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Designing effective multi-user learning environments to enhance game-based learning

Brian C. Johnson
University of Northern Iowa

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Abstract

This literature review examines the properties of specific video games, classified as multi-user learning environments, for commonalities and compares these pieces of software with sound learning theories to determine effective methods of using these types of software for educational applications. This category of software, though not initially developed as an educational learning environment or tool, has gained interest due to the social and entertainment value inherent with this type of game play. This paper reviews relevant published research material that examines the characteristics of both games created for entertainment value and games created for educational purposes to provide insights on how to better develop software in the future that supports effective instructional theories while at the same time engaging the learner. After examining literature around multi-user learning environments, and game based learning, this paper suggests what could be developed as the next generation of multi-user game based learning.

DESIGNING EFFECTIVE
MULTI-USER LEARNING ENVIRONMENTS
TO ENHANCE GAME-BASED LEARNING

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Date Approved

J. Ana Donaldson

~~Graduate Faculty Reader~~

3/12/10
Date Approved

Leigh E. Zeitz

~~Graduate Faculty Reader~~

3-12-10
Date Approved

Jill M. Uhlenberg

Head, Department of Curriculum and Instruction

ABSTRACT

This literature review examines the properties of specific video games, classified as multi-user learning environments, for commonalities and compares these pieces of software with sound learning theories to determine effective methods of using these types of software for educational applications. This category of software, though not initially developed as an educational learning environment or tool, has gained interest due to the social and entertainment value inherent with this type of game play. This paper reviews relevant published research material that examines the characteristics of both games created for entertainment value and games created for educational purposes to provide insights on how to better develop software in the future that supports effective instructional theories while at the same time engaging the learner. After examining literature around multi-user learning environments, and game based learning, this paper suggests what could be developed as the next generation of multi-user game based learning.

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INTRODUCTION

With the recent expansion of the video game industry, video game sales have grown over 6.1 billion dollars from 2000 to 2008, and of that, \$2.1 billion was earned in 2007 to 2008 alone. The majority of the top-selling computer games were multiplayer games (Entertainment Software Association, 2009). A particular group of online video games have emerged which allow hundreds to thousands of people to interact with each other in the same game simultaneously. These games can be classified under the blanket term of *Multi-user Virtual Environments*. A multi-user virtual environment (referred to as a MuVE) is a persistent, interactive, virtual world that represents a specific geographic area in which individuals, objects, and the environment are often represented by computer-generated graphics (Blaisdell, 2006; Klopfer, Osterwei, & Salen, 2009; Prensky, 2007). Eleven percent of all video game players play in these persistent worlds (Entertainment Software Association, 2009).

Although the genre of these games may range from fantasy to science fiction to real-life simulation, there are various similarities between these software types that tie them together. Users of these programs spend hours a week immersed in a virtual world, leading a virtual life, and interacting with other users in these virtual environments. Examples include titles such as *Ultima Online*, *EverQuest*, *Star Wars Galaxies*, *City of Heroes*, *World of Warcraft*, *There*, *Second Life*, and *The Sims*. While these MuVEs have the potential as an educational component, few have actually been utilized or created for this purpose. This literature review will examine common themes and structures among these software types, educational MuVEs, and games as a whole to provide an insight on the development of educational gaming MuVEs that are pedagogically sound and

incorporate social interactions between learners in a virtual world, while delivering a high level of entertainment and long term play value that users have come to expect.

The analysis of this particular topic is important for finding trends in learning characteristics that relate to using gaming software. The necessity of using technology and learning how to work with technology is rapidly becoming a requirement in the daily lives of many. This literature review will explore topics relating to online gaming, describe the pros and cons that exist while using online gaming for educational purposes, examine the needs of learners as they relate to using educational software, and explore ideas that connect these concepts together.

METHODOLOGY

To locate the resources for this literature review, various online resources were accessed through the University of Northern Iowa Rod Library website including ERIC (SilverPlatter), WilsonWeb Education Full Text, InfoTRAC and the University of Iowa. Various books, journals, and online websites were also accessed to provide information used to contribute to this paper. The descriptors/key words used for this paper were as follows: *MUVE, Multi-User Virtual Environments, edutainment, video games, educational games, game design, game theory, computer assisted instruction, multimedia instruction, computer software evaluation, multimedia materials, multimedia design, technology uses in education, postsecondary education, computer uses in education, computer assisted learning, adult learning, authoring aids, programming, design-requirements, program effectiveness, instructional effectiveness, and material development.*

The databases that were selected for this review were chosen based on past experience with the various databases, as well as the wide selection of articles the databases had access to retrieving. The information found for this paper was evaluated based on the quality of the content, the relevance to the topic, and the credentials the author provided. Information was also primarily selected based on how recently it was published, with the majority of resources being selected within the past 10 years. Articles and authors were selected based upon the citations provided in the articles, the credibility of the sources, such as peer-reviewed articles or national/international published conference proceedings, relevance of the articles to the topic to be discussed, and the frequency that sources were referenced by others.

ANALYSIS AND DISCUSSION

In the following section, this review will analyze and discuss several key factors that pertain to the topic of multi-user learning environments. At the simplest level these multi-user learning environments are video games adapted or designed to meet specific educational goals. Although the use and acceptance of video games as an educational tool in and out of the classroom is just starting to develop (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Ketelhut, Dede, Clarke, Nelson, & Bowman, In Press; Paul & Hansen, 2006; Tuzan, 2004), there are many points to discuss such as defining what games/video games actually are, the benefits of interactivity in games, large scale multiplayer games, and social interaction in these virtual worlds. This review will examine these features and elaborate on which aspects of multi-user learning environments can be used to help facilitate and enhance learning.

Games

But what IS a game? A simplified explanation of a game is defined as an “activity engaged in for diversion or amusement : play. A procedure or strategy for gaining an end. A physical or mental competition conducted according to rules with the participants in direct opposition to each other” (Game, 2009). In exploring what a game is in more depth there are several authors who describe the elements of what a game is. Prensky (2007) lists six elements of games: rules, goals and objectives, outcomes and feedback, conflict/competition/ challenge/opposition, interaction, and representation or story. Lepper and Malone identified 5 components that games possess: challenge, curiosity, control, fantasy and interpersonal activity (Malone & Leper, 1987). Chris Crawford in his book, *The Art of Computer Game Design* (1982) proposes that there are

four fundamental factors to all games: representation, interaction, conflict and safety.

Comparing these various different elements of games shows various similarities between them. Each author has an element of challenge / conflict. These descriptions also include a set of rules to handle the conflict/ challenge towards the meeting of a goal or objective. Crawford describes rules as a subsection of conflict, directing the engagement of conflict. Control of the game provides a third similarity found between these authors and developing a story or representation of the world provides a fourth. While not all games have all these elements, a good game does. Prensky (2007) describes a good game as one where the learner cares about the outcome of the game.

Goals and objectives are what the player is trying to accomplish, whether it is user created or provided by the game. Goals and objectives are strong contributors as to why people play games and what differentiates a *game* from a *toy*. Outcomes and feedback are the results or the progress towards the goals and objectives. These outcomes and feedback can be either positive or negative depending on how the player interacts with/in the game, or with other objects/people in the game. Rules are the defining factors of the game by limiting and defining the various actions that the player can make or do. Rules provide boundaries on what is possible, and provide a fair and stable playing field for all participants.

Conflict/competition/challenge/opposition represents the method in which the user works towards accomplishing the goals of the game. Interaction in games deals with how the participants in the game relate to each other, their environment, and the development of social groups in the world. Representation or story is what the game itself

is about, providing background information about the world and guidance on what the individual can or should do.

But why do people play games besides accomplishing goals and objectives? According to Prensky (2007) people play games because games are fun and allow people to play. By having fun while engaged in a game, mechanisms allow for the players to relax which in turn motivates them to play. Play in relationship to games is emphasized as having three main factors. “Play is something one chooses to do, play is intensely and utterly absorbing, and play promotes the formation of social groupings” (Prensky, 2007, p. 5-7).

The question remains as to what makes a good video game. Prensky (2007) outlines eleven basic principles for good computer game designs. These principles provide a useful starting point to keep the learner’s attention when developing the model for educational games. Prensky states that good computer game designs should have a clear vision and strong structure. These games should also be highly adaptive and easy to learn, though harder to master, and be accessible through a user-friendly interface. Individuals within the game should be able to explore and discover things for themselves, while at the same time elements in the game should be provided to mutually assist in solving problems. Lastly a good game should contain a mechanism for learners to save their progress. By incorporating these elements into the design of any game, educationally-based or not, they provide a foundation for a game that is better constructed and in the long run, more enjoyable to the learner or player (Prensky, 2007).

Gee (2003) states that good video games encourage learners to be good problem solvers. Learners learn not just how to solve a particular problem, but new methods for

approaching problems in general while developing new ways to handle problems that may present themselves in the future. Elements in the game and the other players in the game, encouraging active, critical thinking and reflective practices, can facilitate this learning opportunity.

Educational Video Games

There are various components to a game. The primary focus in developing video games has been on entertainment, though a sub-category of video games has emerged called educational video games. A video game is any type of human/electronic interaction which displays a visual representation of the actions on a graphical display (Wolf, 2007). There are two main platforms on which video games are played, either a stand-alone video game console or a personal computer (Wolf, 2007).

For this review, video gaming will be identified as play which is fun, engages the individual in a world based on rules which define how and what can be done, with consequences and results determined by the players' actions (Akilli, 2007). A video game must also have a level of competition, either between individuals or a perceived competition, such as keeping a score (Ke, 2008). Video gaming includes the aspects of failure and experimentation in which the user explores interactions with a virtual environment and objects located within the environment. Objects are not limited to solely inanimate objects, but may include other real-life persons or game-created personalities, referred to as NPC (Non-Player Characters) or AI (Artificial Intelligence) (Dickey, 2007; Wawrzynski, Arabas, & Cichosz, 2008). Games require individual users to participate and interact within them to have a fully-realized experience. Games promote "an attitude oriented toward risk-taking, meaning creation, non-linear navigation, problem-solving, an understanding of rule structures, and an acknowledgment of agency within that

structure..." (Klopfer, Osterwei, & Salen, 2009, p. 6). The final element of a successful game is that it be "creative and enjoyable in its essence" (Akilli, 2007, p. 4). Without the entertainment value of the games, Akilli believes they would not have their attraction or high replay value.

The early development of many educational video games was focused primarily on the educational value of the software. These games of the past, like *Math Blasters* or *Knowledge Muncher*, were little better than *interactive quizzes* of repeated similar scenarios with increasing difficulty (Klopfer, Osterwei, & Salen, 2009). Similar type games tried to mimic the role of the teacher in the classroom and provided stand-alone instruction for the learner (Winn, 2002). These types of games were so focused on the educational value they profoundly diminished the learner's attraction and desire to replay them, limiting their potential as effective educational tools. Unfortunately these software titles lacked a key component, the entertainment value that ultimately captures the attention of the learner. To build a truly effective educational game, the educational pedagogy and the entertainment value of the game must be balanced (Klopfer, Osterwei, & Salen, 2009).

Kickmeier-Rust, Peirce, Conlan, Schwarz, Verpoorten, and Albert (2007) suggest that there are three main types of situations that learners encounter when immersed in a learning game. The first of these is the *learning situation*, where the situation is to teach an educational goal or provide the learner with additional information to further his or her knowledge base. The second situation is referred to as a *game play situation*. In a game play situation, the learner is interacting within the game with other characters, the environment, or virtual objects in the world. In the game play situation, the learner is

using his or her skills and knowledge at playing the game, and is focusing less on the educational attributes. The third and final situation is the *story line situation*. In the story line situation, the learner furthers the story line in the game through educational and game play situations. The successful use of any or all of these three elements in educational games helps contribute to make a story engaging and entertaining to the learner.

Why use educational games to teach? Besides the inherent value of fun or play found in games as a whole, these games can provide access and experiences that users could not participate in without the use of these games. Games can allow learners to explore things that may be physically dangerous for them if they were to practice with them in real life (Dede, Nelson, Ketelhut, Clarke, & Bowman, 2004). Games can also allow learners to participate in activities and experiences, experiment with interactions multiple times in different situations, and to explore cause and effect relations that may not be economically or even physically possible in their real world learning environments (Appelman, 2005). Oversimplifying problems that a learner may encounter in a game can lead to misunderstanding the true intent and purpose of the activity, which often inhibits the acquisition of new knowledge for the learner or leads to learning the wrong information (Winn, 2002). The benefits of using educational games to promote and encourage learning have positive aspects that go beyond the instruction of the learner. The more realistic the game and interactions are, the more authentic the learning is. Authentic learning allows the learners to draw connections between what is experienced in the game to their real life (Winn, 2002). There is consistent research that shows that playing video games increases hand-eye coordination, increases reaction time, and can

help improve a learner's self esteem (Griffiths, 2002). Rosser, Lynch, Cuddihy, Gentile, Klonsky, and Merrell (2007) showed that surgeons who played commercial action games increased their accuracy and their surgical skills by playing the game *Super Monkey Ball*. Using video games in education also helps to engage students. Students are more likely to become involved in the classroom if they are presented with something new and *entertaining*, such as a video game in the classroom (Kadokia, 2005).

An increasing number of people spend their leisure time playing video games. According to the Entertainment Software Association *2009 Sales, Demographics and Usage Data About the Computer and Video Game Industry Report*, 65% of all American households play computer or video games (Entertainment Software Association, 2009). The Pew Research center reports "More than half of American adults age 18 and older (53%) play video games, and about one-in-five adults (21%) play every day or almost every day" (Lenhart, Jones, & Macgil, 2008, para. 1). Of those surveyed, it was shown that 57% had at least some college education and 76% of students in general reported playing video games compared to 49% of non-students (Lenhart, Jones, & Macgil, 2008).

Interactivity in Games

Online learning via video games is also an interactive medium. Interactive, according to the Webster Dictionary 2009, is:

...involving the actions or input of a user; *especially*: of, relating to, or being a two-way electronic communication system (as a telephone, cable television, or a computer) that involves a user's orders (as for information or merchandise) or responses (as to a poll). (Interactive, 2009, para. 1)

Interactive software has the benefit of allowing the user to have control over the program, letting the learner decide the way the program will run, where the learner will navigate to,

and the order in which he/she accesses the information, under the guidance of the software (Palme, 1996). Although all games allow control and interactivity (Crawford, 1982; Malone & Leper, 1987; Prensky, 2007), not all games give users the same amounts.

Interactive games support multiple modes of learning (Passerini & Granger, 2000). By using various types of multimedia in game design, designers are using Gardner's multiple intelligences theory. Gardner's multiple intelligence theory states there are multiple different ways that people learn and process information. Each person has their own individual strengths and weaknesses when it comes to how they learn. What works for one person may not work for another. The methods of learning are broken down into at least nine broad categories: logical-mathematical intelligence, linguistic intelligence, spatial intelligence, musical intelligence, bodily-kinesthetic intelligence, intrapersonal intelligence, interpersonal intelligence, naturalistic intelligence, spiritual / existential intelligence (Gardner, 1999). By understanding that there are multiple different intelligences and each learner has different strengths and understandings in these intelligences, game designers can create interactions and events in the virtual worlds, or provide multiple types of interactions, that target multiple domains of intelligence to assist with acquiring and processing information. Thirty percent of adults say they learn better through the medium of sound (listening), while another thirty percent say they learn the information more effectively through the medium of text (reading) (Greenagel, 2003). Learning can be optimized when information is presented through multiple forms of media (Dastbaz & Kalfatis, 2003).

There are many benefits to using interactivity in learning. By using interactive software, the learners are in control of the speed of their learning (Dickey, 2007). When using technology, learners access materials at their own pace and on their own time. Activity in virtual gaming worlds is not constrained by real time. A learner can be involved as long as it takes to learn the necessary materials or skills. Slower learners may take their time while fast learners can move through the materials at a quicker pace. Gaming also allows for repeatability as users may repeat portions of the game if they do not fully understand the materials that were presented (Appelman, 2005; Cybulski & Linden, 2000).

Interactivity also allows the users to control the sequence of their learning. Learners can explore the software in a non-linear fashion, in contrast to media (i.e, video) which is linear (VNU Business Media, 1997). Interactive software can improve learners' recall and engagement processes in ways that print materials and videos cannot (Kozel, 1997). Allowing users to maintain some control over the sequence of activities or the order the learning materials will be accessed will help to develop an intrinsic motivation in the learners as suggested by Malone and Leper (1987).

Every learner is different and, unless they are targeting a very specific audience, most designers will choose to design software that targets multiple modes of learning. This was shown when the College of Education at Texas Tech University examined the effectiveness of multimedia software on adult thinking and the learning process of educational leaders. In the study it was shown that the selected CD Rom, which included multimedia such as text, graphics, and digital video, was useful in developing reflective thinking and decision-making skills (Claudt, 1998). Instead of limiting the learner to one

particular mode of learning such as text or video, multimedia has the benefits of developing and using multiple forms of media to help those who learn in different ways.

Interactive software also allows for much more than standard video, images, or text in demonstrating how things are done. By using interactive software, the learner can watch and become involved in the processes and tutorials while exploring and developing his or her own learning schemas. The software can be developed so that if the learner needs to hear the directions rather than read them, this can be provided. Learners can have access to images or video to help with their learning process. If the tutorial needs to be repeated, there is ample opportunity to do so (Thornburg, 1996).

Multi-User Virtual Environments

Although there are several different types of MuVEs spanning from the text based MUDs (multi-user dungeons) to MMORPGS (massive multiplayer online role playing games) (Quinn & Cartright, 2008) such as World of Warcraft, which are fully 3-d graphical worlds. This review will focus specifically on the literature relevant to graphical versions. MuVEs are a special type of game in that they can create a persistent virtual world that the user experiences via computer software. The virtual world exists even after the player logs off or is no longer connected to the virtual world. Users connect to these virtual worlds via an Internet connection, allowing access from anywhere that has a computer with the minimum system requirements (varies from game to game), and a live Internet connection. Anyone who has access to the virtual world, usually in the form of a game account, can connect to the world at any time the game is online.

Each learner in the MuVE controls and interacts with the world via his or her avatar. The avatar is the virtual representation of the learner or player of the game. The learner's avatar is controlled and interacts with the environment based on the learner's

commands. Games allow the learner to develop/enhance his or her own avatar, the tools and abilities that the avatar has available, and in some cases, even the environment in which the avatar is active (Klopfer, 2008).

What do MuVEs do to facilitate learning in education? Through interactions with other people, communication, collaboration, and problem-solving skills are promoted (Dickey, 2007). Games in themselves provide an illustrated example of contextual bridging, allowing the learner to visually see and interact with the information being learned. Through the entertainment concept, learners are encouraged and often demonstrate high time-on task. Games are developed to provide motivation. Success or failures through a video game provide useful, repeatable learning situations for students by encouraging students to develop higher-order thinking skills (Akilli, 2007). When learners are confronted with a difficult situation, learning cues are provided to guide the learner, without giving them the full information to solve the problem, then reflection is encouraged on the materials learned. Video games can also use internal evaluation, monitor how or what the learner is doing in the world, and develop personalized or custom learning for each individual's learning through the game. Games can be played at any time, from anywhere in the world providing learners with access to the learning material whenever it is needed with content that can be repeated multiple times (Klopfer, Osterwei, & Salen 2009). There have been several educational MuVEs that have been created to explore the merging of educational learning and online entertainment. The following section documents several key examples.

Disaster at Harperville was developed by Nora Paul & Kathleen A. Hansen (2006) from the University of Minnesota. They modified a commercially available game,

Neverwinter Nights, to teach students effective information gathering strategies by emerging them in a realistic setting for the course *Information for Mass Communication*. Each of the students were to explore the game environment to determine the cause of a railroad accident and develop a story based on the information they gathered discussing the incident with the NPCs (Non-player Character - computer controlled characters in the world) in the game and research done in the game. While developing the game various different response options were made available to the learner when interviewing people through the game, which directed the method in which the NPC dealt with each learner's avatar. Learners had a limited amount of time in which to gather the information and write their story (Paul & Hansen, 2006).

The River City Project was developed at Harvard, under the direction of Chris Dede to have middle school students explore a town plagued by sickness. Students worked in teams to discover the cause of the sickness using scientific inquiry skills and to develop general science knowledge about the materials they were studying. Students could explore various different locations such as the hospital, a university, various industries, and neighborhoods. Students could interact with various different NPCs, other players' avatars, and the instructor's avatar. Visual and auditory clues were provided to the students as they learned scientific inquiry skills. At the end of the project students collaborated and shared their findings with other students in the class (Ketelhut, Dede, Clarke, Nelson, & Bowman, In Press).

Revolution was produced through MIT's Comparative Media. It is another *Neverwinter Nights* game modification where students explore colonial America and determine how their avatars would handle the situations that appear. This game is unique,

out of the games examined, as it allows for multiple scenario endings depending on with whom the learners decide to align themselves. *Revolution* has a strong narrative component for guiding the learners through the lives that they have chosen to represent. The game was developed for middle school learners (Revolution, n.d.).

Quest Atlantis allows middle school students to partake in a variety of game-provided quests to solve the problem of a failing world. Students are engaged in activities that are both offered by the game itself and through quests posted by teachers, which require students to partake in activities that cover a multitude of disciplines and a wide virtual area. Students and educators can access the world outside of their individual class during their free time (Barab et al., 2005; Tuzan, 2004).

There is also an assortment of virtual worlds that have not been explicitly developed as educational MuVEs or educational software, but have the adaptability to be used as such. These virtual worlds include games such as *There* and *Second Life* which have been modified by universities, libraries, corporations, and individuals to provide educational content to users, through real world simulation without the game-like interactions (Second Life Blogs, n.d.; Second Life in Education, n.d.).

The MuVE may or may not have a narrative story for the learner to follow, as the goals and objectives may be developed separately from the game and applied to the specific task at hand. In a persistent virtual world, the story and the game continue to develop and play even after an individual player has logged off (Dickey, 2007).

In the educational MuVEs that are currently available there is usually a single overall story line for the users to follow, *Revolution* and *The Disaster at Harperville* being primary examples. This is in contrast to the commercial gaming MuVEs that do not

have a single storyline for users to follow, but hundreds or thousands of miniature storylines for the player to discover and explore. Although there is not a single storyline for players to follow, most commercial games have a vague overall narrative that characters follow. These miniature storylines may or may not contribute to the overall narrative or be added to the game to give it a particular feel for the user (Dickey, 2007).

While all games have specific goals and objectives for players to accomplish coded into the game, games vary on the amount of modification that a player is allowed to make to a game. Educational games, such as *Democracy 2* allow users to make changes to how the game works, but not to the core of the game itself. These limited modifications do not change the overall concept of the game (Democracy 2, 2007). Commercial games developed for entertainment purposes frequently allow users to modify or change the scope of the game, creating new content for the game beyond the original development. Examples of games that have been modified are the educational MuVEs *Disaster at Harperville* and *Revolution* which were developed by individuals using the game *Neverwinter Nights* as the source of their software (Paul & Hansen, 2006; Revolution, n.d.).

Social Interaction in MuVEs

A multi-user virtual environment is distinctive from other educational games in its structure which allows multiple learners to access the world (and each other) at the same time. This player-to-player interaction is the core feature of a MuVE (Moore, Ducheneaut, & Nickell, 2007). Users can communicate with each other through in-game functions, as well as view and interact with other player avatars in the world. There are many benefits to encouraging social interactions and collaborations between the learners in multi-user virtual environments. Chen and Lei (2006) found that players who were

more socially interactive with other players tended to play the game for longer periods of time than those players who focused on a more solo playing style. This does not exclude person-to-computer interactions, which can include interactions with objects and computer-generated personas (Blaisdell, 2006; Klopfer, 2008; Prensky, 2007).

A contrast to MuVEs are games in which the play style is based on a single user. In single-user virtual environments, when a user quits the game or stops playing, the game world is paused or is placed in a state of stasis until the user rejoins the game. The story line does not continue while the user is not in the game, and resumes from the last point in the game when the player starts to play the game again. In a single user virtual environment interactions are limited to person-to-computer interactions. These types of games are referred to as session-based games (Prensky, 2007).

Motivation in MuVEs and Games

Why do people choose to play games? The primary reason that people choose to play games is because they are fun to play. For software to be successful, educational software in particular, there must be strong motivational factors (play) that encourage the learners to continue playing the game and exploring the world (Tüzün, 2007). Becker (2007) lists several factors that contribute to the motivation of players who are engaged in a game. The first motivational factor is presenting the learner with a specific goal or task to accomplish. The goal or task should provide an adequate challenge while at the same time the risk of failure is present. Upon completion of the goal or task, the game provides the learner a reward that relates to the context and difficulty of the task. Likewise failure to complete the goal or task provides the player with negative feedback. Goals or tasks should be developed so each player has a fair chance to accomplish the task at hand.

Goals and tasks developed with a certain amount of chance associated with them encourage players to repeat tasks upon failure with which players have a tendency to associate their failure (extrinsic reasons), encouraging them to repeat the task (Becker, 2007).

For the learner, the fundamental challenge of a game is having goals to accomplish. These goals play a major part in motivating people to play games (Khine & Shalleh Bin Suja Ee, 2005; Prensky, 2007). The goals can be long, medium, or short term, and are either explicitly stated in the game or are created by the learner. As users create their own goals in the game they are making the software more personally interesting for themselves (Banget-Drowns & Pyke, 2001; Khine & Shalleh Bin Suja Ee, 2005). There may exist a certain level of ambiguity in long-term goals that exist within MuVEs. These goals support Piaget's constructivist learning theory, where the individual player or learner develops his or her own long-term goals and learns by interactions through the learner's environment (Piaget, 1950). MuVEs also support Vygotsky's theory of social constructivism, using the game itself as the role of the facilitator, and providing the learner with guidance. Most interactions in a MuVE take place within a social framework, whether that is a realistic social interaction involving other people, or a perceived social interaction with the computer software (Vygotsky, 1978). A perceived social interaction would be the learner interacting with a scripted computer-generated character/artificial intelligence in the virtual world.

For this literature review, the in-game method for delivering explicitly stated goals or challenges to the learner is referred to as a *quest*. The method or procedure through which the learner completes a quest should be clearly defined with the options

explained in various formats to maintain the learners' interest. These quests help provide motivation for the player to continue playing the game by maintaining the focus of the game on the player. They also provide guidance for the learner, insight on what has happened in the game, or suggestions on what the learner could do next. The learner is allowed to choose various quests that he or she wishes to complete and the order in which the quests are completed. By completing these quests the learner is provided with a reward, that increases with the difficulty of the quest, which could include things such as information, virtual objects for the learner's avatar, or general objects that could be used throughout the world (Dickey, 2007; Gee, 2003).

Each choice that the user makes affects how the world develops or changes. By giving the players control of which quests or choices they make while engaged in the game, the players are allowed to determine which story-lines they wish to develop and explore, enabling multiple ways for the story to unfold and the direction of the game. As the players complete these short-term goals they are provided with a reward, provided with an incentive for learners to undertake the larger and more time consuming goals that are made available through the game. The reward or incentive to finish these goals should scale in value with the difficulty or complexity of the process to reach the goal (Gee, 2003). In developing goals for the players to accomplish, tools such as puzzles are used to facilitate the process of these accomplishments. These quests are the challenges to the learner and provide a strong foundation for game play design. Goals can be accomplished individually or by encouraging cooperation between the players in the game, fostering social interactions and collaboration. To efficiently use goals in games, similarities should be made to relate relevant real life experiences, choices and decisions to in-game

decisions. These related examples foster the connection of simulated experiences to real experiences, making games much more effective learning tools (Khine & Shalleh Bin Suja Ee, 2005). What can be learned from each individual game used in a classroom setting is limited by a teacher's understanding of the game, the learners' imagination on possible applications of the software towards their educational goals, or using information provided with the game to explain how it can be used educationally. When designing an educational MuVE that has applications in the classroom it is important to provide the teacher with suggestions on how to incorporate the technology into the classroom (Dede, Nelson, Ketelhut, Clarke, & Bowman, 2004).

Learning via games is much more than providing access to a virtual world and then expecting a learner to master the content without aids. There needs to be guided learning to take advantage of the materials (Hmelo-Silver, Duncan, & Chinn, 2007). Educational games should provide instructions and guidance through an interesting manner or experience involving interaction in the virtual world through options such as audio or music and highly detailed graphics, all of which contribute to motivating the learner to explore the environment (Khine & Shalleh Bin Suja Ee, 2005).

Currently commercially available games offer many intrinsic rewards to the players of their games; they offer incentives such as points, in-game items, avatar development, or advancing avatar levels. Understanding these ideas and concepts that engage players will be vital in developing the frame work of educational MuVEs that hope to draw in a large number of players or learners (Dickey, 2007). Players can be engaged by providing creative activities and environments that encourage players to develop intrinsic motivation to play the game.

For a game to be successful, it should induce a state of *flow*, which is the optimal state of intrinsic motivation. Csikszentmihalyi, during an interview with *Wired Magazine*, describes the flow state as being "completely involved in an activity for its own sake" (Gierland, 2006, p. 160). The game should constantly focus on the player's experience and keep the player within the flow state, by presenting learners with clear goals or tasks to achieve, with the correct levels of feedback, and a balance of skill and challenges. The key part is finding the balance of all of the elements. Too many challenges, or ones that require too much skill, will frustrate the learner, while providing challenges that are too easy will bore the learner. Feedback and responses are immediate during the flow state. Individuals know immediately if what they did was correct or incorrect, if the choices they made were an improvement or not. Individuals who are experiencing the flow state are so involved in the activity that nothing else matters, learners move beyond being happy about what they are doing and focus on the event or activity itself. The users lose track of time and become entirely engaged in the world or activity. After the event, users who found the flow state usually experience a feeling of happiness or contentment. It should be noted that not everyone experiences flow or experiences it in the same way. Learners must also be actively engaged in what they are doing to experience flow (Csikszentmihalyi, 1990). Beyond finding an event or activity that a user enjoys so much that the experience becomes so important, the flow state is a conduit for excelling at learning. Learners in the flow state have control over their situation and have a strong interest in what they are doing, with a self interest in continuing the activity. Lee and LaRose (2007), in a study examining self-regulation, the flow experience, and video games, point out that individuals who achieve the flow state

while playing video games tend to play games for longer than they had originally set out to and have a tendency to lose self-control in monitoring their time playing. Lee and LaRose also suggest that the flow experience is not related to the time spent playing the game and players may slip in and out of the flow experience during game play experiences.

The worlds of many MuVEs are highly realistic to encourage the idea that Gee (2005) refers to as "embodied empathy for a complex system" (p. 84). What this means is by becoming actively engaged and immersed in a video game, the experience allows the gamer to more fully understand complex systems and relationships. This empathy exists towards more than just the avatar that the learner is controlling, but the entire virtual world in which he or she is immersed is leading to a deep understanding of how the virtual world works and exists beyond the individual. The player becomes a virtual part of the world, doing activities which may not be replicable in the real world (Klopfer, 2008). By designing educational games that encourage flow and embodied empathy, designers are able to create actively engaging games that maintain learners' interest and encourage them to invest a significant amount of time in furthering their own active learning.

It is critical that educators remember, however, that each learner is an individual and what may motivate one learner may offer reduced motivation or may not provide any motivation for another learner (Ke, 2008). Educational games attempt to remedy this motivational discrepancy by providing a wide range of educational and entertaining methods to assist learning, helping students who may not be interested or able to learn in a conventional classroom setting (Dede, Nelson, Ketelhut, Clarke, & Bowman, 2004).

Using MuVEs for Evaluation

For evaluative purposes, MuVEs themselves can provide massive amounts of data on the way learners use the game and interact with the game (Barab et al., 2005). Since all activity occurs in a virtual world through a computer, data tracking systems can be created to track what the learner is doing in the world, how the learner interacts with the world, which tasks the user decides to attempt to accomplish, and how much time it takes to complete various tasks (Tüzün, 2004). By collecting this data, the developers are provided with a means to evaluate the game itself, and determine which learning challenges were most actively undertaken by the learner. This data can also be used to determine if any of the challenges were *problem challenges* and to make modifications for the future based on the data collected (Appelman, 2005). These types of games can provide information on more than just what the learner learns, but also the learner's experience.

Drawbacks to Educational Video Games

While the use of multi-user virtual environments may have many advantages to their use in an education or training setting, there are several drawbacks to using MuVEs. The first drawback to MuVES is they all require a certain level of computer technology. To operate and successfully interact in a MuVE, the learner must have the appropriate computer software and hardware, as well as an appropriate Internet connection to connect to the virtual world. As not all students have a computer or Internet access, their time using the virtual world is limited to areas such as their school or other places with sufficiently-powerful hardware, the correct software, and Internet access (Tüzün, 2007).

Additional challenges include that teachers must have training or be sufficiently familiar with the software to understand how to incorporate it into their classroom. The

instructors also must have an understanding of the strengths and weaknesses of using a MuVE for educational purposes. This obstacle to using a MuVE in the classroom can easily be overcome with training and teacher education (Blaisdell, 2005).

Many MuVEs that are commercially available are not explicitly used for education, and the educational use for them is limited to what the teacher or facilitator can devise for their use. While playing any video game, learners are learning content, but most do not focus explicitly on school-based facts. Gee (2003) also states that the problem is rooted in our current and historical view of learning and education:

Important knowledge (now usually gained in school) is content in the sense of information rooted in, or, at least, related to, intellectual domains or academic disciplines like physics, history, art, or literature. Work that does not involve such learning is “meaningless.” (p. 21)

What this means in relation to the learning process, is that experiential learning could be considered trivial when the learner is not expressly *learning*. There is a need to know how to apply the information learned which supersedes the basics of just knowing facts and information (Gee, 2003). Learning should be active, providing learners with new interesting ways of experiencing the world and becoming actively engaged in their learning.

Learning must move a step past active learning and become critical learning during which "...the learner must be able to consciously attend to, reflect on, critique, and manipulate those design grammars at a metalevel" (Gee, 2003, p. 40). What Gee means is that the learner must know what is acceptable both socially and content wise in the particular semiotic domain (oral or written language, images, symbols, sounds etc that

that convey a particular meaning to a community of similar individuals), and make critical decisions based on this information. The learner must be able to handle different objects or elements in different situations when values of the objects may change based on the environment. In terms of video games and what this means for education, each learner in the virtual world is presented with a situation and is allowed to determine his or her own resolution to the problem. There are multiple ways to handle the problem at hand, where the learner uses past experiences and knowledge of the situation to solve the problem. The learner can explore these options, determine which is the most successful or beneficial, and then engage in the procedure for the solution (Gee, 2003).

CONCLUSIONS & RECOMMENDATIONS

Through this literature review various elements have been repeated throughout the literature, providing concrete theory on the development of games, what makes games fun, entertaining, and attractive for the user to want to spend time playing games. There has been much work on studying educational games, and research conducted on how to best combine the educational aspect of learning to the pleasurable experience of playing video games. Until the last decade the majority of these games were single player games, targeted to an individual player in a session-based world. As the technology has developed, so has the availability and growth of graphical multi-user virtual game worlds, allowing hundreds to thousands of players to become immersed in a single virtual world at the same time, exploring with their avatar, while interacting with the world and other players in the game world. Exploring this topic even further had lead game developers to the next phase in educational games, the multi-user virtual environment with an educational focus. Although there has limited development in the area of educational multi-user virtual environments built specifically for educational purposes, there are many multi-user virtual environments that have the possibility of educational applications, and are easily modified to produce an educational multi-user learning world.

There are many reasons to use multi-user virtual environments as a learning tool. First they are highly interesting and entertaining for learners. Learners who are interested in playing online games spend hours a day immersed in these virtual worlds, finding their own state of flow for this enjoyable activity. Multi-user virtual environments also provide a degree of social interactions that single user learning games cannot provide. In a multi-user virtual environment, the learners interact with other learners in the world opposed to

only computer-generated characters. These interactions with other live humans add new possibilities to these learning scenarios that cannot be reproduced in single user games.

From the review of material there appears to be three basic characteristics of all multi-user virtual environments, the focus of the game, the modifiability of the game and the accessibility of the game. The focus of the game is to what degree the game targets an educational audience or an entertainment audience. The modifiability of the game describes how easily, or if at all, the game can be modified by outside users. The accessibility of the game provides information on how learners can access the game and the technology required to run the game.

Many games currently available are produced with the focus entirely on the entertainment value of the game, with little or no educational value intrinsically available through or in the game. These MuVEs are commonly seen as commercial titles that are available in retail stores, such as *World of Warcraft*, *EVE Online*, and *City of Heroes/Villains*. While these gaming MuVEs may have the potential to be modified into educational MuVEs, while retaining some of their entertainment value, this is not always the case nor is it always easy. It is also important to note that while educational MuVEs and games are built with the intent of being entertaining, this is not always accomplished successfully. These types of MuVEs can be accessed anywhere, limited only by the software, Internet, and hardware requirements.

As MuVEs are developed with more of an educational focus, games such as Harvard's *The River City Project* or MIT's *Revolution* emerge. These MuVEs, while they may contain some entertainment value, are focused on educational goals, and could not stand independently without the educational backdrop. These educational MuVEs should

not be modified since that would destroy the educational framework that has been developed for the game. Many times these games are modifications of other existing games. These games, while allowing for multiple users, have a limited scope of accessibility, requiring the learners to access them in a guided classroom situation.

Through the development of new games and the exploration for new ways to encourage learning, the focus of multi-user games has started to shift to a shared focus of educational and entertainment. These MuVEs have high entertainment value - enough that they could be stand-alone entertainment games, provide a strong educational framework, and are highly modifiable / adaptable by others. This type of MuVE exists in a preliminary stage in the game *Quest for Atlantis*, although this game has a focus that is much more towards education than a shared focus of education and entertainment. *Quest Atlantis* has the advantage that it is highly modifiable by the community as teachers and students are able to create quests for learners to partake in the game. Students can also access the game in their own time and are not constrained by accessing the materials only during class time.

Focus	Modifiability	Accessibility	Examples
Entertainment	Low	Anytime/Anywhere	<i>World of Warcraft, EVE Online, City of Heroes/Villains</i>
Educational	None	Classroom/Guided	<i>The River City Project, Revolution</i>
Entertainment & Educational	High	Anytime/Anywhere	<i>Quest Atlantis</i>

Table 1. Comparison of Suggested MUVEs Categories

There also exists a difference in motivation for current educational MuVEs and commercially available games. In the commercially available titles, the rewards for playing the game include long-term avatar development, while encouraging players to invest large amounts of time to improve their avatars. There is a certain level of competition between players in the world to develop their avatars faster than other players in the world. In the available educational MuVEs the focus is on learning the materials through an alternative method that is perceived as *fun* or *different* because the knowledge is gained through a computer game. The educational MuVEs offer no long-term sustainability for the learners and are one shot games.

The reviewer's recommendation is that educational MuVEs of the future will not be strictly educational games; they will be Educational Gaming MuVEs (EGM) that will be able to stand alone as a gaming MuVE yet have educational value to provide enhanced learning through game-play and engagement. These games will teach a variety of concepts through play and engage learners by creating a state of flow. They will be highly modifiable by the individual user and community to produce customizable and educationally sound components that are easily shared and incorporated into other users' games. Users will be able to create a moment from any time or place. These EGMs will provide a structure that provides the learner with new knowledge through means such as interactive tutorials. There would also be the means to allow the learner to explore his or her own creativity through interpersonal reflection and use of in-game tools to build upon and modify that knowledge. There will exist a social structure or a similar medium available to the learner to expand and discuss what was learned or discovered with their peers through gaming or other software in connections with the game (such as a wiki).

The final aspect of the educational learning process through the game would be the application of the knowledge. These games will allow the user to use real life skills and knowledge in these games to contribute to the development of their avatars and their online gaming experience.

To build a truly effective game based learning environment games must adapt and change depending on the learners. To encourage the future development of this type of game, research could be done on methods to make games more easily modifiable by instructors, or creating software to handle the modification of games. Further research on topics such as advanced game intelligences to handle multiple learners while selecting specific learning scenarios that best fit with the learners' needs and the use of social networking as a medium for game based learning would also be beneficial towards the creation of MuVEs that engage a wide range of learners at the same time. Research should also be conducted on social interactions for learning situations in MuVEs beyond simulations and examining the flow experience as it relates to MuVEs.

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