moving toward the idea of supplying educational games that focus on the same elements that good teachers do. According to Salen, (Ellis, 2009) when creating games, she looks at the best practices of good teaching so that games work in the same way that a good teacher does. Games provide differentiated instruction, as students are able to work at their own pace and level, and they scaffold knowledge based on what does the gamer needs to know in order to be successful and what the gamer needs to know in order to move to the next stage in the game (Ellis 2009). Prensky (2003) also points out that “the reason computer games are so engaging is because the *primary objective* of the game designer is to keep the user *engaged*.”

Engagement is part of the process of learning and it is the goal of the classroom teacher to motivate, stimulate, and engage their students in positive learning experiences. In doing so, “today’s teachers have to learn to communicate in the language and style of their students” (Prensky, 2001). Since most students already know the digital language, teachers should be delivering instruction following the language and design that students are already familiar with. Then teachers can begin building lesson plans around complicated video games and begin the implementation process in their own classrooms (Tyre, 2007).

In Digital Natives Digital Immigrants, Prensky (2001) offers a series of steps teachers can take in order to implement video games into classroom environments. Firstly, teachers need to change the language of their instruction to include "faster, less step-by step, more in parallel, with more random access, among other things" (Prensky, 2001). Next, teachers need to include both the content deemed successful in the past, such as reading, writing, arithmetic, logical thinking, understanding the writings and ideas of the past, most "traditional curriculums" and move to the future in education which "includes software, hardware, robotics, nanotechnology, genomics, etc" (Prensky, 2001).In particular with math students, he suggests that educators need to be focused not merely on using technologies, but using them so students learn to internalize key skills and concepts as well as approximation, statistics and binary thinking (Prensky, 2001). In completing these actions, educators can create digital learning environments in which students are motivated to learn and succeed in any area of study, but particularly in the study of mathematics.

In keeping with Marc Prensky's ideas, a study was conducted in Chile on the effects of video game play in school environments in which 1274 first and second grade students were given reading and mathematical standards-based games on the 1st and 2nd grade levels. The students were divided into the experimental group (those who played the game), the control group (those who did not play the game) and the external group (those that had no contact with the experiment). Each group was given a pre and post test to assess levels of student learning, and completed surveys to assess aesthetic levels of comfort while learning. Their study found that "there was a significant difference between means for children in the experimental schools…and the external control group, but no mean differences were found between the experimental and internal control groups. (Rosas, et al., 2003). This study coincides with my hypothesis for my own study and will be implemented in a similar way.

In order to complete my research, I have evaluated and chose to use Zoombini's Logical Journey and Cyberchase Carnival Chaos, which are both computer-based educational games that teach mathematical skills relevant to sixth graders. Both games are aligned to standards-based mathematics and I plan to model the games to my students using direct instruction and a constructivist approach. I will introduce students to the game using my projector in the classroom and model how to access and navigate each gaming software. Since both games take up to 3 weeks to complete, I will implement the games as soon as my students have become accustomed to the expectations in the computer lab at the beginning of the year so there will be enough time to play the games before the MEAP test. I will begin with Zoombini's Logical Journey, as it is the "easier" of the two and develops logical thinking and problem solving skills through adventures in Zoombini's Isle. This game has four different levels in each of the twelve "puzzles" that students solve. Next I will introduce Cyberchase Carnival Chaos, which is a spinoff

from the PBS show. The game has three difficulty levels to differentiate instruction and has help buttons along the way to promote scaffolding as students complete their mathematical journeys. Built into the game, a success tracker allows me to track the progress of the students along their journeys and support and guide those that need extra help. As students play the games, I will be monitoring and assessing their engagement as well as guiding their experiences throughout their adventures.

Assessment

"We have a standardized testing regime that is focused on skill and drill and facts, not problem solving," Gee (2001) says. "How do we change our assessment regime so that we favor innovation, critical thinking, and problem solving?" This question is at the heart of the debate among educators who seek to create innovative lesson plans that sometimes clash with the high stakes testing arena students take every year. "Rather than planning assessments that evaluate the curriculum, teachers are planning curriculum to match the assessments. The outcomes achieved are no longer those specified by the approved curriculum, and students are being taught how to take tests rather than how to learn." (Simmons, 2004). The research I intend to conduct attempts to take the constructivist, critical thinking and problem solving skills innate in playing games and determine if students can achieve higher scores on standardized tests by participating in the gaming process.

A similar study was done at the University of North Carolina Wilmington (UNCW). "Academic researchers… have concluded that educational video games positively influence student achievement and significantly affect student attitudes and self-efficacy toward the study of mathematics." (Fischetti & Andrist, 2009). In their quantitative study that involved 250 middle school students, 10 math teachers and 2 technology teachers in four middle schools in North Carolina that considered the video game, DimensionM, in math class over a period of 16 weeks. To assess their research, they used surveys and interviews and indicated that "more than 90 percent indicated that some or most of the activities were fun; approximately 67 percent felt the activities were just right in their level of complexity, and about 89 percent believed DimensionM allowed them to demonstrate some or most of their mathematics skills and knowledge." (Fischetti & Andrist, 2009). To assess student achievement, they compared testing scores on a North Carolina achievement test that showed student performance had increased. According to the chief executive officer of Tabula Digital, the company that created the DimensionM series, "The use of modern educational games in formal K-12 settings is at a tipping point. Research has shown that 97 percent of teenagers play video games, and that the amount of time gamers devote to playing video games is three times greater than what they devote to any other activities. So imagine what could be accomplished in a classroom where serious educational video games are readily available - the sky's the limit." (Fischetti & Andrist, 2009). These aspirations induce excitement in digital educational communities as the games that

are currently being created are standards-based and promote both student achievement and significantly affect student attitudes and self-efficacy toward the study of mathematics.

Using similar procedures, a mathematical study was done in Orange County, California that studied the effects of a series of grade level games in the ST Math series, (Spatial-Temporal Math), a fully-developed math curriculum that uses interactive, animated software. In this study, researchers used two cohorts of similar backgrounds and ethnicity to play the games over a four year period in successive levels. 18 schools were in Cohort 1 which implemented ST Math at grades 2-3 and not in grades 4-5 (Group A), and another 16 schools implemented ST Math at grades 4-5 and not in grades 2-3 (Group B). Throughout the implementation, teachers were available in computer labs to observe student interactions and track student growth as they progressed through the series. They also continued with their regular lesson plans to teach mathematical concepts. Teachers were also offered training in the use of the series and acquired the necessary skills to implement ST Math at consecutive levels. Students were assessed on their progress using standardized test scores from the state of California. Researchers also used Individualized Woodcock-Johnson Achievement and Cognitive Measures throughout the duration of the study to randomly assess both groups involved. In order to assess Students' Mathematics Attitudes, researchers used surveys to determine the level of engagement that the series displayed. The results indicate that "Aggregate student scores within each grade in each school show that ST Math positively impacts mathematics achievement as measured by the CSTs." (Rutherford,t. et al, 2010)

It is my evaluation that both of the games I intend to use for my study also meet these criteria. In performing the research method, I plan to use a similar approach to study the effects of game play and student achievement. In order to assess my students' overall experience, I may collect quantitative data by accounting for the frequency of playing games for each student and qualitative data through a survey that rates their satisfaction and interest levels on a score of 1-5 accounting for the interest and motivation accrued by playing these games. To assess student achievement, I will give a MEAP practice exam before my students start playing the games, and then compare the practice scores with the actual MEAP scores to determine if students achieved higher ranking. Using this quantitative data, I will be able to determine whether there are positive or negative correlations linking educational mathematical games and student achievement.

Conclusion

In looking to discover how educational mathematical games might affect student achievement, I saw that there is a growing controversy within the educational community on whether or not games should be used as educational tools. Most of the research suggests that playing any type of game fosters higher-order thinking and problem solving skills. Students are highly motivated and engaged during game play and naturally seek strategies to "beat" the game. Gaming also provides a unique environment where

students have the ability to fail, learn from their mistakes and eventually succeed. Students undergo this process repeatedly throughout a game and will continually seek out answers, either through collaboration with other students (students teaching each other) or through the trial and error process themselves (students learning on their own). Still others think of gaming as a mindless act that actually thwarts higher-level thinking skills and is simply a form of "edutainment" that leads the gamer to disregard education, rather than foster it.

I believe that gaming has a distinct place in our educational system and can and should be used as educational tools within our schools. Although I see valid points on both sides of the issue, after researching, it is clear to me that with the right facilitator and the right game, learning can and does take place, even if it is fun for the learner. Video games inherently allow students to actively participate in the learning process and engage interactively with the game, where they are completely in control, thus bridging the gap between rote memory and actual learning. They remember the process because it is repeated, reinforced and held at a higher interest. Based on this application, students then have the "map" that they need to access in the future when they experience the concept again.

As educators, we constantly tell our students to think "out of the box" and develop the skills necessary to succeed once they move on in the educational process. I believe it is time to take our own advice and invite students to learn in a way they are already used to learning out of school. One of the thought provoking anecdotes that resonated with me was from Prensky's Digital Natives, Digital Immigrants (2001) where a student described that he had to "power down" when coming to school. As a teacher, we obviously want the opposite effect for our students and their school experience. In order to get kids to "power up" in the classroom, we have to present our material in a way that motivates and engages them. I see games as an intrinsic method of delivering instruction that supports the learning and achievement that we want to take place in our schools.

Research Design

Research Question

Most educators today are looking for ways to implement technology in their classroom that supports higher-level thinking skills and promotes success on high-stakes tests. In this research paper, I intend to answer the question, "Does playing computer-based mathematical games increase students scores on standardized tests?"

Procedure

In attempting to answer this question, I plan to use a quasi-experimental design that encompasses the nonequivalent groups design. This approach fits my technique of using pretests and posttests, but accounts for the non-randomization of the groups that I will be testing. The first group (Group A) will be consist of two classes, approximately 55 students, who will be the experimental group that plays the

games. The second group, will also consist of two classes and approximately 55 students ,which is the control group (Group B), and will not participate in game play. In order to initiate my project, I needed to incorporate games that had significant educational value. First, I used the *Video Game Higher Order Thinking Evaluation Rubric* (Rice, 2007) designed by John Rice to assess the level of thinking skills offered by the two games, Zoombini's Logical Journey and Cyberchase Carnival Chaos. According to the rubric, both games scored in the Upper Range which constitutes that the, "game holds several positive characteristics lending itself to higher order thinking." (Rice, 2007).

In order to complete my research, I will use Zoombini's Logical Journey and Cyberchase Carnival Chaos, which are both computer-based educational games that teach mathematical skills relevant to sixth graders. Both games are aligned to standards-based mathematics and I plan to model the games to my students using direct instruction and a constructivist approach. I will introduce students to the game using my projector in the classroom and model how to access and navigate each gaming software. Since both games take up to 3 weeks to complete, I will implement the games as soon as my students have become accustomed to the expectations in the computer lab at the beginning of the year so there will be enough time to play the games before the MEAP test. I will begin with Zoombini's Logical Journey, as it is the "easier" of the two and develops logical thinking and problem solving skills through adventures in Zoombini's Isle. This game has four different levels in each of the twelve "puzzles" that students solve. Next I will introduce Cyberchase Carnival Chaos, which is a spinoff from the PBS show. The game has three difficulty levels to differentiate instruction and has help buttons along the way to promote scaffolding as students complete their mathematical journeys. Built into the game, a success tracker allows me to track the progress of the students along their journeys and support and guide those that need extra help. As students play the games, I will be monitoring and assessing their engagement as well as guiding their experiences throughout their adventures. According to Squire (2003), **"**using video games to support student exploration of microworlds or as a construction tool is more consistent with the emerging paradigm of instruction" and supports the direction in which many educators are now going in 21st century learning environments.

Assessments

In performing the research method, I plan to implement the games into my classroom in successive order before students take the MEAP exam to study the effects of game play and student achievement. In order to assess my students' overall experience, I will collect quantitative data by accounting for the frequency of playing games for each student and qualitative data through a survey that rates their satisfaction and interest levels on a score of 1-5 accounting for the interest and motivation accrued by playing these games. Throughout the implementation, I will observe students by circulating around the classroom and assessing their engagement as well as their motivation in continuing to play the

game. To assess student achievement, I will give a MEAP practice exam before my students start playing the games, and then compare the practice scores with the actual MEAP scores to determine if students achieved higher ranking. I will also test a second group of students who do not play the video games to ascertain the validity of the video game play and student achievement. Using this quantitative data, I will be able to determine whether there are positive or negative correlations linking educational mathematical games and student achievement.

Design Rationale

Educational video games have become frontrunners in an educational debate sparked by the concern of attaining successful scores on standardized tests. This argument has become highly interesting to educators and researchers alike, as the design and complexity of video games has improved greatly over the past decade. Research suggests that video games publicizing educational benefits are becoming more and more prevalent in classrooms, yet the need to identify truly useful educational games exists (Rice, 2007). I believe my research coincides with this need as well as determining if the introduction of educational video games can be a useful tool in promoting successful student achievement within the classroom.

The research methods that I will employ uphold the empirical view on research and will produce sound data to answer my question. By using a combination of research methods: observation, surveys and pre and post testing; I will ensure that my study generates the data needed to support my eventual conclusions and will provide the necessary implications for further research. In keeping my research approach variable, I have gone a step further than other researchers who have sought similar answers. Other researchers have devised simple observations and interview style surveys, and given assessments at the end of the program implementation, however, I believe that using these methods in one study provides the scope that is essential to determining whether or not mathematical video games have an effect on student achievement. My research plan intends to inform educators about the fundamental aspects of using video games in a classroom environment. When administrators, teachers, and parents understand that different computer based educational games serve and augment different learning experiences, they can make informed judgments about how video games are best suited to enhance student learning and achievement.

With the purpose of implementing video games to enhance student learning, educators must first evaluate the games they intend to use to illicit student achievement. In implementing the games, teachers must also scaffold and guide student learning and monitor the learning progress instituted within the game. This is an important step, as games are not "teacher-free", although they are student-centered and offer the educational processes interweaved within the game. Therefore educators should look to video games, "not because games that are currently available are going to replace schools as we know them any

time soon, but because they give a glimpse of how we might create new and more powerful ways to learn in schools, communities, and workplaces—new ways to learn for a new information age." (Shaffer, et al, 2004). In this way, teachers can move towards a new representation of learning through meaningful activity in virtual worlds as preparation for meaningful activity in our 21st century world.

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Appendix- Annotated Bibliography

1. Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of computer games as an educational tool: identification of appropriate game types and game elements. *British Journal of Educational Technology, 30*(4), 311-321. Retrieved July 28, 2010 from http://www.mack enty.org/images/uploads/3251778.pdf

   The researchers in this article tested video games in a college biology class to determine student interest levels, the ways students learn and achievement on tests after playing the games. They found that students learned more from adventure and strategy games and had achievement had no effect with simulation games. This type of research emulates the research that I will complete.

2. Briggs-Hale, C. Judd, A., Martindill, H., Parsley, D. (2006). Afterschool mathematics practices: A review of supporting literature. *Mid-continent Research for Education and Learning.* Retrieved July26,2010 from http://www.mcrel.org/pdf/Afterschool/7895TG_ Afterschool Mathematics LitRev.pdf

   These researchers analyzed 5 best practices for afterschool programs and video games was the third practice that they researched. They found there was a high correlation of student motivation, learning and achievement when playing educational based video games. This article supports my theory that if students play video games, they will score higher on standardized tests.

3. Ellis, K. (Producer), & Ellis, K. (Director). (2009, May 27) Big thinkers: Kate Salen on learning with games. *The George Lucas Educational Foundation.* Video retrieved July 29, 2010 from http://www.edutopia.org/digital-generation-katie-salen-video

   In this interview, Salen rejects the proposal that educational games thwart student achievement and instead contends that gaming in the classroom allows for true learning experiences and social practices that permit students to take on rigorous and relevant information and understand it more deeply. She likens the gaming environment to a good teaching environment because it offers students collaboration, higher thinking skills, differentiated instruction and motivation to continue to learn different tasks. This video supports the idea that gaming is an important movement in education today.

4. Fischetti, C. & Andist, C. (2004, November). UNC Wilmington study shows educational video games positively influence student attitudes toward math. *Business Wire*. Retrieved July 30, 2010, from ABI/INFORM Dateline. (Document ID: 1907277271).

   This article summarizes the research done at UNCW that involved 250 middle school students, 10 math teachers and 2 technology teachers in four middle schools in North Carolina that used the video game, DimensionM in math class over a period of 16 weeks. They concluded that educational video games positively affect student achievement. This research is the exact type of research that I plan on doing and their outcome is similar to what my hypothesis would be. Their research supports what I hope to find in my own research.

5. Gee, J. (2003, October).What video games have to teach us about learning and literacy. ACM Computers in Entertainment, Vol. 1, No. 1, BOOK 01. Retrieved July 25, 2010 from http://wiki.ubc.ca/images/7/7a/Gee_2003-Computers-in-Entertainment.pdf

   Gee presents his theory about the importance of playing video games in schools and lists the "good learning principals taught in good games". He stresses the need for teachers to be highly evaluative before introducing games and then planning and structuring lessons that correlate with game play. He proposes that teachers take a fresh look at the way their classrooms are run and advises teachers to implement gaming to foster student's understanding. This relates to my research because it offers a guide to incorporate games in education, as well as the reasoning of why we should.

6. Gee, J.P. (2005). Good video games and good learning. *PHI KAPPA PHI FORUM,* 85(2), 33-37 Retrieved July 26,2010 from https://www.umt.edu/ce/fire/documents/Pre-workGoodVideoGamesandGoodLearning.pdf

   Gee points out the divide between school systems that teach using the basic skill and drill practice, and video games that offer the application process those students need to distinctly remember the process. According to Gee, schools actually "violate" what cutting edge research has taught us about the way children learn. Gee also disregards the notion that video games have brought about the "death of reading". He ascertains that not only are children reading and writing while playing a video game, much of what they are reading and writing are done at higher levels

than what they are introduced to at school. His remarks correlate to my idea of the future of education.

7. Jong, M., Shang, J., Lee, F., & Lee, J. (2008, January- May). Harnessing computer games in education. *International Journal of Distance Education Technologies*, 6(1), 1-9. Retrieved July 30, 2010, from ABI/INFORM Global. (Document ID: 1527204771).

   This article seeks to look past simply making learning more interesting and investigates the pedagogical potentials in playing computer games. Their study looks first at the "education in games", then "games in education" and offers pedagogy for game based instruction. This resource is valuable to both the historical perspective and the pedagogy necessary to enhance my own research.

8. Kimble, C. (1999, May) The impact of technology on learning: Making sense of the research. *Mid-continent Regional Educational Laboratory.*Retrieved from http://www.mcrel.org/PDF/PolicyBriefs/5983PI_PBImpactTechnology.pdf#search=%22computer-based%20math%20instruction%22

   In this article, Kimble discusses the pros and cons of incorporating technology into the classroom and although she sees very little improvement beyond "drill and practice" software, she acknowledges that technology is here to stay. She identifies professional development for teachers and proper teaching methods as two important factors in the implementation of technology in schools. Her viewpoints add to the "con" piece of my research and give me differing perspectives about gaming and education.

9. Martinez, B. (2010, July 29). 'Hard Truth' on education: New, higher standards for proficiency alter view of years of perceived gains. *Wall Street Journal* (Eastern Edition), p. A.15. Retrieved August 15, 2010, from ABI/INFORM Global. (Document ID: 2094135841).

   In this article, Barbara Martinez describes the definition of student achievement based on four levels of success. She argues that the bar for what it means to be "proficient" has now been set substantially higher and achievement goals for schools are also higher. This article allows me to construct a definition of student achievement and decide how it affects student learning.

10. Papanastasiou, E, & Ferdig, R. (2006). *Computer Use and Mathematical Literacy: An Analysis of Existing and Potential Relationships*. The Journal of Computers in Mathematics and Science Teaching, 25(4), 361-371. Retrieved from Education Module. (Document ID: 1140698991).

This article explores the relationship between math literacy and technology use and contends that although students may use higher level thinking skills while using technology, these skills do not transfer when taking formal assessments. In their study, they found that there was little or no correlation to students using various types of technology and increased academic growth. Their research gives me insights about other projects that were completed on my topic and what they found, even though it goes against my hypothesis.

11. Pitman, T. (2008, December). 6-8 years: The positive side of video games. Today's Parent, 25(12), 168,170. Retrieved July 29, 2010, from General Interest Module. (Document ID: 1664289111).

Pitman discusses the positive aspects of playing video games in an educational setting, while debunking many of negative facets many people hold about playing video games. She establishes that gaming in the classroom holds an important role in 21st century learning and believes that "play" is one of the best ways that students learn. Her distinctions give me both points of view on my topic and allow me to see the other side of my examination into my topic.

12. Prensky, M. (2001). Computer Games and Learning: Digital Game-Based Learning. *Handbook of Computer Games Study*. Retrieved July 28, 2010 from: http://theunshaven.rooms.cwal.net /FTVMS212PDFs/Reading%2004%20-%20Computer%20Games%20and%_20Learning%20-%20Digital%20Game Based%20Learning%20%5BMarc%20 Prensky%5D.pdf

Prensky speaks of Digital Natives who learn higher thinking skills doing what they've always done: playing games. He uses a pro-con approach to fire off debates, such as " Should work be fun?" and "How effective is the learning?"He also touches on his 5 levels of learning in games and instructional strategies that encompass playing computer-based educational games. This is a great resource for supporting gaming in education.

13. Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1–2. Retrieved July 26, 2010 from http://web.me.com/nancyoung/visual_literacy/site_map_and_resources_files/Digital_Natives_Digital_Immigrants.pdf.

    The main focus of this article is to get teachers (digital immigrants) involved in digital literacy in order to keep up with the needs of our digital natives (students). The digital natives Prensky describes are surrounded by digital media to such an extent that their very brain structures may be different from those of previous generations. He focuses on this important distinction and calls for a controversial change in educational literacy. This article helps support my belief that teachers need to keep up with the information highway and make changes in the way they deliver instruction.

14. Prensky, M. (2005), "Listen to the natives", Educational Leadership, Vol. 63 No. 4, pp. 8-13. Retrieved July 26, 2010 from: http://centre4.interact.ac.nz/viewfile.php/users/38/1965011121/ICT_PD_Online/ListentotheNatives.pdf

    Prensky exposes the accepted myth that video games are harmful for children. In contrast, he asserts that games teach a multitude of skills including problem solving, language and cognitive skills, strategic thinking, multitasking and parallel processing. He calls for a movement in education to introduce gaming in education, as children are already playing and learning from them on their own. This article supports my belief that video games can be used to support student achievement.

15. Rice.J.R. (2007). Assessing higher order thinking in video games. *Journal of Technology and Teacher Education*, 15(1), 87-100. Retrieved July 30, 2010, from Education Module. (Document ID: 1184989861).

    Rice speaks to the rich history of gaming and analyzes how games promote thinking, both in lower level cognition and higher level thinking. He differentiates between games that are simply "edutainment" and games that promote higher thinking skills, such as RPG's and NPC's. He provides a detailed list of how to evaluate different games in the classroom in order to determine their validity as educational tools. His research links to mine in that I will need to evaluate a game in which to conduct my research.

16. Rosas, R, et al. (2003) Beyond Nintendo: design and assessment of educational video games for

first and second grade students. *Computers & Education* (40) 71–94 Retrieved August 16, 2010 from http://intrawww.ing.puc.cl/siding/datos/public_files/profes/marianov_IBTFGZAQSAG JSCW/ Reprint-Games_Comp_Educ2003.pdf

This article describes a study in which 1274 first and second grade students were given reading and mathematical standards-based games on the 1st and 2nd grade levels. The students were divided into the experimental group (those who played the game), the control group (those who did not play the game) and the external group (those that had no contact with the experiment). Each group was given a pre and post test to assess levels of student learning, and completed surveys to assess aesthetic levels of comfort while learning. Their study found that there was a significant difference between means for children in the experimental schools. This study coincides with my hypothesis for my own study and will be implemented in a similar way.

17. Rutherford,T. et al, (2010). Spatial Temporal Mathematics at Scale: An innovative and fully developed paradigm to boost math achievement among all learners. *Online Submission, Paper presented at the Annual Meeting of the American Educational Research Association (Denver, CO, Apr 30-May 4, 2010*) Retrieved August 15, 2010 from http://eric.ed.gov/PDFS/ED510612.pdf

This article describes a mathematical study done in Orange County, California that studied the effects of a series of grade level games in the ST Math series, (Spatial-Temporal Math), a fully-developed math curriculum that uses interactive, animated software. In this study, researchers used two cohorts of similar backgrounds and ethnicity to play the games over a four year period in successive levels. They found positive coorelations between game play and increased student achievement.

18. Salomon, G. & Perkins, D. (2005). Do technologies make us smarter? Intellectual amplification with, of, and through technology. In R. J. Sternberg and D. D. Preiss (Eds). *Intelligence and Technology: The Impact of Tools on the Nature and Development of Human Abilities*. NJ: Lawrence Erlbaum Associates, Inc. 74-101. Rerieved July 30, 2010 from http://books.google.com/books? hl=en& lr=&id=Ubn_ECoLXKUC&oi=fnd&pg=PA71&dq=Smarter+%22Technologies+make+us%22+Perkins&ots=yCbNpVNXyu&sig=KOxQZ4CePfOQTuwX54zsriF_fHQ#v=onepage&q=Smarter%20%22Technologies%20make%20us%22%20Perkins&f=false

Salomon and Perkins discuss in this chapter the three ways we view cognitive technologies and their effects: of technology, with technology and through technology. Their findings suggest that the use of technology does in fact make a person smarter "in the sense that they perform smarter". They also found that after studying video gamers who were first introduced to a game scored significantly higher on a post test than those who did not play the game. These findings interest me because they direct relate to the answer I am seeking in my project.

19. Shaffer, D. W. Squire, K. R. Halverson, R. Gee, J. P. (2004, December). Video games and the future of learning. *PHI DELTA KAPPAN*, *87*(2), 104-111. Retrieved July 26,2010 from http://academiccolab.org/resources/gappspaper1.pdf

    The authors describe the importance of playing video games in educational setting and divulge a plan to incorporate gaming through meaningful experiences. They suggest that video games not only support the academic growth of students, but also the social aspects that are gained through partnerships in the gaming process. It is an interesting look at what could be possible in future classrooms due to the collaborative nature of students and gaming.

20. Simmons, Nicola E. (2004, July). (De)grading the standardized test: can standardized testing evaluate schools? *Education Canada*, 44(3), 37-39. Retrieved July 30, 2010, from Education Module. (Document ID: 693070311).

    Simmons offers the perspective that standardized testing in today's schools does not meet the needs of today's learners and the expectations they will have to meet once they walk out into the "real world". She calls for a systematic change in assessing students that achieves critical thinking skills, creative problem solving, effective communication, and the ability to work collaboratively. Her call for change relates to the research I have found about how students learn through gaming and seeks to further the question of identifying student achievement on standardized tests.

21. Squire, K. (2003). Video games in education. *International Journal of Intelligent Simulations and Gaming, 2*(1), 49-62. Retrieved July 30,2010 from http://website.education.wisc.edu/~kdsquire/tenure-files/39-squire-IJIS.pdf

Squire offers several reasons why video games should be used in education today. He offers that while drill and kill video games do not offer the higher-order thinking skills any better than traditional paper and pencil methods, strategy based and simulations games do. He also speaks to violence and aggressive behaviors taught in video games and contends that research just does not accept this as true. This article furthers my intent that video games can and do support higher learning.

22. Tyre, P. (2007, April 16). Gaming the system. *Newsweek.* 17. *Opposing Viewpoints Resource Center*. Gale. Michigan State University Libraries. Retrieved July 28, 2010 from http://find.galegroup.com.proxy1.cl.msu.edu/ovrc/infomark.do ?&content Set=IAC-Documents&type=retrieve&tabID=T003&prodId=OVRC& docId =A161813145&source=gale&userGroupName=msu_main&version=1.0

In this News week article, Tyre uses a anecdote of a 14year old boy immersed in his technology class as an game designer who collaborates with his virtual 'boss" and colleagues about how "CarbonAde" should be designed. She uses this as a stepping stone to introduce some of the ways teachers are using video games in their classroom. This article gives me some ideas for pedagogy used for computer games in the classroom.

23. Wilson, L. (2007, September). Video games are useful educational tools. *Opposing Viewpoints Resource Center*. Gale. Michigan State University Libraries. New Bay Media, LLC. Retrieved July 28, 2010 http://find.galegroup.com.proxy1.cl.msu.edu /ovrc/infomark.do?&contentSet=GS RC&type =retrieve&tabID=T010&prodId = OVRC&docId=EJ3010153262&source=gale&userGroupName=msu_main&version=1.0

Wilson disputes the three biggest myths about using games in the classroom and offers that playing video games in school promotes higher-order thinking and problem solving skills. He links this view and provides examples of games in all content area to support his claim. This is an excellent example of what I hope to find in my research and also offers a wealth of games he has found helpful in the classroom.

24. Van Puymbroeck, Marieke. (2006, August 1). Research update: the joystick generation: video games have measurable social effects on adolescents *The Free Library*. (2006). Retrieved July 30, 2010 from http://www.thefreelibrary.com/Research update: the joystick generation: video games have measurable ...-a0150864279

Van Puymbroeck speaks to the negative effects of playing games in children. He suggests that children have become more defiant, are more likely to commit violent crimes when they get older and become physically unfit because they are constantly sitting while playing these games. He identifies social deficiencies, gender bias, and the physical effects of playing video games within his research. This represents an opposing viewpoint of what my research may suggest.