

ENHANCED LEARNING PERFORMANCE IN THE MIDDLE SCHOOL
CLASSROOM THROUGH INCREASED STUDENT MOTIVATION,
BY THE USE OF EDUCATIONAL SOFTWARE AND
QUESTION-BASED GAMING TECHNOLOGY

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The purpose of this research was to determine if the introduction of a competitive and collaborative computer-based gaming software system into middle school classrooms would result in improved attendance and grades, and motivate students to have a greater interest in their studies.

This study was conducted over a 6 week period, with attendance and performance data being collected from 284 students. Two quantitative surveys were used to measure course interest and motivation: (a) the Course Interest Survey (CIS), and (b) the Instructional Materials Motivation Survey (IMMS). Participation in these surveys consisted of 84 students taking the CIS and 40 students taking the IMMS.

The results indicated that the experimental group showed statistically better scores than the comparison group in attendance and performance. Students participating in the experimental group had significantly lower mean ranks of absenteeism compared to students in the comparison group. Results also revealed significant differences on grades. Students that were in the experimental group had significantly higher grades compared to students that were in the comparison group.

Results of the CIS suggest that a statistically significant difference does not exist on Attention, Relevance, Confidence, and Satisfaction between the experimental and comparison groups. Results of the means and standard deviations for the IMMS Motivation Scores fell somewhere between *Moderately true* and *Mostly true*.

This research study suggests that student's attendance and performance can be improved when quiz based gaming software that is both collaborative and competitive is used regularly in the classroom. However, for student's that participated in the gaming software, their interest in studying the subject doesn't appear to be significantly different from students that did not participate.

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CHAPTER 1

INTRODUCTION

In spite of numerous advances in educational theory and the literature in general moving away from transmissionist and toward constructivist education featuring experiential lessons, a division continues in educational theory between learning and gaming, between education and fun. While students learn in the classroom context, they are only allowed to have fun outside the classroom, and of late, the site of most of their fun is video or computer gaming. In this context, the emergence of video gaming as the primary pastime of a new generation of students has been framed in an “us versus them” manner, utilizing the framework of learning versus fun. When education sets itself up as an institutional bulwark of learning struggling against the might of popular culture and its latest representative, video games, education is placed in a very challenging position.

Video games represent a \$7 billion dollar business in the U.S. alone, exceeding even motion pictures. Most boys at the level of middle school play an average of 4 hours per week, and girls play one or two hours per week. Of the boys, while 50% will play games in arcades, more than 90% do most of their gaming at home (Wilhelm and Reynolds, 2002).

Some educators have developed and introduced educational style video games into classroom sessions, however most students do not care for these games. Additionally, most classrooms do not utilize them effectively. Educators in general remain hesitant about introducing games into the classroom, and at present, most

games in classrooms are computer games with console gaming being almost completely absent (Kirriemuir & McFarlane, 2004).

In order to begin exploring the use of potentially effective computer games in a learning context, this study examined the use of a quiz-based gaming software using question and answer format in middle school classrooms. There are two advantages to this method of question-and-answer testing or gaming, as noted by educators: first, teachers can gain an instantaneous sense of whether or not the lesson they have been teaching has been understood. If a teacher sees a number of wrong answers in such a quizzing format, he or she can review and work through the material until the instructor feels understanding has been achieved (Matheny, 2003). Second, it has been noted the actual use of this type gaming format in a classroom creates a competitive atmosphere where students become more engaged and motivated to answer, and answer correctly, not only to better others, but because the answering is transparent and visible to all (Matheny; Williams, 2005). Games like this can be used as teaching and learning tools as well as an assessment tool. It all depends on how the instructor implements the activity.

Recently, the literature on the effectiveness of computer/video gaming has begun to diverge. Generally, educational computer games (or exogenous games) increasingly are being seen as less effective than fully-immersive and intrinsically-motivating video games (endogenous games). The latter is consuming much of the average, middle school student's non-classroom time. Gee reports that the "edugame" format offers the best of both gaming worlds, as it has elements of both exogenous gaming and

endogenous gaming, He goes on to suggest it may well be the way game designers create for classroom environments in the future (Gee, 2005).

The literature on computer and video games has changed significantly in the last decade. The most pejorative treatment of computer and video gaming still comes from those critics who believe these games are too violent (Piot, 2003), and games, as such, have little redeeming value. It is believed hours playing video games is a waste of time, and excessive use of video games by boys, especially, not only encourages antisocial behavior but also takes away from their schooling. In this framework, heavy video or computer game use is said to result in boys who are unable to control themselves and who may therefore need more supervision by adults in order to increase their self-control (Chiu & Lee, 2001). However, this would not apply to a game that promoted whole-class participation, which is the case of the software used in this study.

In order to more carefully determine the nature of computer game introduction into classrooms, educators have devised a distinction between exogenous and endogenous games (Williams, 2005). Exogenous games are drill games and competitive, question-and-answer gaming environments. These games are termed exogenous because they have an explicit game structure and a transparent educational purpose. While many classrooms do employ these types of games, Williams reports students do not respond to this type of game very positively and certainly do not play them outside of the classroom. Endogenous games, on the other hand, are video games. These are the immersive, environmental-based games of action in playscapes resulting in that flow state of concentration educators covet in gamers (Williams, 2005).

Endogenous games have special qualities that are receiving increased study as possible models for revived educational computer gaming. One characteristic of good games is they are autotelic. This means there are no rewards external to the game; the only reward is in completing the game. It astonished educators who struggle to motivate youth to learn math that many of them play games whose only motivation is autotelic (Guynup & Demmers, 2005). Another quality of a good game receiving quite a lot of attention is flow. Flow occurs when one is so motivated in play that the motivation is embedded in the play process, and all goals outside the game are forgotten (Guynup & Demmers). Many video game players are able to and desire to change into other entities and end up designing part of the games themselves to continue playing at still more difficult levels. This is also of great interest to educators (Piot, 2003). Playability is another issue in gaming receiving much attention as playability is what keeps the player playing. Playability is controlled by a rhetoric of play which provides an underlying momentum to progress through the game, and it may also involve taking part in back stories and tangents. The essence of playability is that the game is always challenging, but never overwhelming in its challenge, so the player progressively overcomes all challenges and continues to play (Guynup & Demmers).

The goal of most gaming theory as applied to the classroom today is to fuse the benefits of exogenous and endogenous games to create a new kind of game, which some researchers have begun to call an edugame (Gee, 2005). These games would have to have a continuous course of action, be strongly goal-oriented, and be exceptionally engaging and even immersive (Gee, 2005).

Problem Statement

This study is guided by the researcher's need to know if computer gaming technology is worth using in the classroom. One of the primary reasons students fail to learn is they are not motivated to learn. If students are not engaged in their studies, and therefore not motivated to learn, little learning actually takes place. Among the various new opportunities that have emerged to possibly help educators improve student motivation are computer games. Computer games are not only engaging, but they are believed by some educators to have embedded in them certain pedagogical advantages which inspire student motivation on a basic level (Gee, 2005).

Computer games may be the answer to the problem of student motivation. The fact that some educational games make use of a question-and-answer approach is an added bonus to motivation; findings have indicated the use of appropriate questioning in the classroom context does engage the learner more, focus the learner on specific objectives, help the learner practice how to retrieve information in order to answer the question, and provide opportunities for the student to engage in feedback and repeat exercises if they experience trouble in the learning process. A question-and-answer computer gaming technology, therefore, may address the problem of student motivation in a productive way.

Purpose of the Study

The purpose of this study was to determine if use of gaming software that has quiz question-and-answer modules led to better student attendance and achievement, as well as a greater interest in the course being studied, than students not using any

type gaming software. Student interest in the course being studied (8th grade American history), and student interest in using quiz based gaming software, was assessed through the use of two online questionnaires. The response pad competitive gaming environment, due to the fact one participates in it in front of the entire class, increases student motivation to understand lessons, demonstrate knowledge of lessons, and improve their achievement as a result of these gains. Games like these often use a scoreboard, where students are anonymously identified so other students don't know who they are, but the teacher is able to identify them. This provides a shield of security and protection that helps increase the motivation and willingness of students to participate in learning experiences.

For competition to be effective in a learning environment, public criticism must be minimized for low performing individuals. Some types of gaming software, because they provided both intrinsic and extrinsic rewards, draws the attention of students and helps them protect their sense of self worth since their identification on the public scoreboard is anonymous. The threat of public failure is virtually eliminated, and students feel free to express themselves and engage in the activity for the sake of the rewards. Students do not skip the activity for fear of failure; they now focus their attention because the format of the activity is fun and non-threatening. They compete with the “crowd” knowing their anonymity will protect them from public embarrassment. In this setting, students are more willing to apply their knowledge, seek out better understanding and more readily demonstrate their knowledge. Therefore, from its design, it is believed data collected during this study will show middle school students are more motivated to

attend class, have better grades, and participate in classroom activities when competitive quiz based gaming software is being used, than when it is not.

Significance of the Study

The significance of this study lies in the fact it may be able to add to the current body of literature regarding those factors (like fun and competition) or tools (like drill and review) helping increase student motivation. Up to now, the literature has proposed a number of ways in which teachers can motivate students to work harder and engage more fully with the subject matter or content. Most studies of motivation, especially in the context of formal education, have left out one important factor in motivation: fun. Researchers studying motivation have found, especially during early childhood, play performs important roles in both psychological and intellectual development. This is primarily because, while play often possesses make-believe qualities, it is a voluntary activity intrinsically motivating. Children engage in play without being told or forced to for the purpose of meeting some extrinsic goal. Play theory thus often corresponds to contemporary educational theory which argues that the more intrinsically motivating educators can make lessons, the more effective will be the learning. If a lesson is intrinsically rewarding, it has been observed, then the student is self-motivated and needs no further encouragement to learn. In the context of play theory, schoolwork should not be construed as a mode of learning opposite from play, but rather schoolwork and play should be seen as part of a broadly conceptualized mode of intrinsically-rewarding learning (Gee, 2005).

The literature on the ultimate impact of computer gaming tends to favor following the above premise, including those modes of gaming which are the most game-like, the most immersive, and the most intrinsically rewarding. As a result, researchers tend to expound on a future where classrooms may present students with just as virtual a world as they currently find in gaming. These have stunning graphics, compelling story-lines, sound, and video (Wilhelm, 2002). Question-and-answer educational games also present certain characteristics—primarily the question-and-answer format—which have been found to also be quite engaging. This format is, additionally, more practical and reasonably introduced into classrooms today. A good comparison would be the popular game show Jeopardy which has been on TV for more than 20 years. The unique question-answer format has become a popular tool with educators across the country. Some teachers recommend their students watch the show and often create their own versions of it to encourage student participation in the classroom (Wilhelm, 2002).

The use of computer gaming to enhance learning is supported by the literature on learning which has begun to take a constructivist direction. What makes human beings respond most effectively to this stimulation? While it might have formerly been proposed, using a model of mind as rational and abstract, a student might require quiet and calm reflection in order to learn, it is now believed children especially learn better when they are interested and excited about a problem; students also are more receptive to a lesson they find enjoyable. When a child visualizes solutions or experiments and plays creatively with a game, critical thinking skills are enhanced. From various converging directions fun and learning are coming together. This study is significant in that it seeks to determine if the use of a question-and-answer computer game

specifically increases the attendance, grades and course interest of students in a middle school classroom.

Research Questions

This study is guided by the following research questions:

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student attendance as measured by six week daily attendance records?
- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student achievement as measured by six week grade averages?
- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student course interest as measured by the Course Interest Survey?

Hypotheses

H₀1 There will be no statistically significant differences between the comparison group and experimental group, in terms of students' attendance.

H₀2 There will be no statistically significant differences between the comparison group and experimental group, in terms of students' achievement.

H₀3 There will be no statistically significant differences between the comparison group and experimental group, in terms of the ARCS subsections of attention, relevance, confidence, and satisfaction in the Course Interest Survey.

Limitations

There are four limitations to conducting this study. First, there is a potential for contamination of the comparison and experimental classes. Second, the researcher does not control how the classes are put together, therefore the study cannot be random. Third, the researcher was dependent upon teachers to collect attendance and performance data as well as getting the students to return the signed Informed Consent Form, so they could take the online survey(s). Finally, teacher variance is not in the researcher's control.

Definition of Terms

- *Edugames*: A term devised to refer to educational games which exploit the best of endogenous and exogenous games in order to create an active, immersive and motivating game in a classroom context (Gee, 2005).
- *Endogenous computer game*: A computer game which is continuous and immersive involving the player in action in a playscape in such a way that gaming and learning fuse in the flow of play.
- *Exogenous computer game*: A computer game where the gaming structure is explicit (such as question-and-answer drilling) and where the educational purpose is clear, explicit and primary. Playing these games feels more like playing traditional board games: the games are exogenous.
- *Flow*: In the context of gaming, flow is a state of mind created by play in a continuous, immersive environment characterized by a point where gaming and learning become one, and motivation becomes entirely intrinsic. In flow, the motivation is

embedded in the play process, and all goals or desires outside the game are forgotten (Guynup & Demmers, 2005).

- *Hard fun*: A phenomenon in video or computer gaming where players are motivated to move continuously from challenge to challenge, each one becoming more difficult, in order to motivate the players to continue playing the game.
- LearnStar® (LearnStar, Inc., Dallas, TX, www.learnstar.com): An educational gaming system in which students engage in a question-and-answer activity initiated by the teacher and answered by all students simultaneously through a combination of projected computer screen and handheld devices.
- *Playability*: The quality by which a game becomes playable in a smooth, continuous manner. Sutton-Smith argues that playability is enabled by one of seven rhetorics of play involving the ideas of progress, fate, power, identity, imaginary, frivolous and self (Guynup & Demmers, 2005).

Summary

This study is based on literature which remains at present ambivalent about the use of computer games in the classroom and also remains split over which is the best kind of video or computer game for classroom use. Currently, there are a limited number of studies which have found evidence that the introduction or use of computer or video games in the classroom lead to improvements in student attendance or academic achievement. Therefore, this study is primarily interested in the interactive element of competitive quiz based gaming software. The author seeks to determine if the implementation and use of this type software in a middle school classroom

contributes to students coming to class more often, achieving better grades, and showing more interest in general about their studies than students not using any type gaming software. If it can be proven this type software does enhance these elements of education, strong support will be provided for those educators who seek to create edugames combining the best of traditional educational computer games and new media gaming.

CHAPTER 2

LITERATURE REVIEW

Introduction

In the past, some educators became incensed their youth were suddenly spending much of their time participating in a tragically isolating media. These young people were either alone in their rooms or, if in public, in places which have been described as a frightening sight where dozens of young children, normally so vivacious and socially interactive, were sitting alone in cubicles...oblivious to their peers engaged in their new media (Maney, 2005). The media that caused such consternation among the educated elite were--books; five hundred years later, video games have caused parents, pundits and educators the same sort of outrage and concern. Video games are vilified as idle pursuits causing a whole generation to be lost to education and proper functioning in society. That so many of the video games played today are violent is also a point of major contention. Finally, there is evidence for a cumulative addictive effect from video games, and the fact they do have a capacity to lead youth astray or at least away from schoolwork and the workplace. In popular culture, video games have become extremely popular and controversial at the same time.

Some educators, having taken the time to experience video games and have begun to consider their educational potential (Gee, 2005; Squire, 2005). Rather than worry if video games are taking away from reading books and book literacy, these educators have begun to wonder if a student who is not proficient in video games will end up at a disadvantage on the job and socially (Maney, 2005). Moreover, these same educators are no longer so sure the book is very good in relation to how these students

will live their lives in the future (Maney). Other than adhering to the popular perception that students' minds are turning into chopped beef on bread as they sit in the dim light, their social lives and educations leaking away (Maney), these educators have begun to argue video games are in fact good for students and have great potential in education. Indeed, Maney states the prejudice against video games is about to become as dated as the four basic food groups, the philosophy of spare the rod, spoil the child, and asbestos as a safety feature. According to Williams, some types of educational gaming, have been found to successfully exploit the fun and competitive aspects of gaming in order to improve student motivation to learn. Even drill and review of content in standardized courses, undertaken through interactive gaming-educational technology has been found to have a positive impact on classroom environment and student learning (Williams, 2005).

Nonetheless, currently video game use in the culture has several transitional challenges. Most people continue to believe the gaming industry should take more social responsibility for the content and impact of video games (Chiu et al., 2004). A large percentage of children and teenagers, ages 11 through 16, continue to use computer or console video games on average 130 hours per month, and many are using computer or video games 3 to 4 hours a night. This is a behavior which might still be classified as abnormal behavior (Chiu et al.). Of all U.S. 11- to 16-year old boys, 25% visited a video game shop at least once in the past week and 18% at least three times per week (Chiu et al.). Studies have also indicated teenagers who do become heavy users may be unable to use self-control in gaming, and as a result, proper supervision by adults may be needed to increase self-awareness and control (Chiu &

Lee et al.). Overall, video game playing is quite prevalent among preteens and teenagers with 80% of all boys playing video games on a regular basis. In addition, of the games these regular users play, violent games dominate, starting as early as the third grade (Piot, 2003).

Increasingly more researchers agree computer and video games will change the way we learn (Shaffer et al., 2004) while also cautioning video games are no panacea. Shaffer and Squire advocate a constructive use must be formulated for home and school. The researchers base this claim on a new awareness that video games let people participate in new worlds, they let players think, talk and act, they let players inhabit roles otherwise inaccessible to them (Shaffer et al.). Some studies have found, in fact, increased video game playing can result in better outcomes in math, physics and language arts though not as much in social studies, biological and logic (Mitchell & Savil-Smith, 2004). As researchers look more closely at video games, they have attempted to target the way in which the games might be beneficial. One study found the video game is educationally relevant precisely when the content is specific and targeted with precisely defined objectives (Mitchell & Savil-Smith). Others more generally concede video games may bring to youth today that same sort of exploratory thrill older persons experienced in the woods behind the school, on (a) bike whizzing down the hills of the suburban back streets, or settled into (a) tree house during a thunderstorm with a good adventure novel (Piot, 2003). Piot believes even the violence of video games is to perform the same role as scatological humor has long performed in boys' culture generally.

Looking more deeply into the mindset of the generation which has grown up on video games, educators are coming to see these young people may be learning in a new and different way (Carlson, 2003; De Castell & Benson, 2004; Halverson, 2005; Klopfer, 2004; Maney, 2005; Mitchell & Savil-Smith, 2004; Squire, 2005). While many educators still believe one must concentrate on one media at a time while studying or reading, one quarter to one third of all youth today say they use other media while they are engaged with one media (Bradley, 2005). They listen to music, use computers, watch TV, read, and do their homework in a multitasking media environment that does not hinder but actually helps their studying (Bradley). This is a generation where Bradley cites 64% of families have the TV on during dinner, 53% of families have no TV rule, 51% of families have the TV on even if no one is watching it, and only 13% of youth have rules about what they can and cannot watch on TV. As a result of this media immersion environment, young people are spending more time multitasking with various forms of media than ever before (Bradley).

More middle school-aged, young people are also planning on going into the profession of designing video games, and education is responding to this demand. A number of universities and colleges have developed video game design programs with the faculty consisting of members who have all worked in the video game industry (Mangan, 2005). A program at Southern Methodist in Dallas, a gaming industry hot-bed, was designed by leaders in the game industry (Mangan). It includes concentrations on art, level design, or software development, and all students take introductory courses in game studies, which examine social, cultural, legal and business aspects of game development, cites Mangan. MIT now offers a variety of courses related to video game

design and has been studying ways to incorporate video games into the classroom, Mangan notes. Stanford University also offers a course on the history of video gaming, and computer graphics courses include a competition to create the best video game (Mangan).

While those who promote video games in education do discriminate between various types of games and their respective values—racing and shooting games have less potential than complex games like Civilization III® (Sid Meier, Take-Two Interactive Software, Inc., New York, NY, www.civilization.com), or the Sim series—the study of video gaming has begun to focus attention on the kind of literacy youth are now developing (Maney, 2005). The conventional wisdom is American seventh and eighth graders play too many video games and do not read or write as a result, and most of the games are bad for them. Conversely, a careful study of the literacy patterns of a group of teenagers found many students are engaged in everyday literacy practices far beyond the school day in ways that their teachers are unaware of (Luttrell & Parker, 2001). Using Holland's idea of a “figured world,” the study found most students use literacy in meaningful ways in social practice as opposed to prescribed classroom use (Luttrell & Parker). These students made deeply personal uses of their reading and writing, and Luttrell and Parker also found most students reported their school based and personal-based literacy practices were at odds. While school was described as a place of discomfort and anxiety where they felt constrained; in their own private spaces, these same students talked about the pleasure they got, for instance, from reading The Bible or writing poems (Luttrell & Parker). This kind of finding is informing an entirely new attitude about video gaming. Rather than deplore and dismiss video games, some

educators are making the bold claim people ought to use Grand Theft Auto in the classroom to think about value and ideology (Carlson, 2003). This statement brings to the forefront two major elements of the issue of video games: how effective can video games be in improving educational outcomes, and what impact do the games have on youth?

Video Games and Education

Video games have always been supported by “celebratory narratives” as well as being condemned for their violence and apparent mindlessness (Piot, 2003). One such narrative states video games are good for young boys especially as they allow them an outlet for their aggression. In video games, children symbolically act out aggressive fantasies, and thus video gaming is a harmless and even therapeutic way for American society to keep the lid on, to sublimate the energies of raucous youth (Piot). Also, as the physical space of the backyard vanishes in American culture, or at least in the playscape of American youth, video games, Piot argues, provide youth today a surrogate site of play and fantasy which is good for them. Proponents of video games extol the hypnotic power of this form of interactive entertainment; some claiming intense, repetitive play may result in an altered state of consciousness (Funk & Buchman et al., 2004). Others have described the flow state one arrives at while gaming, consisting of intense feelings of enjoyment that occur when a balance between skill and challenge is attained in an intrinsically rewarding activity (Funk et al., 2004).

The importance of this last claim of positive benefits is being in a flow state has been associated with enhanced learning, as well as with enhanced susceptibility to

suggestion (Funk et al.). Hence, an increasing amount of attention is being directed toward understanding how it is that middle-school aged children experience video games and how and when they come to experience flow, conducive to learning, in them.

The proponents of video games address the issue of violence in games by arguing violence is pervasive in society, and that games only reflect that. Without a doubt, increased violence is more likely the result of disintegrating boundaries between self and others, between states and other states, and of the overall dissolution, deterritorialization and remapping of the subject and of corporeality (Piot, 2003). Moreover, Piot has written “if one in ten million players becomes a killer, this is surely weak evidence of causal link between video game play and real world violence.” Along this line of thought, positive value is seen in violence as it allows maturing males to explore what it is like to live in masculine bodies (Piot). This process helps young men identify themselves as male for an otherwise emasculated male suburban youth deprived of the old socializing institutions, Piot reports. The violence in video games can also be seen as but one other of many expressions of the “fragmented subjectivity” of postmodern bodies (Piot). In this sense, video game violence is not the only place where persons experience body parts detached from whole and form (Piot). According to Piot, the typical mall where shopping has been segmented into searches for clothing items for different body parts, the body reduced to alienated commodities, also increases alienation, exclusion and violence.

A still more positive train of thought is promoted by Gee (2004) and others at the University of Wisconsin, who argue the violence involved in games has distracted

educators from thinking about them as models for learning. Gee states a change of mindset is needed so more educators begin to think of video games as relevant to educational reform. He argues video games have the potential to be powerful learning tools, because video games are designed to motivate players to successfully learn and improve their skills. Video games were designed to be “hard fun” where each player is continuously challenged without becoming frustrated (Klopfer, 2005), and because they involve problem-solving, collaboration, the development of spatial memory and planning skills. Perhaps the greatest paradox in the interface is video games are not easy and are appreciated as such, whereas classes are continually required to return to basic and easy levels of discourse (Gee). This paradox is solved by the issue of immersion and involvement. Video games creators know learning works best when the learners are so caught up in their goals that they don't realize they are learning or how much they are learning (Gee).

Given this reorientation of the discourse on video games in favor of their educational potential, the progress thus far in the incorporation of computer and video games has been limited. This is primarily due to the slow and generationally-delimited nature of the rollout of computer and video games. To date, computer and video games for educational purposes have developed in an exogenous and endogenous way. The exogenous games include educational computer games, including drill and competitive gaming environments like response pad software, simulations, multimedia edutainment, and other computer games, all of which place learning over playing. While children in classrooms have tolerated the use of these games, in truth, they do not like them in many of the current manifestations and do not play them outside of class. Many

teachers, pointing out the benefits of such games in classrooms, are content to use them to improve in-class learning (Williams, 2005). Endogenous games, on the other hand, are true environmental-based video games wherein players are immersed in continuous action and playscapes seeking a challenging goal. These endogenous games are also termed edugames and are at the forefront of the theoretical drive to incorporate gaming into the classroom (Gee, 2005). At present, however, the gaming environment in classrooms is divided up into endogenous or edugames, which have received new but primarily theoretical attention, and exogenous or educational games, including simulation and multimedia edutainment: with more practical educational use being made of exogenous as opposed to endogenous gaming or competitive drilling. Competitive gaming/drilling computer technology represents an important element of the exogenous gaming/drilling which can be used to positive effect in classrooms today (Fitch, 2005). This review will discuss the entire landscape of computer video gaming as currently employed in middle school classrooms: first briefly reviewing endogenous games and then exogenous games in all their variety, from simulations to competitive drilling games.

Edugames or Pure (Endogenous) Gaming in the Classroom

Though educational gaming, simulations, and multimedia/edutainment games have established a presence in classrooms, the broader world of video gaming has moved beyond this type of game into pure video gaming (Fabricatore et al., 2002; Gee, 2003; Gee, 2005; Kirriemuir & McFarlane, 2004; Squire, 2005). Not only has the stereotype of the isolated gamer been demolished by the emergence of online multi-

user designed games (or MUDs) (Halverson, 2005), but the quick and dramatic development of technology and effects in virtual gaming has been so entirely embraced by so many young people that while children live in the same physical spaces as their parents, they inhabit different worlds, speak in new languages, write in new forms and communicate using media in ways and for purposes their parents can scarcely comprehend (de Castell & Jenson, 2004). Indeed, the concept of practice as defined by anthropologists Lave and Wagner being an activity that involves skills, resources, and tools, and is mediated by personal and cultural purposes (Squire, 2002), as applies to gamers and games must continue to evolve. At present, the vast majority of computer games used in the classroom (are) education-oriented games, as opposed to pure computer and video games (Kirriemuir & McFarlane). Almost all gaming in middle school is done on computers, with no consoles in sight. Moreover, real games, such as Sim City™ (Electronic Arts, Inc., Redwood City, CA, www.simcity.com), are often misused or used in simplistic ways (Kirriemuir & McFarlane). Sim City has been used to teach geography and about cities in middle school, but some have questioned how effective its use thus far has been (Mitchell & Savil-Smith, 2004). Most of current video game practice in the classroom is being outstripped by the increasing use of pure video games by the gaming population where a new level of attractiveness, complexity and playability has moved far beyond educational gaming (Kirriemuir & McFarlane). Thus, a split has opened up, in the last few years, between classroom practice using educational and simulation games and the reality of virtual gaming. In order to accentuate this split Halverson (2005) and others have begun to make use of the term “endogenous” as opposed to “exogenous” game. The latter are educational games,

relatively easy games, whose gaming experiences are not intrinsically related to the learning content (Halverson). By contrast, endogenous games seek to simulate relevant practices of the target environment in the structure of the game, and players learn how knowledge is organized by navigating the games. To date, endogenous games are themselves both the learning content and the learning environment, Halverson states. Also called pure games or edugames, these games are being given a serious look by a group of scholars precisely because in them there is no unnatural barrier separating learning from gaming, and they are fun first and encourage learning second (Mitchell & Savil-Smith).

With advances in gaming technology in the past five years, increasing color, three-dimensionality, character, speed, variety of movement, and settings, these games have come to fascinate researchers because of their immersive, addictive, complex structures (Piot, 2003). To some the mission to incorporate the learning advantages of such gaming into classrooms has become “a moral imperative” (Squire). In the popular press Steve Johnson argues in favor of such video games because of the number of decisions a user must make while playing them (Maney, 2005), and with academics, who are exploring the structure of these games in order to understand more deeply what learning is, these games appear to be on the verge of reshaping learning (Maney). Indeed, summer camp is now evolving into summer computer gaming camp for middle- and high school students at places like Vassar College (Funk et al., 2004). Research on gaming is being undertaken at MIT and the University of Wisconsin which launched the Education Arcade, an initiative that seeks to transform the way that video and computer games are used in the classroom (Roach, 2003). More universities, such as Carnegie

Mellon University's Entertainment Technology Center, are offering degrees in the study of the development of gaming and understanding the learning principles embedded in gaming (Marinelli & Pausch, 2004).

Currently, there is a considerable divide between theory and practice in the incorporation of virtual, pure or endogenous gaming into middle school classrooms (Gee, 2005; Squire, 2005). Much of the literature on this kind of advanced gaming is concerned with ferreting out the educational benefits that appear to be embedded inside of the games.

Researchers applaud pure games for having done a much better job than we have as educators in engaging students and introducing them to new worlds (Trotter, 2004). Squire (2002) has argued by using challenge, fantasy, player control, and curiosity these games may be the most fully realized educational technology produced to date. One of the contradictions of gaming versus classroom instruction that educators struggle to understand is while games are quite difficult, players readily engage them and even want them to be harder (Gee, 2003). Then these students come to class and complain education is too difficult. Also, because of gaming, a gap has opened up in terminology and frame of reference as teachers rarely know what it is to “power up” or “level out” (Marinelli & Pausch, 2004). Another aspect of video games educators are quite interested in is these games help their players learn quickly (de Castell & Jensen, 2004). Once in the game, the players' attention and intelligence are mobilized through interactive game play (that) can encompass the acquisition of motor and perceptual skills, the completion of increasingly complex interlinked tasks, the learning and systematic pursuit of game-based narrative structures, the internalization and

enactment of appropriate affect, and a range of other attendant forms and conditions of learning (de Castell & Jenson). In virtual worlds learning and doing merge and, more than that, games bring together ways of knowing, ways of doing, ways of being and ways of caring (Shaffer et al., 2004). In short, through virtual worlds, one learns about gravity not through an equation but through an experience of its properties in a game context (Shaffer et al.). Thus, learning no longer means confronting words and symbols separate from the things those words and symbols are about in the first place, Shaffer & Squire note. Finally, most importantly, games capture player attention and keep it, most often without the use of text (de Castell & Jenson). They encourage the development of flow which is conducive to deep learning (Guynup & Demmers, 2005). Altogether, these benefits add up to “intrinsic learning,” a much sought after ideal in educational circles. In video games, the intrinsic learning is created because the game structure itself encourages learning and the story format is relevant to the lives of young people in direct or symbolic ways (Mitchell & Savil-Smith, 2004).

In addition to generally meeting the ideals of many educational theorists, video games are also believed to encourage deep learning by incorporating several other features or factors. Video games are believed to elicit in some what is called the Eliza effect where people form compelling bonds with the programs (Okita, 2004). In psychology, the Eliza effect, named after an early video game, describes a state where people have a willingness to see dumb objects with the full attributes of intelligence (Okita). Studies have shown even simple games can “induce...powerful delusional thinking in quite normal people” (Okita). This is encouraged by the fact that so many games are set in fantasy worlds which are most effective when endogenous; that is

when the fantasy world is intrinsically related to the activity with its goals and dynamics strictly determined by the characteristics of the gaming world (Fabricatore et al., 2002). The pull of this world is deepened by the fact the player manipulates a token. The player then encounters non-player controlled entities seeking to destroy one which powerfully focuses one's attention (Fabricatore et al.). If a game has a high level of playability with all elements flowing together smoothly, then it is even more powerfully compelling. Functional and ambient information can be marshaled to make the environment more useful and personal as well, Fabricatore and Nussbaum have found.

As well as drawing users in, these games are lauded for players often learn through failure. When a player fails, he or she must confront gaps or flaws in their current understanding through cycles of recursive play (Squire, 2005). As a result of moving through these cycles of failure and then learning how not to fail, player thinking becomes more and more complex (Squire). Another supporting feature of learning in these games is the games are autotelic. There are no rewards external to the game; the reward is in completing the game itself (Guynup & Demmers, 2005). This fact motivates learning. So does the attainment of flow, defined by Csikszentmihalyi, who coined the word, as a situation where motivation is embedded in the play process, and all goals outside the game are forgotten (Guynup & Demmers). Another aspect of these games educators are quite interested in is the fact players make as well as play the games. As the player becomes involved in the game, he or she begins to map out his own approach and may end up designing mod levels or variations which others may utilize (Shaffer et al., 2004). Additionally, an aspect of gaming receiving increased attention is that games allow the player to “morph” into other characters and allows one to “shape

shift” in a mind-numbing variety of ways, shrinking, expanding, flying, disappearing (Piot, 2003).

A special area of study in gaming is rooted in the problem of playability. It is theorized primarily by Sutton-Smith that playability is encouraged and propelled by one of seven rhetorics of play involving the idea of progress, fate, power, identity, imaginary, frivolous and self (Guynup & Demmers, 2005). If a game is held to the narrative standard of one of these rhetorics, it is believed the game will be more playable and more immersive to players. Likewise, play rhetorics can be merged into the multi-leveled learning process becoming the back-story, intertwining with other rhetorics, and altogether driving a narrative which encourages more playability (Guynup & Demmers). The importance of play rhetorics for educators is they help players get over challenges that are too demanding as children do not enjoy being challenged in areas they are not good at, Guynup & Demmers have acknowledged. As a result, a sense of progress can be created by placing a series of individual challenges in the way which a player progressively overcomes. A sense a fate is instilled in the game by including it in change elements or random questions (Guynup & Demmers).

Besides detailing those elements of games that intrigue and offer promise to educators, other researchers concede there are good and bad games; there are games that encourage learning, and others that do not. While first-person shooter, racing, or sporting games may not help students learn, more complicated adventure-fantasy games and simulation games like Sim City and Civilization III do offer promise to educators (Gee, 2005). Even among games of a single type, there are good and bad games in terms of their learning potential. Accordingly, some researchers explore the

question: educationally, what makes a good video game? Educators are certainly concerned good principles of learning are built into good computer and video games, as Gee points out. These are related to what makes a good video game in the first place. A good game, primarily according to Gee, is one in which basic skills are taught to the player as part and parcel of playing the game. Good games help players learn the more difficult processes as well with what are called “fish tanks,” or stripped down versions of the game, acting as tutorials to help players get through one or two levels (Gee). A fish tank is a simplified ecosystem clearly displaying some critical variable and their interactions that are otherwise obscured in the highly complex ecosystem in the real game, states Gee. The Rise of Nations™ (Microsoft Corp., Redmond, WA, www.microsoft.com), tutorial is cited as a wonderful fish tank. This is a good model for educators, since it is more than drill and skill and it does leave players to their own devices as some progressive educators do (Gee).

Another way in which a good game helps learning is by providing a sandbox; this is defined by Gee, based on the metaphor of a childhood safe haven, as a tangential space where the player can learn to play the game in a context that feels like the real thing, but with dangers and risks greatly mitigated. Again, the Rise of Nations is reported to have an excellent sandbox where one feels the complexity of the game but suffers none of the consequences of failure in it (Gee).

Another characteristic of a good game is when verbal information is related directly to visual information. This is an optimal educational experience as human beings do not understand decontextualized language very well and understand things more generally when they have first experienced lots of concrete examples (Gee,

2003). What is more, as the game progresses, good games continue to create and support cycles of expertise involving both practice and mastery, optimally paced, until one arrives at the conclusion of the game (Gee). Final Fantasy, Gee cites, does a good job of alternative fruitful practice and new challenges such that players sense their own growing sophistication, almost as an incremental curve as the game progresses.

Moderating the degree of challenge is also an important element of a good game. The optimal level of challenge in a good game is described by Gee as “pleasantly frustrating.” This entails a space where what the player already knows is measured against what he does not know, and then challenging him. The space is designed to enhance the trajectory through which the learner traverses them (Gee, 2003). This too corresponds to learning theory (one thinks of Vygotsky's zone of proximal development), where learning works best when new challenges are pleasantly frustrating in the sense of being felt by learners to be at the outer edge of but within their regime of competence (Gee). In other words, each level dances around the outer limits of the players abilities, seeking at every point to be hard enough to be just doable, observes Gee. In order for the frustration of confronting a challenge to be pleasant, learners must feel that their effort is paying off in the sense that they can see, even when they fail, how and if they are making progress (Gee).

Good games give players smart tools, part of the controls, or part of the arsenal provided in an icon which the player identifies with (Gee, 2005). This too is educationally appropriate as learners learn by applying models or tools of conceptualization to issues and not simply experiencing and trying to figure something out (Gee). Good games also ensure the problems presented are well ordered and

sequenced according to difficulty; thus earlier parts of a good game are always looking forward to later parts (Gee). As a result, Return to Castle Wolfenstein® (ID Software Inc., Mesquite, TX, www.idsoftware.com), does a good job of offering players problems that send them down fruitful paths for what they will face later in the game (Gee).

Because deep learning requires extended commitment from the player, good games offer devices encouraging extended play. They offer players identities that trigger a deep investment on the part of the player (Gee, 2005). Some good games, like Animal Crossing™ (Nintendo of America, Inc., Redmond, WA, www.animal-crossing.com), offer blank slate characters the player eventually inhabits with skills. Other games offer defined characters whose skills the player gradually discovers through play. Either way, the player becomes deeply involved. Finally, cognitive research has found perception and action are deeply interconnected (Gee). One learns better by doing than by copying notes. Good games enhance doing by offering just-in-time and on-demand advice or tutorials, by creating fine-grained action sequences, environments, playscapes, and other virtual elements that make every manipulation of the object in the game feel like an action. Consequently, as Gee observes, the Rise of Nations allows such effective control of buildings, landscapes and whole armies as tools that the player feels like God. The actionable aspect of a good game is enhanced by the many opportunities offered for players to design and build, in effect co-create the game. Co-creation is an important educational element as cognitive theory also finds a sense of ownership enhances participation and deepens the quality of learning (Gee). The final element of good gaming is players are able to create communities of action to play the game as a group and thereby greatly deepening the learning experience

(Halverson, 2005). In all these ways good games are distinguished from bad games and are held out as models for educators to transform their classrooms.

The question remains to what extent has this theoretical fascination translated into middle school classroom practice? At present, little is known about what players are learning through playing a game like Sim City (Squire, 2002). Squire reports the pedagogical potential of games and social contexts of gaming have been woefully unexamined in a practical way. Some practical knowledge has been developed through the Society for the Advancement of Games and Simulations in Education and Training and in the Sage journal, *Simulation and Gaming*, but there is actually very little agreement among educational technologists as to the theoretical underpinnings of why we should use games (Squire). Some studies regarding ADHD have found because video games concentrate on students utilizing executive functions they might increase concentration, reduce unwanted hyperactive-impulsive and inattentive behaviors in such students (Houghton et al., 2004). There is some evidence that video game play promotes the release of striatal dopamine, a hormone which ADHD students are said to be deficient, thus improving their educational outcomes (Houghton et al.).

General studies have found as soon as video games are brought into a middle school classroom the level of motivation increases among many of the students (Squire, 2005). Moreover, the instructional context that envelopes gaming is believed to be important in giving an attentive structure to a classroom as well, Squire discovered. According to the theory that learning is a social practice as well, the issue of transferability of learning from games to other areas is an open question. One study found there are ways to use certain games, like Sim City, to transform game playing into

participation in social practice (Squire). An example is provided by Squire of a middle school classroom where Sim City was used, and students were able to better answer historical questions as a result of its use. Another practical possibility for gaming is that the introduction of co-created games would accentuate the individual means of learning and thus encourage customization of curriculum in the classroom (Gee). In fact, one study found letting middle school students in particular design their own games, or modes of games, engaged them far more than otherwise (Schreve, 2005).

In exploring practical applications of games in middle school classrooms, shooter and sporting games are not mentioned. The two most often cited and promoted games, considered to be among the best of all games in terms of their educational potential, are Civilization III and Sim City. Unlike Ages of Empire™ (Microsoft Corp., Redmond, WA, www.microsoft.com), which makes no attempt to model civilizations, Civilizations III provides a wealth of information which players must gradually make use of (Trotter, 2004). That the player in Civilization III must manage a whole civilization certainly brings into immediate use much information and data from many areas and enhances a players understanding of history (Carlson, 2003). Civilization III is mentioned repeatedly in the literature as a prime example of a powerful game with great potential for deep learning (Squire, 2002). In a middle school history course, the use of Civilization III was found to encourage more critical and more complicated questions from students (Squire). This is because rather than break problems down into manageable pieces, Civilization III presents the player with large, complex problems, and managing this complexity continue(s) to be a challenge (Squire). Teachers can create “instructional resources” around Civilization III not only to deepen their students' historical knowledge

but deepen their experience of playing the game. The construction of adjunct timelines, histories, or media based on the history of their civilization is recommended by Squire. A case study of the use of Civilization III in a middle school classroom presents abundant anecdotal evidence the game helped middle school students engage with history more effectively (Schreve, 2005). Sim City is also mentioned often in the literature, and it has been seeing some practical incorporation in classrooms. Sim City was introduced into the Erving Elementary School, in Erving, Mass., for example, where a city planning curriculum was built around the game (Squire, 2005). While one noted city planner pointed out as race and gender play no role in Sim City, and one comes away from the game with a shallow view of the politics of city planning, others argue critiquing the game can also encourage learning (Squire, 2002).

Another oft-mentioned game used by middle school classes is River City, a project funded by the National Science Foundation, where a city experiences a problem like the outbreak of an epidemic, and students must gather information in order to solve the problem. The use of this game has been seen by teachers to improve student involvement in class (Schreve). There are many possibilities. So far however, there are less actual classroom uses than the journal and magazine articles published on the topic, and no one has done empirically grounded research in the successes and challenges of using such a game to support learning (Squire, 2002).

There are some practical drawbacks to the implementation of games in classes from a youth-oriented cultural perspective. Many students, in a middle school classroom where games were introduced, wondered “why are we doing this?” as none of them had ever considered the educational potential of the games either (Gee, 2002). On the other

hand, some true gamers think of gaming as their turf, apart from school, and do not take kindly to schools and teachers involving themselves in their gaming or in making gaming in any way compulsory. If it is the voluntary character of gaming that makes it successful, then, of course, any direct incorporation in a classroom for credit will cause some resistance.

A few specific studies have experimented with the introduction of other video games in middle school classrooms in order to determine their impact on student learning. The simulation game *Sahel Zone* was introduced into one classroom where it was found that the students' ability to guide their studying and give advice to others regarding making their way through the knowledge increased, but the quality of their actual game play decreased (Mitchell & Savil-Smith, 2004). Another study of game use in the classroom was inconclusive about the learning outcome gains, but it found that the instant feedback and accessibility afforded by a computer simulation was appreciated by learners (Mitchell & Savil-Smith). A study undertaken in Chile found when an educational video game was introduced into a classroom, positive effects were found in learning, motivation and classroom dynamics as recorded by Mitchell and Savil-Smith. Using the game *Life Challenge™*, the study found statistically significant learning gains on both knowledge enhancement and self-efficacy scores (Mitchell & Savil-Smith).

In a survey of middle school students who used video games in classrooms, only 35% loved playing the game and thought it was a perfect way to learn history (Squire, 2005). Squire notes many of these students had actively resisted the history curriculum, because they regarded it as propaganda but now enjoyed history through gaming. Even

so, that leaves 65% of students who were less than thrilled or did not like the game. To be sure, a suspicion has developed. Gamers like gaming in the classroom, whereas non-gamers do not. It is acknowledged, certainly, gaming is a particular taste and not for everyone, nor should educators try to force it on everyone. Gaming requires considerable support and skill, and some students simply do not have the experience to make classroom incorporation of gaming productive (Klopfer, 2005). Also, gaming has its own literacy as games do not and in fact should not mirror the world but create their own worlds. This can become a secret language only a few gamers share leaving others out (Klopfer). Failure in gaming is known to cause considerable frustration, and some educators wonder about the capacity of all students to overcome such frustration (Squire). Thus, games may be a poor fit for learners who come to school with damaged beliefs about learning, such as that failure is a value judgment on themselves as students Squire informs. As students grow older, the issue of learning style also becomes an issue. The current educational regime favors one type of learning style, while gaming may favor and be favored by students who have fallen behind because they have a different kind of learning style. Accordingly, a split could develop between gamers and others in classrooms and between gaming and the educational goals of the classroom itself (Squire). Along the same lines, in one case where Civilization III was incorporated in a classroom to help all and especially struggling students to reengage, the successful students were concerned that the more traditional school-based expertise was not being honored in the classroom and they were not convinced that success in a games-based unit would help them on college entrance exams or in college classrooms (Squire).

Where then does the future of video games in classrooms lie? Some argue perhaps a whole new type of game will have to be developed and simply incorporating preexisting commercial games into classrooms will not be enough. An epistemic game is one in which a professional community of practice, or way of life, is built into the structure of playing the game. Thus as one plays, one learns the ropes of a profession, and one does learn by doing (Shaffer et al., 2004). A study of the use of an epistemic game, Madison 2200™, showed players form, or start to form, an epistemic frame of urban planning (Shaffer et al.). In a game like Madison 2200, the student learns how to play, work, and live in a world under certain frames of reference and rules of thumb. This kind of game created “situated learning.” As one plays, one also then begins to see the world around one differently. Shaffer and Squire claim after playing Madison 2200 a student can walk down the same street she had been on the day before and notice things she never had seen before. This is situated learning at its most profound, and it is believed, with some empirical support, this type of original educationally-constructed game can indeed improve student learning in various content areas. While acknowledging that building such games is no small task, the good news is that in many cases existing communities of practice have already done a lot of that work (Shaffer & Squire).

Computer Games in the Classroom

The idea computer games can improve education, however, arrives at a time when most schools continue to organize their classes in a very traditional way (Jonnavithula & Kinshuk, 2005). Most teachers continue to act on the assumption they

can provide all the needed information to students with the help of a few books. However, the changing nature of work, society, and students has made this model increasingly out of date. Increasingly educators are arguing even though students are good at memorizing facts, such an exercise is not what good education is about (Gee, 2004). Many constructivist educators have documented the fact that humans are not good at learning through hearing or reading lots of words out of context of applications that give these words situated or experimental meanings (Gee). While lectures and textbooks, Gee writes, “are fine on demand, used when learners are ready for them,” they are not helpful if the students are not ready for them and have no real need of the information. What is more, current schooling is synchronized in terms of curriculum and delivery, thus school is easy for some and hard for others even when they are in the same classroom (Gee). This maladaptive means of delivery of information results in grading and also designations like special students and others who “fall behind” (Gee). It is believed by many educators video games can alleviate some or all of these problems.

At present, no clear causal relationship between gaming and academic performance has been seen in the literature, with many finding both positive and negative effects (Mitchell & Savil-Smith, 2004). Many educators claim video games can “stimulate the enjoyment, motivation and engagement of users, aiding recall and information retrieval and can also encourage the development of various social and cognitive skills,” Mitchell and Savil-Smith state. Others find, regardless of possible theoretical benefits, the practical level gaming takes away from homework time and results in lower achievement for some students (Mitchell & Savil-Smith). Teacher

reluctance to incorporate video games in classrooms has created a bottleneck in the progress toward a resolution of this debate. Most teachers remain reluctant to consider the use of such consoles in the classroom (Kirriemuir & McFarlane, 2004), for various reasons. Though some studies have found video games do improve student hand-eye coordination, no one yet knows how to incorporate that finding into classroom instruction (Funk et al., 2002). In a survey of attitudes about computer use in the classroom, most teachers reported still feeling ambivalent. One reason was many fear the idea learning should be fun, and they dispute the idea of edutainment which so much educational gaming is invested in. Another reason is students have greater technical expertise, and once the game is involved, teachers experience difficulty keeping students on task, or even on planned activities (Kirriemuir & McFarlane). Moreover, many teachers in middle school simply make use of computer games as a reward for good behavior. This reinforces the idea computer games are just for fun and not to be seriously considered for learning purposes; this is a situation “frustrating” to educational researchers (Kirriemuir & McFarlane).

A common claim in favor of including computer games in classrooms is they help students build problem-solving skills. However, research on the transfer of such skills from games to other areas of study gives very little reason to believe that players are developing skills that are useful in anything but very similar contexts (Squire, 2002). A skilled player in a certain game may, therefore, develop skills helpful in playing other games, but this does not mean that players develop generalizable strategic thinking or planning skills, conveys Squire. Squire also recounts, “just because a player can plan an attack or develop a lightning quick reaction in Half Life™ does not mean that she can

plan her life effectively, or think quickly in other contexts, such as in a debate or in a courtroom.”

In support of video games, on the other hand, is the finding while children learn little when they watch TV passively, TV can be good for them when they watch with adults who get them to think and talk about what they are watching (Gee, 2003). Others argue the increasing disparity between the world of gaming most children live in outside of school and a traditional school environment which is described by one researcher as “suddenly in Dickens” (Carlson, 2003), means educators are going to have to accept findings which indicate children learn best when they are entertained (Carlson). Moreover, children learn better when they must work toward complex goals, use thinking and emotion to get there, and “when the consequences of the actions can be observed,” relates Carlson. Gaming is also beneficial to slow-starting students as it allows for “horizontal learning” where the student can play around to explore what they are about to learn (Gee, 2005). The fact games provide feedback to help even a slow learner progress is also a plus. As Gee remarks, “there are no special learners when it comes to video games...Even an old guy like me can wander the plains of Morrowind long enough to pick up the ropes and master the game.” Overall, games employ well-established learning principles, and thus they should be studied more deeply with regard to their educational potential (Gee). Most importantly, many now understand the dichotomy between education and entertainment is false, as “serious fun” by nature is both work and play, education and entertainment, and both can coexist in a negotiated balance (Okan, 2003). As a result, the old separation between education and

entertainment is obsolete for most young people, or it should be (de Castell & Jenson, 2004).

At the moment, education is at the early stages of applying interactive simulation technology in education (Marinelli & Pausch, 2004). Presently, education is not doing a great job of it yet, Marinelli and Pausch tell us, in incorporating video games in education. The current, most popular, and pervasive mode of incorporating video and computer gaming technology in the classrooms is through educational games. As gaming itself has moved into virtual environment games, exogenous games are increasingly being critiqued for their limitations. Without a doubt, most games are plagued by internal contradictions created by a sense of the separation of education and entertainment. Whenever an educational game designer joins a commercial game design team, it is remarked they “suck the fun out of the game” (Trotter, 2004). Students now nourished by virtual gaming find most educational games to be boring and not fun. Even in the case of an educator critiquing student-designed games as all razzle-dazzle and no content, one may choose to argue the path to learning through video games is lined with temptations, distractions, and elements of risk (McKenzie, 2003), or it may simply be the education-entertainment split has not yet been closed.

At present, most classroom instruction is still built around the content fetish (Gee, 2005). The recent trend in standardization only reinforces the idea, Gee writes, “an academic area...is constituted by some definitive list of facts or body of information that can be tested in a standardized way.” As students become more exploratory, and develop a higher cognitive capacity related to gaming, schools have responded by imposing more rules and decreasing the complexity of cognitive tasks assigned,

creating a mismatch between adolescent development stage and the school learning environment (Halverson, 2005). In stark contrast to this current situation, constructivist educators argue a field is not a body of facts but the activities and ways of knowing through which such facts are generated, defended and modified (Gee). One can, therefore, only learn by doing; in science, for example, one can only learn science by doing science, in classroom experiments and exercises. In this context alone are students' thinking and reasoning developed so that he or she can appraise that information, and separate the relevant from the irrelevant and the important from the trivial (Okan, 2003). As children have been granted far greater power due to technology, teachers must respond more to their needs than vice versa, and this too changes the classroom (de Castell & Jenson, 2004).

Much of the continued use of video or computer games in classrooms is derived from a traditional idea of what learning should be. For many, the computer is helpful as a means of delivering information to users, and it offers some service in terms of presentation and storage of information (Mayer & Moreno, 2002). The traditional approach to gaming is “technical” and focused on teaching skills. But studies have found the skills learned in such “games” were limited to the games, and young students were unable to generalize them to other areas (Blomquist & Luhtanen, 2000). In math, one study found middle school algebra students who learn decontextualized problems are good at solving those problems, but they had little sense of the critical thinking involved in algebra and applying algebra to the world (Squire, 2002). Traditional algebra video games have only repeated this problem in an online or computer context. Online courses have been critiqued as little more than “online course notes,” Squire reports.

Most of the educational games on the market are used by middle school students in classrooms, but these are typically disliked by students because the fun factor is missing (Mitchell & Savil-Smith, 2004). Most middle school students, in a study of such games, reported to Mitchell and Savil-Smith they would never voluntarily play such a game outside of class. It is believed by some designers that the exogenous nature of these games lack a mission, a goal, complexity and an immersive quality, and make them less fun to children. Moreover, while some games do focus on problem-solving, that exercise is not tactical or strategic as called for in pure video games (Blomquist & Luhtanen, 2000). Much of the activity in such games has also been described as pointless, since the use of various elements, such as a spreadsheet, is done without an authentic connection to the regular curriculum (McKenzie, 2003). In many games, the activities involved do not require critical thinking and are automatic, so the student merely skims along the surface of the content without probing, exploring or asking essential questions or creating new insight (McKenzie). Though some of these games are informed by game studies on what motivates players to continue playing, as for example in gambling, where a series of near wins is built in to keep gamblers gambling (Sevigney & Ladouceur, 2002), many educational games lack complex gaming structures.

The structural differences between educational games and virtual games became exposed during 2004 when a first person shooter format was adapted to a nonviolent search game called Go Fish. In order to resolve the differences, the designers had to merge the educational content into individual acts of play (Guynup & Demmers, 2005). This was achieved by increasing the motivation of the game, and

ensuring the game as a whole had “flow” (Guynup & Demmers). The difficulties involved in this merger indirectly highlight the gulf separating the two kinds of gaming at present. Whether drag or drop, puzzle, drilling, matching, or other identification-oriented games, most of these exogenous structures have now been called into question for their educational effectiveness (Jonnavithula & Kinshuk, 2005). Some varieties of these games, nonetheless, have been shown to increase student levels of attention and their motivation to learn, and others have found some concrete educational gains as the result of a drilling-competitive game in a test preparation context (Williams, 2005). This situation is complicated by the fact that so many players are playing virtual games out of school. In a test of a twitch game, an educational game in the sixth grade, it was found users who had easy access to higher resources in gaming became bored quite quickly with an in-class educational twitch game (Mitchell & Savil-Smith, 2004). Users with fewer resources in gaming did continue to make productive use of the game. Another study found more positive results, a game which challenged students to do a job well, through a series of intensive sessions, did guide them through a job and improve their performance on certain tasks (Mitchell & Savil-Smith). Generally, the results of studies of the effectiveness of educational games find middle school children will and do play the games in class, and indeed, often play beyond their time, becoming distracted by them, and absorbed in them. However, measuring exactly what they are learning is problematic (Kirriemuir & McFarlane, 2004). Other studies have found still less encouraging impact of educational games on children's educational outcomes (Hesketh & Waters, 2003). In general, then, computer games and educational games have been shown to be somewhat successful in raising achievement levels, but this has occurred

only in courses where specific objectives can easily be stated such as math and language (Mitchell & Savil-Smith). Specific advantages are based in what kind of gaming format is being used: at present, exogenous gaming in classrooms include simulation and multimedia entertainment and competitive/interactive drilling games.

Simulation and Multimedia Edutainment

Two relatively strong trends in video or computer gaming that have emerged from the traditional educational game framework are simulations and edutainment/multimedia games. Each type of game has deriving rules about what works and what does not work (Halverson, 2005; Mitchell & Savil-Smith, 2004). There is some evidence these types of games do achieve more noticeable results.

Simulation games have been used in middle schools for some time. These are generally believed to offer more promise as they are linked to simulation gaming already being made use of in business and other areas of adult life such as the military. Simulation games are primarily made use of to enhance children's spatial abilities and for general cognitive development (Mitchell & Savil-Smith, 2004). Simulations are often made use of in training programs and are increasingly being designed for players to practice the skills necessary in a variety of businesses (Halverson, 2005). By using branching narratives, simulations are now more able to allow both novices and experts to make use of the same game in different ways. Simulations can also build in challenge as the novice improves his or her performance, Halverson notes. Simulations are also beginning to merge in the direction of pure video games in allowing, for example, teams to develop during play. In America's Army, a noted simulation game used by the U.S.

Army to train soldiers, players can now learn much more about strategy and conducting missions by joining into teams. The Army additionally sees such a capability as a cutting edge way to interact with peoples' minds, not to teach facts, but to teach worldviews (Carlson, 2003). In studies comparing simulation games with traditional classroom educational computer or video games, it was found simulation games show greater retention over time than conventional classroom instruction (Jonnavithula & Kinshuk, 2005).

Another positive element of simulations is it offers feedback and allows students to test themselves on how far they have come unhindered by the stress and anxiety associated with academic testing (Jonnavithula & Kinshuk). When comparing the two kinds of game, it becomes apparent instruction games simply drill and practice students concerning certain facts, while simulations enable knowledge enhancement (and) intrinsic skill development, as recounted by Jonnavithula and Kinshuk. Finally, simulation games are favored by many because they can do what many teachers find difficult, drench students in the colors and complexities of another time and place (Trotter, 2004) and give them a more experiential sense of a context.

At this point in time, simulation game use receives its most significant amount of support, not from middle schools, but from the college-level educational community. Simulations have provided efficient and safe learning opportunities for medical, architectural, business and scientific students, and activity-based simulations such as mock trial, the Model UN, or lab experiments have always been a staple of the school instructional program (Halverson, 2005). Some subjects, such as systems thinking, geology, immigration, or global warming, states Halverson, are even believed to be

better taught using simulations. Simulations have also been used to enhance the managerial skills of school leaders. Simulations are favored on this level as they allow one to model professions, build professional epistemic frames, and then instruct users in a just in time or on demand way as mandated by educational theory for older students (Halverson). The importance of modeling the epistemic frames of various professions in simulations is students learn by doing, and they learn by learning the rules and ways of thinking of various professions or the profession they may choose to pursue—a type of learning which is much more valid than simply learning facts (Halverson).

Some limitations continue to interfere with the productive incorporation of simulation games into middle school classrooms. While undoubtedly fun, some argue they are not necessarily engaging (Halverson, 2005). If the game does not have a series of relevant activities, with compelling goals, defined paths, and action-linked sequences that teach lessons, then the simulation may be ineffective (Halverson). In order to preclude the creation of pointless simulation, goal-based design has become more prevalent. According to this scenario, each level has a goal, and opportunities to learn from failure are built into the game, describes Halverson. Only with goals and learning from errors is an authentic, engaging learning environment created (Halverson). Halverson tells of two games which have integrated player experimentation and strategizing in the study of electricity and historical causation, and they are Supercharged and Revolution.

The limited time span of class time often curtails simulation play before learning occurs, teachers often need more support material than they are provided, and at

present many games do not allow players to save their progress, so that they can resume play where they left off during the next class. Additionally, versions of the game need to be tailored to the curriculum (Kirriemuir & McFarlane, 2004). Also, simulation games are quite costly to make, inhibiting rollout and tailoring. Other games simply have elements not appropriate for the classroom context. One simulation had a “4-minute full motion video” in its introduction which could not be disabled, and therefore had to be played at the start of every session (Kirriemuir & McFarlane). Many simulation games have features and elements simply not necessary, nor required, in the classroom. As a result, middle school students are tempted to use some of these functions, providing unplanned outcomes to the session, conveys Kirriemuir and McFarlane. This dynamic in turn empowers students to want to bring their own games to middle school which many teachers and schools remain reluctant to allow for licensing issues and also as a matter of controlling the lesson plan (Kirriemuir & McFarlane).

Another area where educational gaming continues to explore new frontiers is in multimedia or what is often called edutainment. Edutainment has been supported by educators who argue students today live in a different media world, and their world must be accommodated (Landt et al., 2001). Edutainment computer or video programs must be so entertaining it is hard to distinguish work from play (Landt et al.). By combining “technology and grease” (Landt et al.), it is believed students learn better. Edutainment, as a mode of video or computer game presentation, remains at present a hybrid, part way between instructional gaming and virtual gaming. It relies on visual as opposed to textual material, its format is often narrative or game like, and it addresses the student in a more informal, less didactic manner (Okan, 2003). Most tellingly, it involves

interactive pedagogy, and totally depends on an obsessive insistence that learning is inevitably fun, reports Okan. This type of gaming adheres to a constructivist view of learning which replaces a knowledge-acquisition view of learning. According to Okan, adding new information and memorizing information, isn't the same as "true education," which occurs when one builds a mental representation that makes sense to the learner, and teaching involves acting as a cognitive guide on authentic academic tasks, such as through discussion and guided discovery (Okan).

A more important way in which edutainment responds to the media environment in which students live is it concentrates on developing and maintaining student focus (Landt et al., 2001). A major problem in the new culture of "information surplus and time scarcity" is attention. Most students today have developed highly efficient and effective deployments of partial, subsidiary and intermittent attention strategies through multitasking and switching from one media to another often in their daily lives (de Castell & Jenson, 2004). In this, students are adapting to what Havelock has termed a major shift of cultural paradigm from print back to image occurring in the new media world (de Castell & Jenson). The essence of the "new attentional economy" is anyone with the remote control in hand owns and controls a full economic share of her or his own attention, informs de Castell and Jenson. The unimodal, text-based means, which schools have used to gain student's attention, are no longer adequate to gain the attention of multimodal, multitasking youth, who have never known the text-bound world from which their elders have come (de Castell & Jenson). In order to properly design a multimedia environment for classes, a proper theoretical model of attention must be used. Lanham has argued in an era of information surplus the essence of attention is to

enframe, select, and organized from the vast stores of available raw data those elements that enable the movement from information to knowledge (de Castell & Jensen). Consequently, each student develops an attentional economy, and the purpose of a multimedia program should not simply be to gain attention but to empower students to use their attention to build new knowledge. In order to analyze the attentional economy of simulated or other games, Lanham developed a rhetorical theory; he found far from installing a new framework for the operation of human attention, (digital technologies) have in fact enabled a return to older, preliterate attentional practices (de Castell & Jenson). Rather than concentrate on text, multimodal attention bifurcates responses, developing cognitive strategies that have more to do with ancient rhetoric than modern Western notation (de Castell & Jenson). In gaming, de Castell and Jensen report many of these structures are found to be embedded, framing, organizing, and structuring knowledge in rhetorical ways that transcend text.

As a consequence, while some critique multimedia and edutainment gaming as all bells and whistles, other educators see those bells and whistles as the harbingers of a new attentional economy. Studies have shown multimedia succeeds or fails as education entirely on the mode of presentation. As in other areas of video gaming, gaming theory feeds this area of study. Looking at gambling, again, it was found a sequence of near wins in a gaming experience will keep the gamer gaming (Sevigney & Ladouceur, 2002). In the sequencing, spacing, and delaying of wins, the player's interest is sustained. Study is also called for into how the spacing affects player emotions, because these variables are partly responsible for differences in gambling duration (Sevigney & Lacdouceur). While some educators will undoubtedly feel

uncomfortable linking gaming theory to learning, among the rhetorics of attention Lanham argues multimedia edutainment must be informed by, gaming strategies are among the arsenal.

Animation is also supported as one of the most exciting forms of pictorial presentation used in an edutainment context (Mayer & Moreno, 2002). Studies have shown animation may or may not lead to learning, depending on how it is used, explain Mayer and Moreno. As a result of these findings, a search is underway to discover how to conform animation to educational needs and also what makes animation more effective and attention-getting to students (Mayer & Moreno).

Most multimedia, edutainment, middle school, classroom gaming continues to use verbal and pictorial means as well as dynamic materials such as video or animation (Mayer & Moreno, 2002). Evidence suggests placing visual material next to verbal material enhances student understanding. Moreover, how one situates and utilizes the visual material (i.e. in Lanham's term, what the rhetoric of attention is) impacts the learning potential. The theory as to why visual enhancement of verbal material should enhance learning is based on the cognitive theory of multimedia learning. According to this theory, the mind selects from words a cause and effect chain of meaning, while at the same time the eye selects from images another cause and effect chain of meaning. As these processes occur, the visual method of meaning-making is integrated with the verbal, so the learner has corresponding pictorial and verbal representation in the working memory at the same time (Mayer & Moreno). If a learning environment encourages the double, visual and verbal integration of meaning, this is believed to be more likely to result in meaningful learning (Mayer & Moreno). In a study of microworld

mathematical and botany games, using visual and verbal material, a model of optimal multimedia learning was developed. It was found that students learn better when there is animation and narration combined than from narration alone primarily, because students are better able to make mental connections between the two. It was also found that the screen text is next to the animation, to strengthen the student's ability to make a mental connection. Students, in addition, learn better when the elements of narration and animation are presented at the same time rather than separated in time, as again, students are better able to make mental connections (Mayer & Moreno). The combination of narration and animation is most effective when extraneous sound, music, or video, which may be irrelevant and thus block the making of mental connections, is omitted. Also, students learn more when the narration is a voice over than when it is presented as an on-screen text as they tend to become overloaded by visually taking in image and word, Mayer and Moreno discovered. Finally, narration is more effective when it is conversational than when it is formal as this personally involves students in the conversation. In the study, it was found when a multimedia edutainment environment adheres to such principles, then attention was held, and students learn.

However, it appears such optimal cases of design are rare. Too often the design of multimedia environments is inopportune for learning and can even have negative learning effects. One study found the non-linear association-based structure of multimedia or internet presentation is apparently theoretically apropos to constructivist theory; in fact, too many learners continue to be lured by the visual appeal of the presentations and wander from one item to another without direction (Okan, 2003). As a

result of this shallow exploratory behavior, made potentially still more negative by the “butterfly defect,” which states no two students will search the same material the same way, or one student search the same material the same way twice. At present the literature remains encouraged but unconvinced by the potential of multimedia edutainment computer and video gaming in the classroom.

Drill/Competitive Computational Games

Of the educational, computer gaming modules presently being used in classrooms, drilling competitive games are receiving the most practical use in the current, standardized, educational environment. One of the most popular of this type of computer gaming technology is LearnStar® (LearnStar, Inc., Dallas, TX, www.learnstar.com), which is one of a growing number of products with the capability of permitting students to respond simultaneously to an instructor's question (Fitch, 2004). In a comparable module called Classtalk, students are equipped with transmitters allowing them to transmit responses to a standard computer screen monitored by the teacher, Fitch reports. LearnStar can operate with wireless handheld key pad devices by which students are individually able to respond to games or tests presented by the teacher at a general screen (Matheny, 2003). The students participate in such exercises, sometimes in a competitive gaming format, so the teacher can gain a quick sense of the degree to which a lesson was understood. It is believed by a number of teachers who have used LearnStar such immediate response does “accelerate learning” as the teacher does not have to wait until test time to see a student did not

understand a lesson (Matheny). LearnStar is also believed to improve learning, because it is both interactive and competitive in nature (Williams, 2005).

LearnStar has moved out front in computer game classroom implementation. This game allows students to respond to questions simultaneously and in an instantly recorded fashion where the answers—whether right or wrong—are visible to all (Matheny, 2003). LearnStar is at the cutting edge of classroom drilling technology which increasingly involves projection equipment for the display of computer-based instruction materials as well as internet access and other videotape media. The presence of such media has dramatically enhanced the means by which classroom presentations are made (Fitch, 2004). LearnStar is a particularly advanced form of in-class technology as its software is controlled by the teacher, not the other way around, and it allows students to provide immediate feedback during lessons which in itself “creates teachable moments” (LearnStar, 2005). While some in-class technology creates cumbersome technical problems for teachers, LearnStar, those who have used it indicate, is easy to use and increases efficiency in the classroom (LearnStar).

LearnStar offers a format believed by many to offer the best of both gaming worlds. It has elements of both exogenous gaming and endogenous gaming. While some experimental games have been introduced using the “edugame” format (Gee, 2005), LearnStar is already in the classrooms, popularly implemented, and resulting in successful improvement of test scores which puts it on the cutting edge. The LearnStar format is believed to help students think faster, and students find the competitive aspect of LearnStar to be very appealing. LearnStar may be the ideal classroom computer game and the foundation for any future synthesis of educational computer games and

edugames in classrooms (Matheny, 2003). By retaining its exogenous educational game structure, LearnStar is able to align itself to standardized modules of learning, and thus its multi-level, multi-subject content has become popular for students preparing for standardized tests. On the other hand, by being operationalized with projected screen and handheld response devices, there is an immediate, competitive atmosphere which may serve as the classroom equivalent of a virtual playscape as it involves students in competitions that may become engaging on a level exceeding the mere learning of a lesson. Table 1 shows LearnStar's' exogenous and endogenous characteristics.

Table 1
Mapping of the LearnStar System

<i>Endogenous Characteristics or Elements</i>		<i>Exogenous Characteristics or Elements</i>	
Has challenging goal(s)	Y	Emphasize learning over playing	Y
Promotes critical thinking and problem solving	Y	Contains drill and competitive gaming	Y
Player is immersed in continuous action	P	Gaming experiences are not intrinsically related to the learning content	Y
Contains playscapes	P	Relatively easy to play	Y
Contains "flow"	N	Lacks complex gaming structures	Y
Considered "hard fun"	N	Contains multimedia	P
Contains tactical or strategic problem solving	N	Contains matching, or other identification-oriented elements	P
Contains "playability"	N	Contains drag or drop elements	N
Game is the learning content and the learning environment	N	Activities involved do not require critical thinking and are automatic	N
Contains "virtual" game elements	N	Contains puzzles	N
Game is "autotelic"	N	Contains simulation	N

Note: Y = Yes, LearnStar has this characteristic; N = No, LearnStar does not have this characteristic; P = Partially, LearnStar can or may have this characteristic at times during the game.

One of the major reasons for its popularity, is all of LearnStar's content is aligned to state benchmarks and many of its questions are tailored to standardized tests. Thus LearnStar has been found to "improve....students' performance on annual accountability tests" (LearnStar). LearnStar has been increasingly used in the preparation of students for standardized testing. It has modules in a variety of content areas. It is being used often in content areas such as Language Arts (grammar, writing, reading), Social Studies (economics, American government, US history, world history, geography), science (earth, physical, life) and math. LearnStar also offers specialized modules for ESL, Life Skills, GED, SAT, and Standardized test prep (Super Skillbuilders focuses on language arts and math) (Matheny, 2003). At present, LearnStar offers a library of content consisting of more than 35,000 questions, which are grouped into activities ranging from 5 to 15 questions (LearnStar). Most of the content in LearnStar's current version modules are developed from national and state standards of each academic subject area, according to LearnStar data. For that reason, the most widely used LearnStar programs to date are the k-12 curriculum and the Skillbuilder program, both I and II, which combine a number of content areas being used by schools to improve their students' performance on annual accountability tests (LearnStar). In 2006, LearnStar released a new version in which each question is aligned to all the state standards, so teachers can search for questions dealing with a particular standard, or they can use the pre-existing activity group. One customizable feature that has become very popular is the Editor which allows the teachers or students to create their own questions and activities.

Several elements of LearnStar and similar video presentation of lessons have been explored for their educational benefits. The visual effect combined with the game-like atmosphere of the LearnStar module, with students answering questions in a competitive framework, have been found to improve learning (Matheny, 2003). Matheny believes such a format helps students think faster and also makes learning fun. In one school, students found the visual interaction as well as the competitive aspect of LearnStar very appealing and made learning easier and more effective (Matheny). Other positive aspects of LearnStar reported by students were its ability to allow them to see what they know, without being graded, and students could answer questions anonymously, removing any self-consciousness or feeling of being put on the spot which characterizes so much classroom discussion (Matheny). These elements too help students learn and making learning fun (Williams, 2005).

The LearnStar program helps develop cognitive strategies which are the fundamental ways of processing information. According to Benjamin Bloom's taxonomy of Mastery Learning there are six levels of critical thinking. With LearnStar, students' basic knowledge and comprehension (Levels 1 and 2) are reinforced as they engage in multiple-choice and short-answer activities. Furthermore, the math activities at all levels (K-12) provide ample practice of applying formulas and problem solving (Level 3 - application). Level 4 (analysis) is practiced in many of the English activities (fact vs. opinion in readings, analyzing sentences grammatically), as well as Science activities (comparing and classifying animals/objects/elements).

When used in addition to curricular activities, the process of participating in a LearnStar game promotes critical thinking and problem solving. For example, the

“countdown” format provides multiple-choice answers with clues appearing to help students deduce the correct answer, and the “wipeout” format removes incorrect answer choices, thus helping students to deduce the correct answer. The ability to analyze by deduction is a critical thinking skill and problem-solving strategy. Participants in the session will see a variety of question types and will observe how these levels of critical thinking are practiced.

A critical component of game-like technologies like LearnStar is the opportunity they provide for students and teachers, and students and students, to interact more often (Fitch, 2004). With high teacher-learner ratios in schools, interaction is sometimes reduced in today's classroom. This becomes truer the older the student gets to the point that by the time a student gets into college there are very few opportunities for student-teacher interaction, as observed by Fitch. Interactivity is the two-way communication that occurs between learners and the educational materials that are presented during an instructional lesson, Fitch comments. LearnStar is definitely social. The activities can be done using teams/pairs of students which promote collaborative learning. Computer-based instruction in general has been praised for its potential to improve interactivity between student and teacher (Fitch).

Studies have found, notes Finch, interactive learning heightened student interest and improved higher cognitive learning. In computer-based instruction interaction may be the most important factor (Fitch). Indeed, Finch tells of studies of CBT and other packages finding interactivity was a critical aspect of computer-based instruction. Not only is computer-based instruction used to increase interaction in the classroom, but such instruction cannot optimally function without this interaction. This dynamic has

been proven in distance learning where the amount of interactivity that develops is critical to the success of the lesson (Fitch). Thus, there is convincing evidence that interactivity is a critical part of any form of technology-based learning, Fitch notices.

A secondary importance of interaction is that its development also begins a process of reorienting the teacher toward the student. The transmission model, in which the teacher pours content into a student's head, is gradually being replaced by the constructivist or interactionist model where learning takes place best when constructed within the framework of the learners' own understanding (Fitch, 2004). The focus of LearnStar on standardized content, and simple competitive testing with regard to the content, would seem to preclude such an evolution under its use. Handheld devices used by students are believed by some to encourage more interactive learning in general (Trotter, 2002). Though in some cases students may wander away from lessons in gaming contexts with handhelds, most students see a hand held as empowering. Studies have shown children with Palm Pilots or other handheld devices get more into their homework, and use of such technology also reduces paperwork issues and problems related to delivering paper work to class (Trotter).

In class, various input devices including handhelds greatly enhance the quality of teacher-student interaction since the teacher now can better assess the whole class's comprehension of a lesson rather than relying on the raised hands of a few bright students (Fitch, 2004). Through LearnStar and other devices, Fitch records, the instructor can know immediately the responses of all students through a display on a computer. One instructor reports LearnStar allowed him to see immediately that a large number of students misunderstood a concept he was trying to get across. He quickly

identified the problem and re-presented his lesson in a way that greatly reduced the misconception (Fitch). Another effect of LearnStar in particular, due to the fact once the activity has started no latecomers can join in, is all students get to class on time. Fitch found students even inquire in advance when LearnStar is going to be used, not to be late to class. However, this incentive may be diminished in the newest version, because there is an option allowing latecomers to join in. An additional benefit of LearnStar is the results of a question exercise not only go to the instructor, who sees how individuals answered, but it goes cumulatively to the class as a whole, so a student immediately sees where he or she stands in terms of the whole class (Fitch). The presence of a screen relaying such information also results in a much greater degree of focus and concentration in a LearnStar classroom with one instructor noting he was struck by the attention the students paid to the material (Fitch). Overall, the results of studies of the effectiveness of the LearnStar teaching environment reveals students who used such technology on a weekly basis to supplement traditional lectures, and the students did indeed enhance their understanding of core mathematics principles (Williams, 2005).

LearnStar is noted among numerous game-style teaching tools for its competitive games. As a consequence, studies as to its effectiveness have focused on the degree to which competitiveness improves learning. Because human beings are so competitive, a little competition is believed by many to be an effective technique to motivate people to learn and to excel (Chang et al., 2003). Besides, adding an element of competition is widely believed to be a motivational enriching strategy in play (Chang et al.). Thus, competitiveness is believed to be instrumental in such games, enhancing student motivation to learn. Competition is known to help to engage students in initially

uninteresting or routine educational activities, conveys Chang and Yang. Adversely, competition also means there are winners and losers with the winners being encouraged to continue and to improve their learning while the losers often becoming disappointed or discouraged. Hence, game designers for games such as LearnStar have studied how to structure the games such that all participants should have a chance of winning and thus remaining motivated (Chang et al.). The creation of a game system involving arithmetic skills was found, if properly structured to allow all players a chance at winning, to increase gamer motivation and also encourage players to take more risks and even start playing in more competitive contexts (Chang et al.). In a study of student response by Chang and Yang, most students thought playing a game is a good way to learn, and they thought the games helped them memorize more knowledge. With regard to motivation, it was found when students were given the opportunity to defeat other users (or students) as well as learn, that increased their motivation (Chang et al.).

In a study of the use of LearnStar in a college classroom, 100% of students reported they believed LearnStar was fun, and 95% said they would make use of LearnStar again (Williams, 2005). On a scale of 5, LearnStar received a 4.23 evaluation with regard to the question of whether or not LearnStar helped them learn the material of the course more effectively. Moreover, while many of the tested students had previously revealed themselves to be extremely difficult to motivate, notes Williams, many of them had become excited about learning through LearnStar. The students demonstrated their motivation by making use of LearnStar in other ways as well. Not only did they participate in in-class lessons with LearnStar and made use of LearnStar

to review materials, the students employed LearnStar in preparing themselves for standardized tests (Williams). Teachers also noted LearnStar improved student motivation; this was especially from the “drill and review” tools of the system, Williams reports. The competitive format was also believed to work well for conceptual questions, and LearnStar was increasingly used in math classes in assisting students in acquiring deep understanding of the fundamental concepts, Williams has observed.

Motivation to learn is also said to be enhanced in LearnStar by its competitive games increasing (student) motivation to assimilate new ideas (Williams, 2005). Plus, LearnStar's benefits are tangible. In the Texas Tech study, it was found by Williams that students who used LearnStar received an average of 70% of a departmental comprehensive exam, compared to 47.7% for those students who did not use LearnStar. Nor was this differential due to the fact students in the comparison group were poor students compared to those given the opportunity to work with LearnStar, as the SAT scores of the two groups of students were comparable (Williams). In a study of students taking a comprehensive exit exam, LearnStar students demonstrated a 15 to 20% higher score on the comprehensive exit exam (LearnStar). In a study of the Dallas Independent School where LearnStar was used, the number of students passing both the math and language standardized tests doubled after using LearnStar in class and in preparation (LearnStar). By and large, based on studies of its implementation in classrooms at various levels of education, LearnStar has developed a track record for improving student outcomes and also enhancing student motivation.

Summary

This literature review has explored the complicated question of how video games can help middle school students learn more effectively in the classroom setting. A number of researchers argue video games can indeed enhance learning. They claim games can have real impact on students and their cognitions is founded, perhaps ironically, on a negative discourse which explores the impact of violent video games on children as possible source of increased aggressive tendencies or even actions (Anderson et al., 2003; Chiu et al., 2004; Funk et al., 2002; Piot, 2003). On the basis of the finding that, indeed, repeated exposure to violent video games can lead to aggressive thinking or actions, educators have argued elements of video games that appear to embed in them beneficial educational principles can be used to impact student outcomes positively. In the world of video games, educational games designed on computers specifically for educational purposes, also called exogenous games, have received much use but with little ultimate impact on learning (Guynup & Demmers, 2005; Johnnavitula & Kinshuk, 2005; Mayer & Moreno, 2002; Okan, 2003; Okita, 2004; Trotter, 2004). Therefore, simulations and edutainment games have emerged as a frontier in classrooms, yet here again the training orientation of these games limits their potential. The greatest theoretical potential in video gaming is seen by educators in pure or endogenous video games where gamers move through dazzling virtual environments on various immersive adventures (Gee, 2005; Kirriemuir & McFarlane, 2004; Squire, 2005). These games astonish educators because players, otherwise poor students who complain about how hard school is, plunge themselves into very complicated and difficult games and play long hours until they master these games. Detailed study has

been made of the elements within these games which have profound potential to create deep learning (Fabricatore et al., 2002; Gee, 2003; Gee; Kirriemuir & McFarlane; Landt et al., 2001; Squire).

At present, however, a particular exogenous gaming type, concentrating on drill and review, of which LearnStar is the leading example, appears to have experienced the most success when implemented in classrooms and is tailored to the realities of the accountable and standardized classroom environment of today (Williams, 2005).

Whether or not these games actually lead to better learning in practice is at present not conclusively determined given the limited number of empirical studies of this issue.

Nonetheless, there is some evidence video games do improve student motivation and educational outcomes (Mitchell & Savil-Smith, 2004; Schreve, 2005; Williams), because they provide immediate feedback, are competitive and fun, and utilize positive interaction to reduce the gap between teacher and student in the everyday middle school classroom.

CHAPTER 3

METHODOLOGY

Introduction

Computer and video gaming use among middle school children, particularly boys, has risen dramatically in recent years. As a result, some educators have expressed concern that schools are losing the attention of the young to these games, and accordingly, student interest in classroom activities and motivation to perform well in school are on the decline. This study looked at a computer gaming system called LearnStar® (LearnStar, Inc., Dallas, TX, www.learnstar.com) which involves competitive question-and-answer sessions with whole class participation. In LearnStar both students and teachers see clearly and immediately what is understood and what is not in an ongoing process of learning. Competitive gaming using LearnStar can take place at different levels over a network. For instance, competition can take place between two or more groups within a single class, between different classes, or even between different schools. It is even possible for several schools within a school district to compete with other schools in a different school district. However, the scope of this research was limited to students competing with each other within their own classrooms in the same school. This study is part of a growing number of studies which seek empirical evidence from case studies to provide proof that computer gaming technology, when implemented in middle school classrooms, can improve student attendance and achievement. This study, additionally, inquires if computer gaming technology can motivate students to a greater interest in the subject matter being studied than similar students not using any type computer gaming technology.

The quiz based, computer gaming system chosen for this study, LearnStar, is an interactive software solution for classrooms that has a competition format. It uses real-time group interactivity which virtually ensures 100% participation while the teacher remains in complete control. LearnStar is a combination of elements of traditional educational gaming in the classroom and new media technology-based gaming. In its implementation, with the teacher projecting a question and students answering the question using handheld devices, it creates a competitive atmosphere. Results relating to a student's level of understanding are communicated immediately to the teacher and the class, which opens up the classroom to enhanced interactivity. Furthermore, it provides educators with a degree of solidity as most of its popular modules are built upon standards. Hence, students who use LearnStar have been found to improve their standardized test scores.

LearnStar can be integrated into whatever technology platform is being used in a school. Its uses full duplex communication between computing devices to create a technology environment both collaborative and engaging. Every student can easily participate in the instructor led activity from hardwired computer desktops. Personal digital assistants (PDAs), using TCP/IP configurations, or radio frequency keypads, deliver LearnStar's content and are designed to give teachers the ability to customize activities to their specific objectives. Whether they are making minor adjustments to the content provided by LearnStar or developing completely new competitions from scratch, the fill-in-the-box template ensures ease of use by instructors. Descriptive controls help insert a variety of multimedia files to enhance the instructional impact of the activity.

Teacher's can even challenge their students to create competitions for use in their classes.

Subjects

This study was conducted over a period of six weeks. The population was eighth grade students within two schools in the Irving Independent School District (IISD), Dallas County, Texas. Six American history classes were used at Lorenzo de Zavala middle school where LearnStar gaming software is used weekly in the classroom. Also studied were five American history classes at Austin middle school where LearnStar has not been introduced into the classroom, and students were instructed using traditional educational means. Both groups were selected because there was much similarity between them, in terms of class size, gender composition, ethnic composition, and level of achievement. The same teacher at Lorenzo de Zavala middle school instructed all six classes, and a different teacher at Austin middle school instructed all five classes there.

This measure of selection was decided upon so that, should the use of LearnStar result in a rise in student attendance or performance, such a change would be statistically visible. The sample consisted of 284 (experimental $n=136$; comparison $n=148$) total students and included 127 males (experimental $n=60$; comparison $n=67$) and 157 females (experimental $n=88$; comparison $n=69$) engaged in the study. The age range was 14-16, with 151 age fourteen (experimental $n=73$; comparison $n=78$), 117 age fifteen (experimental $n=56$; comparison $n=61$) and 16 age sixteen (experimental $n=7$; comparison $n=9$). The experimental classrooms were at Lorenzo de Zavala and the comparison classrooms at Austin. These schools are 1.3 miles apart

and are in the same social/economic neighborhoods. This is in line with IISD reported demographics concerning the total middle school population as a whole.

Of the 284 students who participated in the study, 84 (experimental $n=40$; comparison $n=44$), returned the Informed Consent Form, and therefore could take the online survey(s). Of these 84 students, only 40 from the experimental group took the Instructional Materials Motivation Survey (IMMS), as this survey accesses the students' interest in the software being used.

In similar previous studies, Keller and Song (2001) used a total of 60 tenth grade students from a Developmental Research School affiliated with a Florida university. Gabrielle in 2003 used 784 undergraduate students divided into 12 sections with randomly assigned treatment and control groups.

Cohen's power tables (1988) lend support for the selected sample size. With two approximately equal groups, and assuming a medium effect size at 2/3 power and an alpha of .05, Cohen recommends 34 per group (at alpha .01 the recommended number is 62 per group) (p. 313).

This study involved middle school students because the literature has indicated it is in the middle school years that the impact of video gaming and its culture reaches a critical mass (Greenfield, 1994). This may or may not lead students to pay more or less attention to their class work. Thus, the middle school years are of crucial importance in determining whether or not students find a way to support or deplete their learning through gaming. Institutional Review Board approval as well as informed consent for participation was obtained (see Appendices A-C).

Research Design

This study attempted to determine if the introduction of the LearnStar question-and-answer computer gaming technology into a population of middle school students could improve student attendance and achievement. It was, additionally, examining if this computer gaming technology could motivate students to a greater interest in the subject matter being studied, than similar students not using the LearnStar system. This was determined by the use of the LearnStar quiz-based gaming software in five experimental classrooms with a combined total of 136 students. The teacher of these classes had implemented the use of the LearnStar system. Students participated in gaming with LearnStar weekly over the course of a six week grading period. Six comparison classrooms with a combined total of 148 students not using LearnStar at a different middle school were selected to be as comparable as possible to the target group of students.

This study used a post test-only, control-group design and the tester was not able to assign individual students randomly to the groups. Two quantitative surveys were used in order to collect data. This data provided a full profile of the impact on student interest in the subject being studied and in the software being used (the latter in the experimental group only): (a) the Course Interest Survey (CIS) (see Appendix D), designed by John M. Keller and based on the ARCS model, which gauges student motivation related to the course being taught with 34 Likert-type scale responses; and (b) the IMMS survey (see Appendix E), also developed by Keller and based on the ARCS model with 36 Likert-type scale responses. Wording in each survey was changed

slightly from the original template to reflect the specifics of this study. These two surveys were Web-based and delivered online.

The CIS survey attempts to determine student attitudes toward the American history instructional materials they had been studying. Students who returned the signed Informed Consent Form in both the experimental and comparison classes were asked to take this survey. The IMMS survey attempts to determine student attitudes toward the LearnStar gaming system. Only students who returned the signed “Informed Consent Form” in the experimental classes were asked to take this survey. Before being able to complete a survey, each student was required to enter a unique user ID.

Performance and attendance data for the six week study period were generated by electronic reports. All of the data were analyzed in order to answer the three research questions at the core of this study. First, the data were analyzed in order to determine if the use of LearnStar would show a significant difference in student attendance in the combined experiential classes as compared to the combined comparison group classes. Second, grades were examined to determine if the use of the LearnStar system in the combined experiential classes would show the levels of student achievement, as measured solely by grades, to be significantly higher than the combined control group classes. Finally, data from the online surveys attempted to determine student attitudes toward the course studied as well as the use of the LearnStar system, to see if the students using LearnStar showed a significantly higher interest in studying the subject matter than the students not using LearnStar.

Instrumentation

Two surveys were used to measure motivation: (a) the CIS which was designed by Keller to gauge student motivation related to the course being taught; and (b) the IMMS, also developed by Keller and based on the ARCS model. The IMMS gauges the motivational effect of instructional materials. These two surveys were converted to a Web-based format.

The Course Interest Survey (CIS)

This study used the CIS which was designed by Keller to gauge student motivation related to the course being taught. This survey uses a Likert-type scale of 1-5 where nine items of the 34 are reverse items. In relation to the course, it was designed to assess the four components of the ARCS model (attention, relevance, confidence, and satisfaction) as well as an overall motivation score.

The Instructional Materials Motivation Survey (IMMS)

The IMMS was also developed by Keller and based on the ARCS model. The IMMS gauges the motivational effect of instructional materials and uses 36 ARCS-related questions. This survey uses a Likert-type scale of 1-5 where 10 of the 36 items are reverse items. In relationship to the instructional material, it was designed to assess the four components of the ARCS model (attention, relevance, confidence, and satisfaction), as well as an overall motivation score.

Research Questions

This study focused on three primary research questions. All three questions were involved with determining the degree of interest and involvement of students resulting from the introduction of LearnStar question-and-answer computer gaming technology in their classrooms.

The research questions guiding this study were:

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student attendance as measured by six week daily attendance records?
- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student achievement as measured by six week grade averages?
- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student course interest as measured by the Course Interest Survey?

Hypotheses

H₀1 There will be no statistically significant differences between the comparison group and experimental group, in terms of students' attendance.

H₀2 There will be no statistically significant differences between the comparison group and experimental group, in terms of students' achievement.

H₀3 There will be no statistically significant differences between the comparison group and experimental group, in terms of the ARCS subsections of attention, relevance, confidence, and satisfaction in the Course Interest Survey.

Summary

This study proposed to examine the impact which the implementation of the LearnStar computer gaming program has on a middle school classroom in Texas. In order to provide concrete results, the study focused on three questions with regard to the overall impact of the LearnStar gaming system on students. First, the study looked at whether or not use of LearnStar caused student attendance in the combined experiential classes to be significantly higher than the combined control group classes. Secondly, the question was whether or not LearnStar enabled students in the experimental group to attain better results in their achievement levels than those students in the control group. Finally, the study explored the question of whether or not student attitudes showed a significantly higher interest in studying the subject matter than the students not using LearnStar.

CHAPTER 4

RESULTS

Introduction

This study looked at a computer gaming system called LearnStar® (LearnStar, Inc., Dallas, TX, www.learnstar.com), which involves competitive question-and-answer sessions in which the whole class participates, and both students and teachers see clearly and immediately, what is understood and what is not, in an ongoing process of learning. The methodology used in this study was to see what impact the use of a computer gaming software system like LearnStar has on student's attendance, achievement and attitudes toward their studies. Six week grades and attendance data were gathered for the population of eighth grade students studying American history within two middle schools in the Irving Independent School District, Dallas County, Texas. One school, Lorenzo de Zavala, used LearnStar weekly in the classroom, while the other school, Austin, used traditional educational means in their American history classes. These schools are less than one and a half miles apart, and are of the same demographic makeup.

The sample consisted of 284 students. The mean age of students was 14.53 ($SD = 0.61$); 157 (55.3%) of the students were female and 127 (44.7%) were male. The experimental classrooms, composed of 148 students (52.1%), were at Lorenzo de Zavala and the comparison classrooms, composed of 136 students (47.9%), were at Austin middle school. Only 84 (experimental $n = 40$; comparison $n = 44$), students returned the Informed Consent Form, and therefore could take the online survey(s). Of these 84 students, only 40 from the experimental group took the Instructional Materials

Motivation Survey (IMMS), as this survey accesses the students' interest in the software being used. More detailed demographic information about the participants can be found in the Subjects subsection of Chapter 3.

By comparing attendance and grades in these two groups, an attempt has been made to show that the use of LearnStar increased the level of student attendance and achievement. This study used a post test-only, control-group design. Two quantitative surveys were used to measure confidence and motivation: (a) the Course Interest Survey (CIS), and (b) the IMMS. These two surveys were delivered in Web-based format. More detailed information regarding the two surveys used in the study may be found in the Instruments subsection of Chapter 3.

Data Analysis

All statistical data were analyzed using SPSS version 13.0 for Windows with a preset alpha of .05. Descriptive statistics (means/standard deviations and frequency/percentages where appropriate) were obtained on demographic data. Means and standard deviations were obtained on the four CIS and IMMS Motivation Scores (attention, relevance, confidence, and satisfaction).

The analysis broke down the results so that some determination could be made as to the impact of LearnStar on a multidimensional construct of student involvement. First, the data were analyzed in order to determine if LearnStar had any impact on attendance. The attendance in the experimental classrooms, based on LearnStar being used, was measured against the attendance records in the comparison classrooms. Second, the data were analyzed to determine if use of LearnStar in the experimental

classrooms, improved grades, versus the comparison classroom. Third, student self-assessment was solicited using online Web-based surveys, to determine if the students, after being exposed to the use of LearnStar in the classrooms, feel like they are more motivated to participate. Their response to these questions determined the extent to which they believe that a question and answer quiz-based gaming software like LearnStar is an effective way of improving their participation and motivation in class.

Through the analysis of the data obtained, this study was able to derive a measure of the impact of LearnStar on the target student body. Finally, the self-assessment assisted in determining whether or not the students themselves think that they are more motivated as students after having made use of a competitive, public gaming module like LearnStar.

Irving ISD provided the raw data for attendance and grades for the 6 week research period. The two online Web-based survey instruments provided the raw data for measuring course interest and motivation. The results of the study are discussed beginning with Research Question 1 and conclude with Research Question 3.

Research Question 1

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student attendance as measured by six week daily attendance records?

Research Question 1 examined whether or not the use of the LearnStar competitive gaming software had any effect on student attendance, between the comparison group and the experimental group, over a 6 week period.

The specific null hypothesis tested:

H₀1 There will be no statistically significant differences between the comparison group, and experimental group, in terms of students' attendance.

To examine Hypothesis 1, a Mann Whitney *U* test was conducted on attendance records. Mann Whitney *U* (nonparametric test of mean ranks) was conducted due to the sample having severe positive skewness and lending itself unfavorable toward transformation. Results of the test suggest a significant difference in Attendance, $U = 8125.00$, $p < .01$; students participating in the LearnStar program had significantly lower mean ranks (128.24) of absenteeism compared to students that did not participate in the program (155.60). Therefore, null hypothesis was rejected.

Research Question 2

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student achievement as measured by six week grade averages?

Research Question 2 examined whether or not the use of the LearnStar competitive gaming software had any effect on student achievement, between the comparison group and the experimental group, over a 6 week grading period.

The specific null hypothesis tested:

H₀2 There will be no statistically significant differences between the comparison group, and experimental group, in terms of students' achievement.

To examine Hypothesis 2, an independent sample t test was conducted on student achievement scores. A one sample K-S test revealed that the sample is normally distributed and Levene's test of equality of error variance were not significant—all assumptions were met. Results of the t test showed a significant difference, $t(282) = 10.55, p < .001, d = 1.26$. Students that were in the LearnStar program had significantly higher grades ($M = 87.36, SD = 8.12$) compared to students that were not in the program ($M = 76.30, SD = 9.45$). Therefore, the data causes one to reject the null hypothesis.

Research Question 3

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student course interest as measured by the Course Interest Survey?

Research Question 3 examined whether or not the use of the LearnStar competitive gaming software had any effect on student course interest, between the comparison group and the experimental group, over a 6 week grading period.

The specific null hypothesis tested:

H₀₃ There will be no statistically significant differences between the comparison group and experimental group, in terms of the ARCS subsections of attention, relevance, confidence, and satisfaction in the Course Interest Survey.

To examine Hypothesis 3, a MANOVA and four ANOVAs were conducted on the 4 CIS Motivation Scores (Attention, Relevance, Confidence, and Satisfaction). A one sample K-S test revealed that the sample is normally distributed; Box's M and Levene's test of equality of error variances were not significant—all assumptions were met.

Results of the MANOVA were not significant, $F(4, 79) = 2.26, ns$. Results of the univariate ANOVAs are presented in Table 2, where Attention, Relevance, Confidence, and Satisfaction did not differ significantly between students that were in the LearnStar program and those that were not. Means and standard deviations of the four CIS Motivation Scores by the LearnStar program are presented in Table 3. Therefore, the null hypothesis was retained.

Table 4, although not directly related to Hypothesis 3, presents the means and standard deviations for the IMMS Motivation Scores (Attention, Relevance, Confidence, and Satisfaction). According to the IMMS score where: 1 = *Not true*, 2 = *Slightly true*, 3 = *Moderately true*, 4 = *Mostly true*, and 5 = *Very true*, the mean responses for Attention, Relevance, Confidence, and Satisfaction fell somewhere between Moderately true and Mostly true.

Table 2
ANOVA on Attention, Relevance, Confidence, and Satisfaction (Yes vs. No)

Motivation Scores	<i>f</i>	<i>sig.</i>	²	<i>power</i>
Attention	2.89 (0.48)	0.09	.034	0.39
Confidence	0.14 (0.33)	0.71	.002	0.07
Relevance	0.00 (0.45)	0.96	.000	0.05
Satisfaction	0.20 (0.38)	0.66	.002	0.07

Note. *df* = 1, 82.

Table 3

Means and Standard Deviations for the CIS Motivation Scores (Yes vs. No)

Motivation Scores	LearnStar Participation					
	<u>Yes</u>			<u>No</u>		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
Attention	40	3.98	.64	44	3.72	.73
Confidence	40	4.11	.59	44	4.06	.56
Relevance	40	4.16	.64	44	4.15	.69
Satisfaction	40	4.09	.61	44	4.15	.63

Table 4

Means and Standard Deviations for the IMMS Motivation Scores

Motivation Scores	<i>n</i>	<i>M</i>	<i>SD</i>
Attention	40	3.45	0.65
Confidence	40	3.85	0.58
Relevance	40	3.06	0.71
Satisfaction	40	3.43	0.87

Summary

The results of this study present the impact that LearnStar has on student's attendance, achievement and attitudes toward their studies. Three types of statistical analyses were conducted: Mann Whitney-U, *t* test and multivariate analysis of variance. These analyses were conducted to assess mean and mean rank differences between students that participated in the LearnStar program and those that did not.

Results of the Mann Whitney-U test revealed a significant difference on attendance. Students participating in the LearnStar program had significantly lower

mean ranks of absenteeism compared to students that did not participate in the program—the null hypothesis (H_01) was rejected. Results of the t test also revealed significant differences on grades. Students that were in the LearnStar program had significantly higher grades compared to students that were not in the program. The null hypothesis (H_02) was rejected indicating that the difference of the means between the experimental and comparison groups are not zero.

Results of the MANOVA suggest that a statistically significant difference does not exist on Attention, Relevance, Confidence, and Satisfaction between the experimental and comparison groups. The null hypothesis (H_03) was retained, indicating that the difference of the means between the experimental and comparison groups are equal to zero.

This research study suggests that student's attendance and performance can be improved when gaming software that is both collaborative and competitive is used regularly in the classroom. However, for student's that participated in the gaming software, their interest in studying the subject doesn't appear to be significantly different from students that did not participate.

CHAPTER 5

CONCLUSIONS

Introduction

Student motivation continues to be a problem for many students, and a primary reason for their failure to fully engage in their studies. As educators search for new ways to improve student motivation and learning, some have looked to a surprising place, computer/video games, for an answer. Researchers have found that by using computer games in class, teachers can improve student motivation to learn (Gee, 2005). As a result, a body of research has emerged which argues that computer games may be the answer to the problem of student motivation.

This study tested the efficacy of the gaming technology when used in classrooms, focusing specifically on whether or not by using a specific game, a teacher can improve attendance and also student achievement as reflected in final grades. LearnStar® (LearnStar, Inc., Dallas, TX, www.learnstar.com), one of a “growing number of products with the capability of permitting students to respond simultaneously to an instructor's question” (Fitch, 2004), operates by having them provide answers to games or tests presented by the teacher (Matheny, 2003). As such, LearnStar is at the cutting edge of drilling media technology, mostly involving projector equipment for the display of computer-based instruction materials, a technology which many teachers believe has “dramatically enhanced the means by which classroom presentations are made” (Fitch, 2004). LearnStar has been found to be particularly useful in preparing students for standardized testing, making use of modules from different content areas, as well as specialized modules developed by the company with specific reference to various

standardized tests (Matheny, 2003). Though LearnStar consists of what is termed an “exogenous” game, some argue that it also elicits improvements students see from using “endogenous” games, including quicker thinking, and an increase in motivation due to the appeal of competition (Matheny, 2003). LearnStar also has advantages with regard to the management of the classroom, as it provides teachers' with immediate feedback so that they have a sense if a lesson has been learned or not, and, the competitive atmosphere created by LearnStar motivates students to strive for correct answers, as the answering is transparent and visible to all (Matheny, 2005). However, proponents take care to note that student self-worth is not challenged by LearnStar, as the answers are provided anonymously, virtually eliminating the threat of public failure. Students reported that they liked LearnStar because it allowed them to see what they know, without being graded, and they did not feel self-conscious or put on the spot as they are in so much classroom discussion (Williams, 2005). In a study of the use of LearnStar in another college classroom, 100% of students reported that they thought LearnStar was fun, and 95% said that they would make use of LearnStar again (Williams, 2005). On a scale of 5, in fact, LearnStar received a 4.23 evaluation when students were asked whether or not LearnStar helped them learn the material of the course more effectively. Moreover, even those students who reported previously it has been “extremely difficult to motivate” them, have now become excited by learning and are motivated to learn using LearnStar. Finally, LearnStar in practice begins a process of reorienting the teacher toward the student, away from a transmissionist and towards a constructivist framework, as, through the process of the give and take of LearnStar, learning begins to happen within the learner's own understanding” (Fitch, 2004).

This study examined the use of games in selected middle school classrooms. Conducted over the period of six weeks, the study involved the use of a game in several American history classes in the Irving Independent School District, Dallas County, Texas, in order to determine if the use of the gaming module would improve student attendance, performance and interest. The classrooms selected were deemed similar in student characteristics, so the results would provide a statistically visible change. The results of the five classes using the gaming program were compared to the results of six classes not using the game, with both groups selected being as comparable as possible. The results indicate that the use of the game did have an impact on student attendance and achievement, but little impact on changing overall student views with regard to the relevance of the course and their satisfaction with the course, curriculum or subject matter.

This game's whole-class participation mode is believed to counteract the concern by many that gaming isolates children, boys especially, reducing their motivation to learn. This game is also believed to incorporate cognitive strategies that entail the development of critical thinking skills along a continuum of six levels from basic knowledge to analytic activities. It is argued that the countdown format of this particular game encourages critical thinking by asking the student to choose an answer from among multiple choices and deducing the correct answer in a sequential manner. The current study found that the game did improve attendance rates and student achievement as measured by test results.

Interpretation of the Research Questions

This study was guided by three core research questions:

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student attendance as measured by six week daily attendance records?

The results of the study with regard to research question one indicated that the students participating in the gaming program had significantly lower mean ranks of absenteeism compared to students that did not participate in the program.

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student achievement as measured by six week grade averages?

The results of the study with regard to research question two indicated that students who were in the gaming program had significantly higher grades compared to students that were not in the program.

- Will the use of computer gaming technology in the middle school classroom produce statistically significant differences between the comparison group and the experimental group in terms of student course interest as measured by the Course Interest Survey?

The results of research question three indicates that when measuring student attention, relevance, confidence and satisfaction in the course, there were no significant differences between students that were in the gaming program and those that were not.

According to these results, two research questions obtained a positive result, while one did not reveal differences. While the students using the gaming program in class did improve attendance and grades, it did not significantly alter a student's sense of the relevance of the studies, their level of attention, their confidence in performing well in class, and their overall satisfaction with the course. It would appear from these results that while games utilization can greatly improve the mechanics of a class in such a way that student's will be more motivated to attend and perform in class, and in their studies in general, the subject matter or content of the course remains the focus where issues of attention, relevance, confidence and overall satisfaction reside. It remains to be determined that, if gaming programs are used in a course involving a subject matter that a student has little interest in and no confidence in their abilities in, whether the game will not alter this fact. Moreover, in terms of overall student satisfaction with a course, it is also the content or subject matter of the course where this issue resides, and the game is apparently unable to alter that issue.

The findings with regard to the research questions suggest that student appreciation of gaming exists apart from their viewpoints about various subject matters or course or curriculum content. The findings suggest that the primary advantages of game are more mechanistic in nature, involving the idea of gaming itself. This finding conforms with previous findings that this gamer appears to work best in test-preparation modes where drilling or question-and-answer approaches are successfully utilized to improve test-score results in any number of topics covered by various modules. That is, the game operates in a content-free framework, as a gaming mechanism that enhances the mechanics of learning regardless of the content of the course in very targeted and

goal-oriented contexts. This finding would also correspond to the advantages of the game (LearnStar) as a so-called exogenous game, noted for their straightforward approach to learning.

At the same time, the findings suggest that the games ability to transform the classroom into a place where students are more attentive, have more confidence in their abilities, believe that what they are learning is relevant, and in general are more satisfied with the course, remains unproven. While the game can get more students into the classroom, and keep their attention in a way that translates into increased motivation and higher grades, it is less successful in deeply altering the student response to the content or curriculum of the course. Therefore, while LearnStar can improve the methods of the classroom, it has not yet proven itself capable of deeply transforming the learning taking place in the classroom.

Implications of the Research Findings

All of the positive results achieved thus far in studies of the effectiveness of exogenous games have, in light of the findings of this study, a familiar ring. One study of the use of such a game in a classroom found that while the game was appreciated by students because it provided for instant feedback and access, overall, the results with regard to learning outcomes was inconclusive (Mitchell & Savil-Smith, 2004).

By contrast, endogenous games, consisting of immersive action-oriented games in which the mechanics of the game are deeply embedded (thus, *endogenous*) in the gaming experience, are the type of game that many educators are looking toward as a future model for more motivated, attentive, relevant and satisfactory education. These

so-called edugames, such as Civilization® (Sid Meier, Take-Two Interactive Software, Inc., New York, NY, www.civilization.com), are garnering much more theoretical attention, and are at the forefront of the theoretical drive to incorporate gaming into the classroom. It is only in studies of the use of more endogenous games in classrooms that positive results with regard to such issues as student attention, sense of the relevance of the course, or overall satisfaction were obtained. In one study of the introduction of video games into a classroom the student not only loved the gaming climate but thought that it an enjoyable way to learn history (Squire, 2005). The author of the study noted that, prior to the study, most of the students involved actively resisted the study of history, primarily because they regarded it as propaganda. However, after introducing gaming, these same students began to like computer gaming.

In this study of the use of game programming in an American history course, where it was found that while the gaming technology improved attendance and performance, the motivation was circumscribed by the gaming environment, and did not extend to the content or curriculum, neither altering the students' sense of the relevance of the course or their overall satisfaction. The disparity between the findings of this study with regard to LearnStar and previous findings in the literature regarding the advantages of endogenous over exogenous gaming would seem to place LearnStar in the category of exogenous gaming.

In addition, the literature has indicated that gaming is good for improving motivation in some kinds of courses, while less successful in other courses. Meaning, the effectiveness of gaming is content-bound. Gaming results in better student outcomes in math, physics and language arts, but not result in improved student

achievement when introduced into social studies, biology or logic classrooms (Mitchell & Savil-Smith, 2004). The reason for this variation of effect based on content is believed by some researchers to be linked to the nature of learning in different disciplines. Studies have shown that the video game especially is more educationally relevant when the content of the course is specific and targeted and there are “precisely defined objectives” to be learned (Mitchell & Savil-Smith). In the absence of objective knowledge and clear goals, the potential of gaming declines. Thus, studies have shown that there are limitations with regards to gaming according to curriculum area. Moreover, studies have found that gaming is less effective in improving learning outcomes in the social studies, of which American history is one. Therefore, by finding a significant difference using American history content the value of gaming is evident. However, given the nature of this study it is recommended that additional, controlled investigations be done.

A special element of what might now be termed in-between games like LearnStar is competition. A number of studies in gaming have examined the extent to which competitiveness improves learning. Exploiting the natural human sense of competitiveness, many educators argue that a little competition can help people learn and excel” (Chang et al., 2003). Competitiveness is believed to be instrumental to the impact games have on students, and is believed to improve student motivation to learn. One study showed that by introducing competition into a classroom environment, students who had found class uninteresting and routine began to feel more motivated in class. The results of this study suggest that competitiveness per se may interest students in coming to class and participating in the implementation of the gaming in

class, but that the competition is limited to improving motivation to participate in the gaming experience, and does not extend to lasting improved attitudes about the course itself.

Many educators worry that in competitive contexts, where there are winners and losers, while the winners may be motivated to move on to higher achievement in learning, the losers may become disappointed and discouraged, and experience a loss of motivation in learning. In the context of these contending attitudes about competition in education, LearnStar structured its games with a built-in anonymity and other elements which mean that everybody can win and remain motivated (Chang et al., 2003). This corresponds to previous studies of gaming structures that allowed all players a chance of winning, finding them to have a positive impact on gaming. One study found that such games did increase gamer motivation and encourage players to take more risk and be more competitive (Chang et al.).

The results of this study may also be limited by the nature of the execution of the study. By comparing classes that used the game, LearnStar, to those that did not use any gaming, with the goal of achieving a clear-cut sense of the impact of the gaming program, the study may have foregrounded the mere presence of gaming, and recorded and restricted student response to the gaming element alone.

Summary

This study examined the relevance of computer gaming to an educational context. It explored the impact on student learning by considering how much impact the introduction of a well-known educational gaming system into middle school American

history classrooms had. The study hoped to contribute to a growing body of knowledge concerning the potential positive impact of computer and video games on education, which remains a controversial topic to many.

This study, therefore addresses a significant issue, but one whose development thus far has been constrained by popular misconceptions about gaming, and by confusion about the relationship of gaming entertainment to gaming in school. In fact, so notorious has gaming become to some educators, the idea of actually enlisting gaming to improve learning appears counterintuitive and not a little morally suspect. It is precisely because of the climate of fear and misconception about gaming that proponents of edugaming need to provide many more detailed, quantified studies proving or disproving the positive impact of gaming on learning. This, is the overall discursive context for this study.

Specifically, the results of the study found that while use of gaming in a history classroom did indeed improve student attendance and encouraged more students to participate in class in a competitive, motivated way, leading to better grades, it did not improve student motivation with regard to deeper and more lasting issues in learning.

APPENDIX A
INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



Office of Research Services

DISCOVER THE POWER OF IDEAS

February 3, 2006

David Dorr
Department of Technology and Cognition
University of North Texas

Re: Human Subjects Application No. 06-019

Dear Mr. Dorr:

As permitted by federal law and regulations governing the use of human subjects in research projects (45 CFR 46), the UNT Institutional Review Board has reviewed your proposed project titled "Enhanced Learning Performance in the Middle School Classroom through Increased Student Motivation by the Use of Educational Software and Question Based Gaming Technology." The risks inherent in this research are minimal, and the potential benefits to the subject outweigh those risks. The submitted protocol and consent form are hereby approved for the use of human subjects in this study Federal Policy 45 CFR 46.109(e) stipulates that IRB approval is for one year only.

Enclosed is the consent document with stamped IRB approval. Please copy and use this form only for your study subjects.

It is your responsibility according to U.S. Department of Health and Human Services regulations to submit annual and terminal progress reports to the IRB for this project. Please mark your calendar accordingly. The IRB must also review this project prior to any modifications.

Please contact Shelia Bourns, Research Compliance Administrator, or Boyd Herndon, Director of Research Compliance, at extension 3940, if you wish to make changes or need additional information.

Sincerely,

Handwritten signature of Scott Simpkins

Scott Simpkins, Ph.D.
Chair
Institutional Review Board

P.O. Box 305250
Denton, Texas 76203-5250

940.565.3940 TEL
940.565.4277 FAX

940.369.8652 TTY
www.unt.edu

APPENDIX B

INSTITUTIONAL REVIEW BOARD INFORMED CONSENT FORM (ENGLISH)

University of North Texas Institutional Review Board

Informed Consent Form

Before agreeing to your child's participation in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study and how it will be conducted.

Title of Study: "Enhanced Learning Performance in the Middle School Classroom Through Increased Student Motivation, by the Use of Educational Software & Question Based Gaming Technology"

Principal Investigator: David L. Dorr, a graduate student in the University of North Texas (UNT) Department of Technology & Cognition.

I consent to allow my child to participate in this study being conducted at Lorenzo de Zavala middle school during the spring semester of 2006. I understand that participation is entirely voluntary; I can withdraw my consent at any time and have the results of the participation returned to me, removed from the experimental records, or destroyed. I understand that the researcher is collecting data in an attempt to determine if using LearnStar motivates students to better attendance, participation and performance. I also understand that my child will be completing two 15 minute surveys regarding his/her participation.

There are no foreseen risks in participating, and I understand that my child's grade will not be negatively impacted through participation. Participation carries no extra workload beyond the surveys, and my child will be expected to complete all required classroom assignments regardless of participation in this study. The results of this participation will be confidential and will not be released in any individually identifiable form without prior consent unless required by law.

While this study is not expected to be of any direct benefit to your child, it is hoped that the results will show that the use of LearnStar in the classroom encourages students to come to class more often, arrive on time, participate more fully, and be more motivated in general about their studies. If it can be proven that LearnStar does in fact enhance student motivation, strong support will be provided for teachers to use these types of games more often.

In case any questions arise, you may contact David L. Dorr, Computer Education & Cognitive Systems graduate student at (972) 342-0772 or his major professor, Dr. Jon Young at the UNT Department of Technology and Cognition at telephone number (940) 369-8377.

This project has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB may be contacted at (940) 565-3940 or sbourns@unt.edu for any questions regarding the rights of research subjects.

Your signature below indicates that you have read or have had read to you all of the above and that you confirm all of the following:

- You understand that you do not have to allow your child to take part in this study, and your refusal to allow your child to participate or your decision to withdraw him/her from the study will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your child's participation at any time.
- You understand why the study is being conducted and how it will be performed.
- You understand your rights as the parent/guardian of a research participant and you voluntarily consent to your child's participation in this study.
- You have been told you will receive a copy of this form.

Printed Name of Parent or Guardian

Signature of Parent or Guardian

Date

Child Assent Form

You are being asked to be part of a research project being done by the University of North Texas Department of Education. This study involves whether or not a student's class attendance, grades and motivation to participate in class activities improves, when the LearnStar gaming software is used in the classroom. You will be asked to go to an Internet website where you will take two short 15 min. surveys about motivation. If you decide to help with this study, please remember you can stop participating any time. If you would like to help with this study, please sign your name below.

Signature of Child

Date

Signature of Principal Investigator or Designee

Date

APPROVED BY THE UNT IRB
FROM 2/3/06 TO 2/2/07
JB

APPENDIX C

INSTITUTIONAL REVIEW BOARD INFORMED CONSENT FORM (SPANISH)

Revisión por el Consejo Institucional de la Universidad del Norte de Texas.

Forma de Consentimiento Informado

Es muy importante que usted lea y entienda cómo se llevará a cabo y el propósito y los beneficios de este estudio de investigación, antes de estar de acuerdo a la participación de su hijo/hija en dicho estudio.

El título del Estudio es: "El mejoramiento del rendimiento de aprendizaje en el salón de clases de las Escuelas Secundarias (Middle School) a través de un incremento en la motivación del estudiante por medio del uso de Programas (Software) Educativos, y de Tecnología de Juegos Basados en Preguntas".

Investigador Principal: David L. Dorr, estudiante de posgrado de la Universidad del Norte de Texas (UNT). Departamento de Tecnología y Cognición.

Yo doy mi permiso y consentimiento para que mi hijo participe en este estudio que será llevado a cabo en la Escuela Secundaria Lorenzo Zavala durante el semestre de primavera del año 2006. Yo entiendo que el investigador está recopilando información para intentar determinar si el uso de "LearnStar" motiva a los estudiantes para un mejor rendimiento, participación y asistencia. También entiendo que mi hijo/hija tendrá que completar dos encuestas de 15 minutos después de su participación. Entiendo que la participación es totalmente voluntaria y que yo puedo pedir que mi consentimiento sea retirado en cualquier momento o que los resultados de la participación sean retirados de los registros experimentales. Además también puedo pedir que me sean regresados o sean destruidos los resultados de la participación.

La participación no lleva consigo ningún trabajo extra más allá de contestar las encuestas, y se espera que mi hijo/hija complete todos los trabajos requeridos para sus clases aún cuando esté participando en este estudio. No hay previsto ningún riesgo en la participación de este estudio, y yo entiendo que las calificaciones de mi hijo/hija no tendrán ningún impacto negativo a través de su participación. Los resultados de esta participación serán confidenciales y no pueden ser difundidos en ninguna forma identificable sin previo consentimiento o a menos que la ley lo requiera.

Aunque no se espera que este estudio pueda beneficiar de alguna forma directa a su hijo/hija, tenemos la esperanza de que los resultados puedan demostrar que el uso en el salón de clases del programa "LearnStar" anima a los estudiantes a presentarse en clase más seguido, llegar a tiempo, participar completamente y a estar más motivados en general en sus estudios. Si podemos probar que es un hecho que el programa "LearnStar" mejora la motivación del estudiante, se les podría dar un apoyo muy fuerte a los maestros para que usen este tipo de programa de juegos más a menudo. En caso de que surgiera cualquier pregunta, usted puede ponerse en contacto con David L. Dorr, estudiante de posgrado del departamento de "Computer Education & Cognitive Systems" al teléfono (972) 342-0772 o con su profesor de estudios de maestría, Dr. Jon Young en el "Department of Technology and Cognition" de la Universidad del Norte de Texas al teléfono (940) 369-8377.

Este proyecto ha sido revisado y aprobado por El Consejo de Revisión Institucional (IRB) de la UNT. En caso de que usted tenga cualquier pregunta con respecto a los derechos de investigación sobre estos temas, deberá ponerse en contacto con el IRB de la UNT al teléfono (940) 565-3940 o por correo electrónico a sburns@unt.edu.

Su firma al calce indica que usted ha leído o le fue leído a usted todo lo establecido arriba y que usted confirma todo lo siguiente:

- Usted entiende que usted no está obligado a dejar que su hijo/hija forme parte de este estudio, y que su decisión de no permitir la participación de su hijo/hija o de retirarlo del estudio no puede llevar consigo consecuencias o una pérdida de beneficios o derechos. El personal que lleva a cabo el estudio puede decidir en cualquier momento el retirar a su hijo/hija de la participación en este estudio.
- Usted entiende el por qué se está llevando a cabo este estudio y como se llevará a cabo el mismo.
- Usted entiende sus derechos como padre/tutor de un participante en estudios de investigación y usted voluntariamente ha dado su aceptación para la participación de su hijo/hija en este estudio.
- Usted ha sido informado de que usted recibirá una copia de esta forma.

Nombre Impreso del Padre o Tutor

Firma del Padre o Tutor

Fecha

Forma de Consentimiento del Hijo/Hija


A usted se le ha preguntado si quiere formar parte del proyecto de investigación que se llevará a cabo por el Departamento de Educación de la Universidad del Norte de Texas. Este estudio quiere saber, si los estudiantes asisten o no asisten a clase, si mejoran sus calificaciones y si tienen más motivación para participar en las actividades de clase, cuando el programa (Software) de "LearnStar" se usa en su salón de clases. A usted se le pedirá que entre en la página de Internet cuando tenga que llenar las dos encuestas cortas de 15 minutos acerca de la motivación. Si usted decide participar en este estudio, por favor, recuerde que usted puede hacer que paren su participación en cualquier momento. Si usted desea ayudar con este estudio, por favor, firme su nombre abajo.

Firma del Hijo/Hija

Fecha

Firma del Investigador Principal o Asignado

Fecha

APPROVED BY THE UNT IRB
FROM 2/3/06 TO 2/2/07


APPENDIX D

SAMPLE STATEMENTS FROM THE COURSE INTEREST SURVEY

(Reproduced with permission from John M. Keller.)

Instructions:

- There are 34 statements in this questionnaire. Please think about each statement in relation to the American history instructional materials you have studied, and indicate how true it is.
- Give the answer that truly applies to you, and not what you would like to be true, or what you think others want to hear.
- Think about each statement by itself and indicate how true it is. Do not be influenced by your answers to other statements.
- Record your response directly to the right of each question.

Remember, please note the response scale before you answer the questions. To help you keep the scale in mind as you respond to each question, the column headings are color coded.

- 1 = Not true
 - 2 = Slightly true
 - 3 = Moderately true
 - 4 = Mostly true
 - 5 = Very true
1. The instructor knows how to make us feel enthusiastic about the subject matter of this course.
 2. The things I am learning in this course will be useful to me.
 3. I feel confident that I will do well in this course.
 4. This class has very little in it that captures my attention.
 5. The instructor makes the subject matter of this course seem important.
 6. You have to be lucky to get good grades in this course.

APPENDIX E
SAMPLE STATEMENTS FROM
THE INSTRUCTIONAL MATERIALS MOTIVATION SURVEY
(Reproduced with permission from John M. Keller.)

Instructions:

- You should only be taking this survey if your American history teacher uses LearnStar in the classroom.
- There are 36 statements in this questionnaire. Please think about each statement in relation to the LearnStar instructional materials you used, and indicate how true it is.
- Give the answer that truly applies to you, and not what you would like to be true, or what you think others want to hear.
- Think about each statement by itself and indicate how true it is. Do not be influenced by your answers to other statements.
- Record your response directly to the right of each question.

Remember, please note the response scale before you answer the questions. To help you keep the scale in mind as you respond to each question, the column headings are color coded.

- 1 = Not true
- 2 = Slightly true
- 3 = Moderately true
- 4 = Mostly true
- 5 = Very true

- 1 The LearnStar lessons are eye-catching.
- 2 The content of this material is relevant to my interests.
- 3 The exercises in the LearnStar lessons were too difficult.
- 4 This material was more difficult to understand than I would like for it to be.
- 5 I learned some things that were surprising or unexpected.
- 6 The LearnStar lessons look dry and unappealing.

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