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Go With The Flow: Examining The Effects Of Engagement Using Flow Theory And It's Relationship To Achievement And Performance

Karen Cooper
University of Central Florida

GO WITH THE FLOW:
EXAMINING THE EFFECTS OF ENGAGEMENT USING FLOW THEORY AND IT'S RELATIONSHIP TO ACHIEVEMENT AND PERFORMANCE IN THE 3-DIMENSIONAL VIRTUAL LEARNING ENVIRONMENT OF *SECOND LIFE*.

by

KAREN E COOPER
B.S. College of New Jersey, 1982
M.S. Syracuse University, 2004

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at the University of Central Florida
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Major Professor: Atsusi Hirumi

ABSTRACT

Virtual Worlds have become an attractive platform for work, play, and learning. Businesses, including the public sector and academia, are increasingly investing their time, money, and attention to understanding the value of virtual worlds as a productivity tool. For example, educators are leading the way with research in Second Life, one of the more popular virtual worlds, as a potentially powerful medium for creating and delivering instruction. Still, little is empirically known about the value of virtual worlds as viable learning platforms.

This study examined the instructional potential of Second Life for creating engaging activities, and to investigate the relationship between Second Life and learning in educational settings. It was hypothesized that a positive relationship exists between a learner's level of engagement and achievement. Achievement was assessed as a learner's level of recognition and recall of factual content. It was also hypothesized that a positive relationship exists between a learner's level of engagement and their performance. Performance was assessed as a learner's level of participation, initiative and effort. Additionally, exploratory research was conducted to examine the factors that contributed to both performance and engagement. Lastly, the relationship between other demographic factors of age, Second Life skill level, and ethnicity, with engagement was explored.

This research used an empirically tested unit of web-based instructional framework known as a WebQuest. A 3D version, named *VWQuest*, was created in Second Life. One hundred volunteers completed participation. Using role play, participants participated in a quest for information. While exploring, participants were asked to take photos as evidence of their experiences. Upon completion, they took a knowledge check multiple-choice quiz, and a survey which measured their perceived level of engagement during the activity.

Regression analysis indicated no positive correlation between a participant's level of engagement and his or her achievement. However, a positive correlation was found between participants' level of engagement and their performance. *Second Life skill level* was significantly correlated to performance, and engagement was found to be a mediator between skill level and performance. Most significantly and unexpectedly, participants' performance varied so greatly, the performance rubric was revised four times before it comprehensively captured the diverse range of performances. This evidence suggests that open-ended and creative opportunities to perform yield levels of creativity, engagement, and innovation within immersive platforms, unexpected and far beyond that of traditional instructional settings.

Investigating flow dimensions, engagement elements of user *control* and *loss of time* were found to be the most significant contributors to performance, and accounted for the greatest amount of variance in explaining performance. Confirmatory factor analysis showed that the flow factors of *defined goals* and *feedback* loaded the highest, suggesting a strong relationship between the two factors. Demographic analysis revealed no significant mean difference between gender and engagement, or between age and engagement. The majority of participants were between 40 and 50 and was instructors or educators, not students.

For those interested in understanding appropriate and effective instruction in complex, immersive environments, this study brings together new important implications for all of them. Instructional designers may benefit from these findings in their creation of instructional content; instructors may benefit in their curriculum design and teaching methods; and researchers may understand specific facets with instructional potential – engagement factors, technologies, and instructional frameworks –worthy of further investigation.

This dissertation is dedicated to my husband John, whose love and support inspired me throughout this whole journey. I love you and am most grateful for your belief in me, your optimism, and your unending encouragement.

To my three incredible, young adult children, Matthew, Andrew, and Lindsey, whose love strengthened my determination to accomplish this research. I thank you for your patience and flexibility from the bottom of my heart.

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LIST OF ACRONYMS/ABBREVIATIONS

2D	two-dimensional
3D	three-dimensional
ACHT	achievement value as measured using the knowledge check scores
AGE	age range
AUTO	autotelic; intrinsically rewarding experience
CHSK	balance between activity challenge and individual skill
CTRL	sense of personal control over the situation or activity
CTRN	high degree of concentration with focused attention
ENGT	overall engagement as measured using flow sum score
ETHY	ethnicity
FDBK	direct and immediate feedback during the activity
GOAL	clear goals and perceived to be attainable
LPLC	experience the merging of action and awareness; temporary loss of place
LSLF	a temporary disappearing of self-consciousness or ego
LTIM	distorted sense of time; one's experience of time is altered
PERF	performance value as measured by photo package scores
SLSL	Second Life skill level

CHAPTER ONE: INTRODUCTION

Within academia, educators face issues of increased workload, reduced budgets, and fewer resources. They seek to effectively utilize technology to improve curriculum, to create workload efficiencies, and to offer effective courseware despite budget cuts. More and more educational institutions are turning to technology formats such as internet-based, distance-learning courses. For the past several years, online enrollments have been growing substantially faster than overall higher-education classroom enrollments. The expectation of academic leaders has been that these enrollments will continue growing substantially (Allen & Seaman, 2007). This technology affords institutions several advantages: reaching a larger audience of students, managing larger class sizes, taking advantage of content reuse, and accessing extensive repositories of content.

A rapidly increasing collection of research can be found that addresses learning in various technology-based contexts, from online courses to informal contexts such as chat rooms (Hayes, 2006). Online learning is growing so rapidly today that the number of students taking at least one online course is growing more than ten times as rapidly as the number of enrollments in post-secondary education (Smith, Smith, Samors & Mayadas, 2008). With an increasing number of online courses and degrees offered via the Internet and rapidly increasing enrollment in such courses, it is important to assess and understand web-enabled technologies, particularly the more emergent technologies which can affect or contribute to learning (Guru & Nah, 2001).

However, as educators are met with new teaching platforms, many uncertainties surface for instructors such as suitable designs for technology-based instruction, student engagement, and appropriate metrics for assessing achievement. And as technologies continue to advance and become mainstream instructional tools, it becomes increasingly important to understand the

dynamics and value of the more sophisticated technology options, including virtual worlds. It is also necessary to understand the construct of student engagement in these environments and its impact on student achievement. The focus of this study involves an advanced technology, the virtual world of Second Life, and how it interrelates with student engagement and achievement.

Virtual Worlds

One type of online medium attracting a growing number of people is the social virtual world (Book, 2004; Hayes, 2006). A virtual world is a computer-based simulated environment: a synchronous, persistent network of people, represented as avatars, facilitated by networked computers (Bell, 2008). Simply put, it is a digital universe available from a computer. These worlds are characterized by a shared social space, a graphical user interface, real-time interaction, user-created content, persistence, and active support for in-world social groups (Book, 2004). A virtual world has immersion and social media functionality. Virtual worlds are not necessarily games, as games have pre-defined rules and goals; they may not always have specific rules and goals. They allow for user-created content, user-defined purpose and a sense of presence with others at the same time and place. They create new opportunities for learning, innovation, and collaboration that go beyond the physical and geographical limitations of the physical world. *Second Life* (Linden Lab, 2003) is one of the more popular virtual worlds.

Second Life as a Learning Environment

Second Life boasts the ability to go beyond simply being a method of distance learning to becoming a tool that has reached both formal instruction and informal knowledge-sharing in communities of practice (Ondrejka, 2007). The demographics of the participants reveal that the interested audience is not just the traditional teenage male. The audience is balanced by both men and women residents, and the median age is early 30's.

Educators understand Second Life to be both a tool and a platform for today's learner. With more than 1,500 universities and 1,500 educators already using Second Life (Ondrejka, 2007), a growing knowledge repository of learning content is being created. As one of the founders, Ondrejka believes educators are the biggest trailblazers in virtual worlds. In his opinion, virtual worlds will become an increasingly persistent platform for education, and professors are among the most active pioneers (Young, 2008). Figure 1 illustrates a Second Life island and a virtual Second Life campus.

Over the past several years, educators have begun exploring virtual worlds like Second Life as a powerful medium for creating instruction. It has been used as an educational strategy (ANGEL Learning, 2008) to promote peer to peer learning; mentorship and apprenticeship relationships; learning by doing with hands on activities; role play; and self-directed, inquiry-based learning to name a few. In addition to educators striving to create a pedagogically sound learning environment, both educators and learners desire the learning content to be engaging.

Figure 1: Examples of Second Life Areas used for Training and Education.

Engagement and Flow

Flow is defined to be an intrinsically motivated optimal state characterized by intense concentration and enjoyment. It is the holistic positive sensation people feel when they act with total involvement, concentration, and immersion (Csikszentmihalyi, 1975, 1990). When in the

state of flow, people become absorbed in the activity, tuning out most everything else. Csikszentmihalyi (1987) identified the following nine elements accompanying an experience of flow: (1) clear, attainable goals, (2) direct and immediate feedback, (3) balance between activity challenge and individual skill, (4) high degree of concentration, (5) merging of action and awareness, (6) temporary loss of time, (7) temporary disappearing of self-consciousness, (8) sense of personal control, and (9) an autotelic, intrinsically rewarding experience. Flow theory then, posited by Csikszentmihalyi (1975, 1990, 1997), is a theory that describes the immersed state that exists in an individual premised by the above elements.

It had been shown that Flow theory can be effective in areas such as athletics (Marsh & Jackson, 1999), recreational textile production (Blood, 2006), video games (Belchior, 2007), music assessment (Wrigley, 2005), organizational effectiveness (Cassidy, 2006), and ballet dancing (Levine, 2006). Educationally, flow has also been positively correlated to learning, engagement (Shernoff, Csikszentmihalyi, Schneider & Shernoff, 2003), and achievement in studies of teacher readiness (Hood, 2007) and principal leadership (Cartwright, 2006; Danehy, 2006; Safier, 2004).

Flow in Technology Environments

During the last 15 years, researchers have studied and written about how flow is experienced within computer-mediated environments (Venkatesh & Davis, 1996; Finneran & Zhang, 2002; 2003). Researchers have studied flow with computer-mediated mathematics (Sedig, 2007), office productivity software on desktop computers (Ghani & Deshpande 1994; Webster, 1993) and general web activity (Chen 2006; Chen, Wigand & Nilan, 1999). As the theoretical foundation for exploration, play, and online engagement, flow has been studied in hypermedia learning environments (Konradt, Filip & Hoffman, 2003), online search experiences

(Mathwick & Rigdon, 2004), online consumer settings (Koufaris, 2002), online behaviors (Chen, 2006), and effective digital game-based learning designs (Kiili, 2005).

The aforementioned research studies all indicate a positive relationship between flow and achievement as well as the transference of flow into a wide variety of settings, from traditional to 2D web-based platforms. Yet, despite these findings, there exists no empirical research to date that has studied flow as an engagement framework within a 3D virtual environment. These 3D environments offer much to be studied because of their unique characteristics. The use of avatars may lead to an increased sense of identification; 3D visualization capabilities may lead to a greater sense of immersion; and direct manipulation of objects may lead to an increased sense of control – all of which are underlying dimensions of Flow theory. The relationship between 3D virtual environments and learning potential that stems from immersive engagement thus becomes an important topic for research.

Furthermore, the nine flow dimensions have been categorized according to their relationship with each other by previous researchers (Venkatesh & Davis, 1996; Finneran & Zhang, 2002, 2003; Kiili, 2005; Chen, 2006). For example, in one study the first three dimensions, *goals, feedback,* and *challenge-skill balance* were posited as antecedents to an activity; the second three, *control, concentration,* and *autotelic experience* were seen as experiences; and the last three, *loss of self, loss of time,* and *loss of place* were seen as consequences of an activity or experience (Chen, 2006). The relationships between these dimensions, especially in an emergent platform like virtual worlds, are believed to be important, particularly for creating engaging learning experiences. Investigating the relationship between factors leading to engagement in a virtual setting thus becomes an important topic for research.

Problem Statement

Despite a growing interest in virtual world spaces for education, little is known about their strengths and limitations as learning environments (Hayes, 2006). Furthermore, although engagement has been shown to be effective in a large variety of content areas, scant empirical research has been conducted that tests its potential in a more sophisticated technology environment such as virtual worlds. Moreover, as virtual worlds become more widely explored, it is important to study these worlds as learning environments. Currently, no empirical studies examine potential pedagogical value by examining the relationship between learner engagement and achievement in these environments. Possible explanations for the lack of studies may be that these environments are still so new and complex.

Purpose

This research sought to better understand the use of virtual worlds as learning environments for creating engaging activities and to better understand the relationship between these worlds and user achievement and performance in educational settings. The factors that lead to engagement and their potential relationship to enhanced performance were examined primarily through the lens of Csikszentmihalyi's Flow Theory (1997).

The conceptual framework, depicted in Figure 2, shows the relationship between the primary factors under study. The figure presents the nine flow dimensions, as a predictor of engagement and performance. The learning activity, which takes place in Second Life, is the mechanism used to examine the relationship. For the purpose of this research, flow score measured engagement. The knowledge-check quiz measured achievement, and the photo package score measured performance.

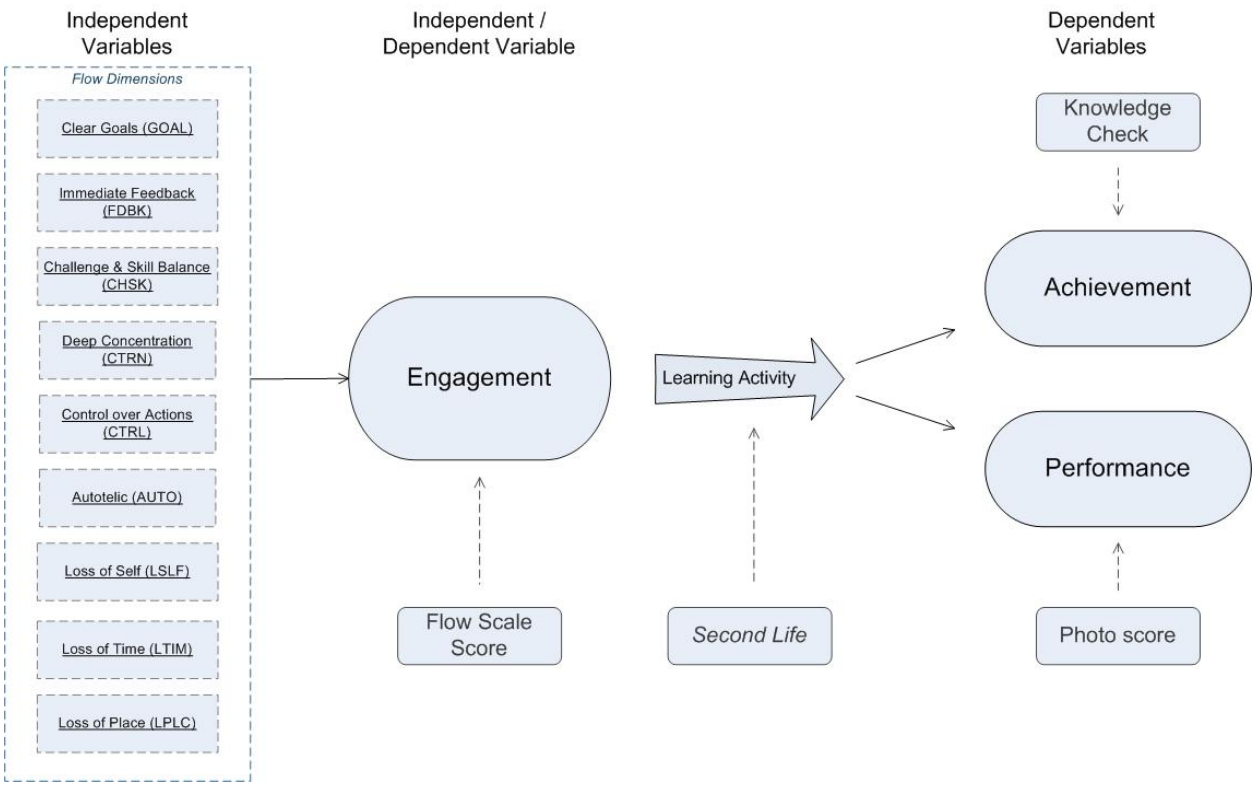


Figure 2: Conceptual framework indicating the proposed relationship between engagement using flow dimensions, with achievement and performance.

First, it was hypothesized that more engaged students may recognize and recall more, and subsequently, increased learning would be reflected in their achievement scores. Therefore, higher levels of engagement would be positively correlated to higher levels of achievement and lower levels of engagement would correlate to lower levels of achievement. Second, it was hypothesized that more engaged students may participate more, which would be reflected in their performance scores. Therefore, higher levels of engagement would be positively correlated to higher levels of performance, and lower levels of engagement would correlate to lower levels of performance. Lastly, it was hypothesized that some elements of flow may contribute more significantly to learners' overall engagement state. An examination of the factors contributing to engagement such as learners feeling empowered, losing track of time, perceiving challenge,

receiving timely feedback, or a combination of these elements would suggest which were the most significant factors.

To test the hypotheses, a study was conducted using an educational audience within Second Life. The educational audience included participants who were current students, teachers, or educational administrators. The design employed a self-directed, inquiry-based approach for instruction. An activity was designed in the form of a role play in which participants were asked to explore and experience an educational area within Second Life. The activity measured aspects of achievement and performance. Following the activity, data relating to the learner's perceived level of engagement was requested. This research hypothesized a positive relationship between a learner's level of engagement and their likelihood to learn. Regression analyses and factor analyses were used to identify the relationship between engagement and achievement, and the relationship between engagement and performance, as well as to investigate the factors that contributed most towards engagement within this virtual environment. Chapter three contains further detail of this research's design, audience, intervention, and procedure.

Significance of Study

This research presents important findings for a large audience including educators, instructional designers, and researchers.

Educators

Virtual worlds as learning platforms continue to become increasingly popular for educators although hardly any empirical research exists which examines their effectiveness as learning platforms. While some technology-based empirical research designs have tested instructional designs, instrumentation, activity intervention, or audience, the intention of this study is to focus on the virtual worlds as an instructional platform and its related outcomes,

including potential engagement and achievement. For educators, this has great value towards implementation, delivery, and integration of well-designed and delivered instructional content.

Instructional Designers

Understanding the context of effective learning with advanced technology platforms is important because many systems costing millions of dollars are invested and rejected because of poor design and poor user interfaces (Venkatesh & Davis, 1996). In these cases, educational interventions aimed at dimensions of flow may be more efficient than complex and costly designs that do not foster engagement, only frustration. As an instructional designer, understanding design issues associated with complex platforms like Second Life as well as the flow factors that can contribute to the design process can help alleviate and eliminate costly, frustrating, and likely unused instructional content.

Researchers

This serves as an empirical study, examining a topic of much interest and visibility. Research is needed to help identify first-hand the relationships between learning content, learning interest, and these attractive, yet challenging, platforms, especially for the rapidly growing community of educators within Second Life. Second Life is a complex technology, novel, illusive, attractive, with learning implications empirically unknown at this time.

Limitations

This research study has the following limitations. First, the target population was limited to those interested in the potential value of virtual learning environments for education. This was by design, as the study sought to uncover potential educational benefits that can be derived from it. An additional limitation was the reliance upon volunteer sample groups which could potentially result in biased findings. Although using a volunteer pool allowed for the leveling of

hardware readiness and basic navigational readiness, this may limit the ability to generalize the findings to a more diverse student profile typical of a class setting.

Additionally, it is recognized that different virtual worlds possess different capabilities as virtual learning environments. This study was limited to a specific, free, globally-available virtual world. The effectiveness of user engagement on achievement should be limited strictly to this particular virtual world. This study relied on subjective assessment for elements of flow. Although the instrument, Flow State Scale (FSS-2) (Jackson & Ecklund, 2002) has been formally tested for reliability and validity across multiple domains, the data was comprised of self-report responses.

Chapter two follows with a review of current research examining virtual worlds, using Flow Theory as an engagement framework and the inquiry-based instructional design. The following literature review helps present an argument for the need as well as the value of this empirical research study.

CHAPTER TWO: LITERATURE REVIEW

Chapter Two reviews literature related to each of the major components of this study. The review presents in order, (a) discussion of technology and virtual worlds and their impact on education, (b) discussion of the educational potential of the virtual world Second Life, (c) Flow Theory, as a measure for engagement and as the theoretical framework for this study, (d) description of the instructional design, and (e) the current momentum and adoption factors for integrating virtual worlds, flow, instructional design and learning.

Technology

Our 21st century society is faced with rapidly developing and ever-changing political, social, economical, and technological situations. The presence of a persistent networked cyberspace technology allows for near-global computerized accessibility and has brought forward revolutionary new ways to exploit information transfer and communication. Cyberspace was once thought of as a distant cosmos, a digital outland that left the physical world behind. Today the 21st century reality of cyberspace is a blend of the digital and physical with a borderline so blurred it's not really a line at all (Levy, 2008). The impact of this blur as it relates to technology-based education is the focus of this study.

Educational Technology

Because of its impact, technology becomes a necessary survival skill for society, including our educational system. Educators must keep pace with rapidly changing situations by adapting their skills and levels of expertise. Current instructional design, learning goals, and teaching methods, as well as appropriate learning environments, must support the development of the changing skills required by technology. As a result, educational approaches to teaching and learning have changed dramatically over time from simple repetitive exercises to learning

using today's complex technologies, particularly computer-mediated technologies. Therefore, different modern educational strategies have been developed which incorporate technology into today's curriculum.

The impact of computer-mediated technologies in education can be seen through the number of students participating in online courses. Almost 3.5 million students were taking at least one online course during the fall term of 2006. This number reflects a nearly 10 percent increase over the number reported the previous year (Allen & Seaman, 2007). Online enrollment shows a 9.7 percent growth rate, exceeding the 1.5 percent growth of the overall higher-education student population (Allen & Seaman, 2007). That is to say, the online enrollment rate is growing faster than the on-campus student enrollment rate. Nearly 20 percent of all United States higher-education students were taking at least one online course in the fall of 2006 (Allen & Seaman, 2007).

21st Century Learner

Prensky (2005) established the term *digital natives* to describe a generation that grew up surrounded by electronics. They are comfortable using email, text messaging, Web 2.0 technologies, video games, and other newer technologies such as virtual worlds. Digital natives are very collaborative and capable of multi-tasking; they expect immediate feedback from technology and from people (O'Connell, Grantham, Workman & Wong, 2009). For the purpose of this study, *digital natives* refer to individuals with an inherent comfort and willingness to engage digital technology more specifically than individuals from a former generation or from an earlier birth year.

Tony O'Driscoll (2008), a leader in technology and innovation-based education, comments on the state of today's digital natives' readiness to learn. He wrote:

On the societal front, the MySpace generation is truly wired. Or is it wireless? In either case, their connectivity to others is both pervasive and persistent. They view the computer as a connector not a cruncher. They are not willing to be passive consumers of broadcast media, instead they demand to be active co-creators of content and insights, and they want ongoing push-pull/dialogue to occur in the sense-making process that amounts to traveling on many vectors of successive approximation toward the truth. (p.1)

The desire of 21st century learners to be active participants in the learning process helps support the need to explore new learning platforms for their learning potential and supports the goals of this research exploration.

The impact of technology on education has also caused a demand for new flexible learning settings. Camilleri & Montebello (2007) wrote:

Emerging trends in the fusion between education and technology are indeed showing that modern-day learners are requesting more informality and flexibility in their own educational process; hence the introduction of concepts such as virtual worlds and augmented reality. Platforms making use of this type of innovative technology have in fact been found to yield a more flexible and robust learning environment which offers enhanced personalization and dynamicity in the presentation of information. (p.1)

A discussion of one of these new learning settings, specifically virtual worlds, follows.

Virtual Worlds

A *virtual world* is a synchronous, persistent network of people facilitated by networked computers (Bell, 2008). Within virtual worlds, information is arranged in 3-dimensional (3D) space and accessed via geo-spatial referencing using X, Y, and Z planes. The user is immersed in content in a virtual space that is often shared in real-time and is globally accessible. The

experience is social where users, by way of a unique representation of themselves called *avatars*, interact with one another using voice, text chat, or gesturing. An *avatar* is a digital representation of a person or being within a virtual world. In most sophisticated virtual worlds, avatars are customizable, so the sense of unique identity and representation is possible.

2D vs. 3D Spaces

Within 2-dimensional (2D) online environments, typically thought of in terms of web pages, information is typically text-based and delivered in a top down format. Although newer web technologies offer interactivity and participation, they are still largely a uni-directional dissemination of information. That is, even when multimedia content is available, once the information is presented, the audience is still predominantly passive.

In 3D environments, users have the perception of being fully immersed in the content. The information space surrounds the users' field of view. Through the persona of an avatar, users can touch and manipulate, walk, and fly. Most 3D computer environments provide teleporting capability for avatars – in other words, the avatar can be instantly transported to another location within the virtual space. Teleporting is analogous to a hyperlink in the 2D web space in which a click can launch and transfer the reader to a new location.

The difference between 2D and 3D environments becomes significant in some settings. Consider the following scenario of a person learning about China. Using the web, the individual might navigate to a native Chinese web site. Because navigation is completed through hyperlinks, he or she must understand the language and content of the link in order for it to be meaningful. That person may not learn much, or even successfully navigate the site, unless he or she understands the language and the content. Alternatively, in a 3D immersive environment, navigation is accomplished via movement. The person's avatar walks through a visual and

auditory space. He or she is not required to know a language in order to successfully navigate the space. In teleporting to a virtual China, a person could successfully navigate and possibly learn by just experiencing the area through observation of virtual structures and people. The potential to learn and experience is not dependent on knowing the language. Capitalizing on this capability is expected to offer powerful alternatives that improve teaching effectiveness. These different methods may have significant implications for extending and improving learning outcomes.

Virtual Worlds for Learning

As mentioned, virtual worlds offer a multi-sensory experience that cannot be found or is limited within the web. Instruction may potentially be enhanced through the visual (text or graphics), auditory, or tactile experience. Virtual worlds also offer a unique immersive experience, where the presence of an avatar plays a key role. Dr. Paulette Robinson, Assistant Dean for the National Defense University and an instructional technology expert, believes the immersive nature of virtual worlds has a profound influence on cognition. Because the avatar representation of a person indicates that he or she is engaged while in a virtual world, there is less distinction in his or her brain between the person and the avatar (TSJ, 2008).

Applications

Instructional applications that may be useful enablers for learning within virtual worlds include 3D modeling, real-time collaboration, problem-solving activities, and independent inquiry-based exercises.

3D Modeling

Three dimensional modeling allows a student to understand by using rotation and multi-dimensional perspectives. Objects like complex molecules that are best represented spatially can be seen and understood more thoroughly due to visualization capabilities. Imagine learning about

a naval ship by being able to board the ship, walk around, and explore the galley, deck, and bunks.

Real-time Collaboration

Real-time, synchronous collaboration among students is enhanced in several ways. First, the visual appearance of an avatar as human representation may create a real sense of presence (Hornik, 2008). Secondly, body gestures and lip movement may help add to the realistic effect of authentic collaboration. Most virtual worlds also allow for real-time media sharing, so users can simultaneously view a presentation-slide or a video. Lastly, the knowledge that there are real people behind interacting avatars may help to simulate an authentic experience, saving the cost, time, and overhead of real face-to-face participation (Helmer & Light, 2007).

Problem Solving

It has been found that digital natives employ savvy problem-solving skills in virtual world environments. In one study, students logged communication records, continued to build collaborative knowledge, and tackled obstacles by finding alternative solutions when traditional feedback was delayed (O'Connell, Grantham, Workman & Wong, 2009).

Independent Inquiry

Self-directed learning activities may in fact be one of the strongest applications that can be applied within virtual worlds. Taking advantage of student-centered strategies, the learning opportunity can take place any time and from anywhere. Some activities, such as the activity used in this study, combine student-centered constructs with exploration. Such structure lets learners participate in the instruction on their time and from their preferred location. This flexibility allows learners to work at their own pace, spending as much time as they wish exploring and manipulating their environment.

Affordances

The following summarizes several potential outcomes that virtual world learning experiences may provide.

Enjoyment

Three dimensional applications may provide a more engaging, immersive, memorable, and fun experience (KZERO, 2008). This may be why some of the most popular games in the world, like World of Warcraft with 11 million global users (WoW, 2009), are based on virtual world technology.

Fail-safe Environment

Virtual worlds enable new learners to practice and role play in a safe medium, often in the presence of mentors or instructors, before they apply their skills in the real world. These learners are afforded the ability to fail safely with few repercussions, costs or irreversibility (Heinrichs, Youngblood, Harter & Dev, 2008).

Efficiencies

Similar to the Web, virtual worlds can support the "anywhere, anytime" learning design. In addition to convenience, this method also supports a cost-effective way to deliver curriculum to a geographically distributed audience.

Automated Metrics

Some virtual world platforms include recording, time-stamping, automatic data logging, and replaying. These metrics enable instructors to review the learner's performance, interactions with other subjects, and time on task.

Gaming or Problem-Solving Skills

Virtual worlds often have quests, hunts, or game-like scenarios that can assess how well individuals perform in a challenge or how well they work together as a team towards a goal. The use of dynamic problem solving in realistic-looking 3D environments can facilitate the re-creation of real-world situations.

Informal Learning

Many researchers indicate that the majority of knowledge accumulated by learners using technology tools comes from informal discussions with peers and colleagues and not from the actual study of a course (Clough, Jones, McAndrew, Scanlon, 2008). Virtual worlds can easily mix and match formal courseware with informal and personal content including videos, application sharing, blogs, and wikis. In addition, many virtual world providers are integrating enterprise social-networking tools so that it is easier to find, meet, and stay connected with colleagues.

Familiarity and Preference

As previously mentioned, most of today's learners are digital natives, familiar and comfortable with technology. Students today are very fluent with computer games and social-networking software, since they have grown up using these tools (Prensky, 2005). Many leading universities are already finding virtual worlds to be a serious learning environment for attracting students (Calongne, 2008). Students today are attracted to institutions which have invested in the software technologies with which students are comfortable (Badger, 2008).

The affordances listed above support a comprehensive set of learning experiences. Those, coupled with a multi-sensory experience, may provide for a highly effective, engaging learning environment.

Summary

Current hype surrounding the virtual world environment has generated significant interest in the education community. Although virtual worlds have been an active research topic for a long time, the technology was not ready for complex application scenarios until recently. New, interesting, and powerful virtual world platforms, such as Second Life, Active Worlds, Multiverse, Open Croquet, OpenSim, and Sun's 3D Wonderland, have been developed with hopes to complement or even to replace traditional learning settings. Nonetheless, it is still unclear what the real benefits and limitations are to using these technologies as opposed to using more traditional teaching methods. In hopes of avoiding the same pitfalls as past e-learning solutions, which just applied traditional learning approaches to a new technology, this research intends to empirically explore the educational potential of one virtual world, Second Life, as a valuable platform for facilitating and enhancing a learning experience.

Second Life™

One of the most popular and widely used virtual worlds is a world known as Second Life™. It is one of over 150 different virtual worlds in existence today (KZERO, 2008). Second Life was released to the public in 2003 by Linden Lab (2003), a San-Francisco-based company founded in 1999 by CEO Phillip Rosedale. Today Linden Lab employs 200 employees worldwide.

The client application is a free downloadable software program. The environment of Second Life is created almost entirely by its 18 million registered users. Users, represented by digital avatars, are known as *residents*; being logged onto or being inside Second Life is referred to as being *in-world*. Residents navigate by walking, flying, or teleporting.

Second Life uses a land metaphor for the computer space that is used to render 3D content. Land is made up of islands where parcels of land are bought and sold by its residents. When first launched in 2003, it consisted of just 64 acres of land (Linden Lab, 2003). Today Second Life (Linden Lab, 2009):

- has expanded to over 1.2 million virtual acres on 20,000 servers,
- includes 1.8 million active residents,
- has 70,000 concurrent users, on average,
- contains over 130 terabytes of user-created content,
- exchanges $1.9 million between Linden and US dollars per day.

Although Second Life may seem like a computer game, it is not. It is a real-time dynamic distributed environment. The primary capability is content creation. This allows users to build and create a uniquely customized, personalized environment that could be suited for their specific purpose. Second Life has a high-level, built-in scripting language and building tools, making it extremely easy to build content and to create scripts. The vast majority of all content has been constructed by its residents. Residents use Second Life to socialize, play, do business, and learn.

Interestingly, the demographics for Second Life are different from the massive multi-player online gaming environments. Instead of the expected young male audience that is typically found playing online games, the median age of individuals participating in Second Life is early 30's. Participation is equal among men and women, with women slightly more likely to continue participating in it than men (Ondrejka, 2007).

Second Life appears to offer additional benefits to the 3D virtual world platforms. First, because of its virtually unlimited potential for content creation, the concept of *stigmergy*

(Robbins, 2007) – the ability to create lasting content – has emerged. Specifically, object creation is persistent, therefore development is evolutionary. Residents make changes to the environment that will remain consistent from one use to another. Second, personalized identification via highly customized avatars is seen as a unique and positive attribute of Second Life (Salt, Atkins & Blackall, 2008). This gives opportunity for the creative and personal expression of individual and unique personalities. Third, Second Life's global community reaches the broadest audience possible, allowing for synergistic contributions of development and design. Lastly, the platform delivers multi-modal communication – text chat, audio, video, gestures, and action.

Engaging Environment

Second Life is being used for a wide range of purposes including independent, interactive experiences. One popular experience is bowling. Splitsville is an in-world bowling alley that mimics its real-world bowling establishment located in Tampa, Florida. Residents can put on a bowling glove, select a ball and throw it, creating a realistic bowling simulation. Bowling scores are calculated automatically (Splitsville, 2008). This simulated activity can be not only fun for residents but requires no other individuals to play, and it can be played over and over, at any hour of the day.

Another popular option for residents because of their interactive capability is arcade games. Zorkmid Zone (Zynadu, 2008) is one such arcade. Residents can interactively play slot machines, bingo-like games, and other independent skill-based games. Figure 3 illustrates both the bowling and the arcade area in Second Life.

Figure 3: The areas of Splitsville and Zorkmid Zone in Second Life.

Both of these examples suggest the attraction and allure that Second Life can offer as an engaging environment. It is engagement in Second Life that will be examined later in this study.

Learning Environment

The 2007 Horizon Report (Johnson, Levine & Smith, 2007) references Second Life most frequently in its examples of virtual worlds for education, citing rapid acceptance. It also predicts that virtual worlds, like Second Life, when used as learning environments are likely to be embraced in a manner very similar to the rise of the web in the 1990s. Several learning opportunities are listed below.

Immersive Learning

Educational institutions are increasingly turning to Second Life to provide a learning environment that is more interactive and immersive than traditional classrooms (SimTeach, 2008). Perhaps immersive experiences that do not exist in the real world or that are not easily accessible to learners, but can be created and experienced virtually, are the most interesting to educators (Bowers, Ragas, & Neely, 2009). Two such examples of immersive experiences provided in a virtual world include a simulation of a human heart in which avatars can travel

through the chambers of the heart just as a cell does, and observation of the planets in the solar system from the perspective of the sun, with the planets rotating in real-time around the avatar.

Independent Learning

Second Life offers a platform for independent, self-directed learning and exploration. One of the most effective examples of this is the Nutrition Game at Ohio University's Second Life campus (Ohio University Second Life Campus, 2008) as shown in Figure 4. The object of the activity is to learn about the nutritional value of the items offered at fast-food restaurants, including how they affect your health and how to eat more healthfully at fast-food restaurants. The learner has the opportunity to select food items for meals for one day from menus at three locations. Each food item lists a nutritional value, including calorie count, percentage of a day's worth of amount of cholesterol, and fat content which were derived from governmental and academic sources. Counts are automatically tallied as food is selected. After the learner selects three meals, the game is over. The player receives a summary of the daily nutritional intake, suggestions for improvement of choices, and further reading resources.

Figure 4: The Nutrition Game at Ohio's University's Second Life campus.

3D Visualization

Built by a real life artist, one of the most famous art works in-world is Feather Boa's Flesh and Blood (Caribbana Boulevard, 2008). Figure 5 shows that the artwork was built with

layers. The image changes as the position and orientation of one's view changes, making the layered image appear three dimensional--very similar to a holograph. Because of these types of visually complex tricks, many image designers in real life are increasingly promoting Second Life as a place for 3D architectural and artistic inspiration.

Figure 5: Three dimensional artwork in Second Life.

Supplemental Learning

As with any new technology or tool, Second Life may add the most value to instruction when it is used in combination with other tools. O'Driscoll, Cross, & Trondsen (2007) emphasizes their belief that virtual worlds are not aimed to replace forms of learning. Worlds such as Second Life are seen as a tool "to enhance the experience and transfer of learning." The important message being that this technology may enhance the learner's experience in a way that more traditional learning curricula cannot. With this approach it is not intended to teach entirely within virtual spaces but to use those spaces in conjunction with other tools such as blogs, podcasts, course management systems, and other Web 2.0 tools. That way Second Life is used for its strengths and other tools are incorporated into lessons for their benefits.

One example of successful supplemental support is *Really Engaging Accounting* (Hornik, 2008), in which a traditional accounting lecture course is supplemented with two in-world activities. These activities provide visual representation and practice opportunities to support acquisition of difficult accounting concepts. Figure 6 illustrates both the campus area as well as the accounting model used as a supplemental tool for learning to balance accounting equations.

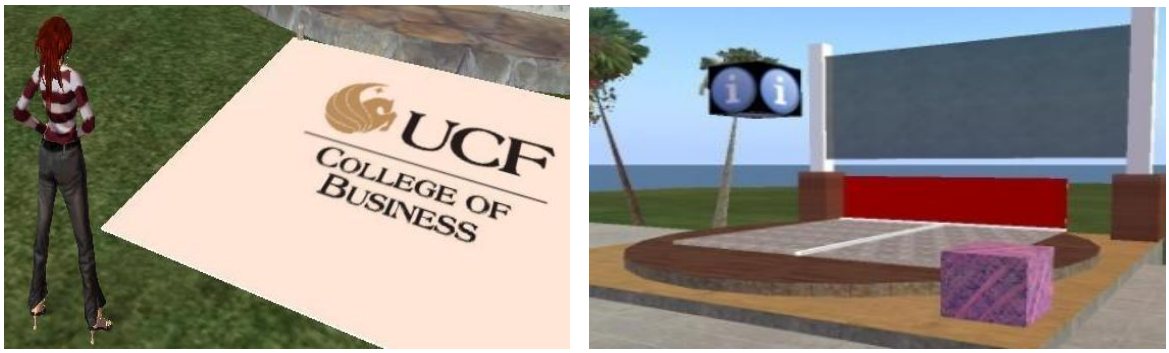


Figure 6: University of Central Florida's campus for accounting and the accounting model in Second Life.

Sensory Rich Learning

O'Driscoll (2007) discusses the seven sensibilities specifically available in Second Life that provide a sensory-rich experience for the learner. They are *Sense of Self, Death of Distance, Power of Presence, Sense of Space, Capability to Co-create, Pervasiveness of Practice,* and *Enrichment of Experience*. The sense of self is brought about by the presence of an avatar - an extension of the virtual reflection of oneself. This feeling of individual extension can lead to a sense of presence as a result. Distance becomes insignificant due to teleporting capabilities, negating space limitations. Size is considered relative because objects are scalable, creating a unique sense of space. A unique aspect of Second Life is the ability to co-create with peers and within social networks. The learner becomes an author and a creator. Additionally free instructional content is abundant. Pervasiveness of practice is said to be "baked into" the culture

and the environment of Second Life. Lastly, the virtual world is thought to provide an augmentation of experience that may not otherwise be available in real life.

These sensibilities are believed to foster positive outcomes towards educational goals and may provide Second Life with an edge as a learning platform. It is an immersive activity using a sensory-rich setting that will be examined in this research.

Educational Audiences

Second Life currently has well over 1,200 dedicated educational islands, with many more higher-education institutions owning a presence smaller than an island (Johnson, 2008). As more educators explore and understand the potential of platforms like Second Life, courses and whole curriculums are being established in different capacities and disciplines. Additionally, training events, workshops and discussion groups are available in Second Life to help faculty develop effective uses for instruction (Johnson et al., 2007).

Instructors

In order for any new technology to be pursued, certain beliefs and conditions surrounding the adoption of the newer technology need to be met. One study found that the availability, reliability, and ease of use of physical resources are the most important organizational factors in the decision to adopt a given technology. Motivation factors, such as personal satisfaction and a perceived improvement in teaching were the second most important factors (Roberts, Kelley & Medlin, 2007).

It has been suggested that instructors find using Second Life in their curricula both satisfying as well as manageable to integrate. In one study instructors reported that the more Second Life was integrated into the class structure, the more satisfied they were with it (Roberts, Kelley & Medlin, 2007). This finding was supported by the fact that 93.8 percent of respondents

reported their intention to use Second Life again. Furthermore, instructors found satisfaction in incorporating curriculum into Second Life and may intend to continue it as an educational tool.

Researchers

Scientists and other researchers are interested in virtual worlds such as Second Life. The Weather Channel has developed instruction that lets users simulate sports in varied terrains with highly challenging weather conditions (tsunamis, avalanches, flash floods). According to Drew Stein, CEO of the contractor who built this virtual experience, users spend an average of 30 minutes per visit, and the attraction draws a crowd around the clock. From an instructional perspective, this perceived engagement is powerful. Additionally, because it is a digital environment, time on task can be closely measured via scripting tools. "You're talking about a user actually paying attention, and you can time it. That's hard to replicate in any other medium." (Cohen, 2008, p.2).

Second Life provides an open platform for creativity and experimentation yet many researchers question whether using this platform for research is realistic and viable. Williams Sims Bainbridge, program director in human-centered computing at the National Science Foundation, believes:

My general perspective is that virtual worlds are at least as real as many parts of the so-called real world. Is religion “real?” Is music “real?” Is the stock market “real?” These institutions are real only because many people take them seriously. They are socially and culturally constructed rather than being innately real (Baker, 2008a, n.p.).

Jayme Renee Albin, Ph.D, assistant director at Behavioral Associates conducts research using virtual worlds for treatment of phobias, particularly the fear of flying (Baker, 2008b). During an interview with *LinuxInsider*, Albin indicates that virtual worlds are an amazing

technology because it allows for exposure to environments that normally would be too overwhelming to face. “It allows for the ability of control and accessibility for repeated exposures,” she says. “As long as the subjects are viscerally aroused in the virtual world the treatment can be effective.” (Baker, 2008b, n.p.)

Public Sector

The interest in using virtual worlds as a serious learning platform spans further than academic researchers. The public sector has become interested in understanding potential uses for these new environments. Both military and government organizations have begun investigations.

Military. The United States military recognizes that rapidly evolving gaming and visualization technologies have potential to change radically their approach to training and education. Interest is growing, and early forms of exploration have been started by several services. Such service providers understand the importance in remaining current with leading technologies, and they recognize the rising global interest. Furthermore, efficiencies that may be gained by using virtual worlds for training in collaboration, data visualization, rapid prototyping, combat readiness, or scenario training have piqued serious interest in our military.

The National Defense University (NDU) is leading the exploration of virtual worlds, currently focused on comparing and contrasting large-scale business virtual worlds. NDU believes there may be real economic value in virtual worlds for the Department of Defense (DoD). Dr. Paulette Robinson, Assistant Dean for the University, commented that she gave a presentation to a Canadian audience where everyone was represented in Second Life, and the event saved the university $2500 per person in airfare (TSJ, 2008).

Training and education of our servicemen is a large and important part of our military's focus. Following the lead from the academic community, the military is interested in teaching efficiently by taking advantage of remotely available, globally accessible, and massively scalable training opportunities. Additionally, simulated training scenarios allow the military to train in a fail-safe environment as well as create simulations that would otherwise not be affordable or feasible to train with in real life.

The U.S. Army National Guard has contracted the development of a virtual world for emergency management and preparedness training. The National Aeronautics and Space Administration (NASA) built a presence in Second Life to engage today's high school and college students and to develop their interest in math and science careers.

The U.S. Air Force has developed a comprehensive 21st century Air Force training program that includes new recruits receiving an avatar that remains with them for the duration of their service career (TSJ, 2008). Additionally, they have developed a simulation game in Second Life for instructing and assessing interdisciplinary leadership, framing it in the context of a military learning exercise. These developments help the Air Force to understand the capabilities for supporting simulation gaming in education (Strickler, 2009).

State. State governments, including the state of Missouri, are using Second Life to reach out to a new generation of IT workers. Other government agencies have begun using virtual worlds like Second Life in the tourism industry, for economic development, and to serve as a virtual gateway to real lives, cities, or states (Wyld, 2008). And many city and state governments are beginning to investigate the value of virtual conferencing and meetings, collaboration, training and simulation, real-time global decision-making, emergency preparedness, and testing and demonstration of policy scenarios (Wyld, 2008).

Second Life has piqued the interest of a large spectrum of audiences, including academia and the public sector. The desire to understand how this platform can be harnessed has instructors, researchers, and instructional designers actively and presently pursuing its value. This study aimed to examine a virtual world, namely Second Life, and to address this very timely and growing curiosity.

Technology Impact

The time to investigate, explore, and understand leading-edge technologies is now. Wyld (2008) quotes the director of the Centre for Learning Innovation at Insead Business School, who drew parallels between the life cycle of broadcasting and the Internet. "Just as radio gave way to the more immersive experience of television, today's flat, single-user websites will morph into more interactive, immersive multiple-user experiences."

Additionally, because of the influence of television, video games, and the Internet, today's learners have a new profile of cognitive skills. This profile includes fairly sophisticated development of visual-spatial skills, such as iconic representation and spatial visualization. It is believed that today's education must adapt to these changes, and education requires a balanced media diet using each technology's specific strengths to develop a complete profile of cognitive skills (Greenfield, 2009).

Momentum

There have been numerous predictions made in the last few years about the growing interest in the metaverse and 3D immersive environments. Sarvary (2008) predicts that within five years, the metaverse will most likely be the dominant Internet interface. According to IARPA (2009), industry experts predict the number of virtual world users will exceed a half billion by the end of 2009. Others have predicted that by 2020, virtual worlds will be as

widespread as the Web is now (Rawlinson, 2007), and there is growing belief that virtual worlds may even replace the web browser as the way we interface with the Internet (Last, 2007). Moreover, researchers predict that virtual worlds will be as significant a technological disruptor as the invention of the personal computer or the advent of the Internet (Mims, 2007).

Many forecasters predict that virtual worlds such as Second Life will become an indispensable business tool. Erica Driver (2009), Co-Founder and Principal, ThinkBalm, an independent IT industry analysis and strategy consulting service, says:

> The immersive internet is a perfectly natural extension of the way people already teach and learn, rehearse business activities, network and meet, collaborate and communicate, innovate, and manage real-world systems – that the immersive internet to get work done will be mainstream for information workers within the next 5 years. (n.p.)

Gartner Group (2007), a leading IT research and forecasting organization, predicted that by the end of 2011, fully 80 percent of all active Internet users will have a presence in the developing sphere of virtual worlds. While some have criticized Gartner's 80 percent projection for being overly optimistic (Wilson, 2008), there can be no doubt that the way we interact with the Internet is undergoing a profound change with the advent of virtual worlds (Wyld, 2008).

Summary

Technology is clearly an integral part of the 21st century learning experience. Furthermore, Second Life as a virtual world clearly has far-reaching interest and perceived potential to enhance the learning experience. Therefore the integration of technology, specifically virtual worlds with education is thought to bring new levels of piqued interest in learning and possibly achievement. O'Driscoll, Cross, & Trondsen (2007) refers to virtual world experiences as more engaging than other digitally mediated technologies, and more significantly,

a platform with potential for an engaged state of being that he refers to as Flow. It is this experience of engagement and the concept of flow that is the theoretical focus of this research. A discussion of flow as a framework for engagement within the learning domain follows.

Flow Theory

The following section describes the theoretical foundation of this study and how the notion of engagement may be tied to areas of improved and greater learning.

Engagement

Engagement has many different interpretations with regard to learning. Engagement can be viewed as "the amount of physical and psychological energy that the student devotes to the academic experience (Astin, 1984)". Student engagement may be associated with increased time on task, and the development of deep learning, resulting in better classroom performance (Hornik, 2008). Student engagement has been associated with important learning outcomes including performance, satisfaction and retention (Chen, Gonyea, & Kuh, 2008).

Engaged learning is a concept studied by Stanford Research Institute researcher Barbara Means (1994). According to Means, engaged learners are responsible for their own learning, often energized, strategic, and collaborative; involved in authentic tasks; participate in interactive learning; and learn through exploration.

Learners who are engaged invest personally in the quest for knowledge and understanding, partly because the questions being investigated may capitalizes on their curiosity. They believe the work is relevant and the questions are essential. They will cooperatively work with others, sharing both the workload and their ideas. Engaged learners are believed to make thoughtful choices using different strategies, and employing careful consideration and strategic

thinking. They may feel excited, intrigued and motivated to reach insight. Their work feels both important and worthwhile (Means, 1994).

There exist many discussions surrounding the experience of engagement. Contributing factors such as social presence, motivation, technology acceptance, and content enjoyment have been formally studied. This research studied engagement using the principles of Flow Theory.

Flow Theory

Theorist Mihaly Csikszentmihalyi (1975, 1990, 1997) describes flow as "the holistic positive sensation people feel when they act with total involvement, concentration, and immersion." Flow represents those moments when everything comes together for the individual; it is often associated with high levels of performance and a very positive experience (Jackson & Ecklund, 2002). Flow theory then (Csikszentmihalyi, 1975, 1990, 1997) can be said to be an engagement theory defined as an intrinsically motivated, optimal state characterized by complete enjoyment and very positive experience by an individual.

Csikzentmihaly (1975, 1990, 1997) posited nine specific dimensions necessary for flow to be achieved.

1. The expectations of what to accomplish and accompanying rules are discernible; the *goals* are clear and perceived to be attainable. (GOAL)
2. There is direct and immediate *feedback* during the activity. (FDBK)
3. There is a balance between activity *challenge* and individual *skill*. (CHSK)
4. An individual exhibits a high degree of *concentration* with focused attention. (CTRN)
5. The merging of action and awareness; a temporary *loss of place*, is experienced. (LPLC)
6. *There is a distorted sense of time*, one's experience of time is altered. (LTIM)
7. The individual has a temporary loss of *self-consciousness* or ego. (LSLF)

8. A sense of personal *control* over the situation or activity is experienced. (CTRL)
9. The activity is an *autotelic*, intrinsically rewarding experience. (AUTO)

As an engagement theory, Flow theory has been shown to be effective in dozens of learning, performance, and achievement areas such as instruction (Arendtsz, 2007), music assessment (Wrigley, 2005), reading-teacher readiness (Hood, 2007), organizational effectiveness (Hoefer, 2008), and motivational performance (Levine, 2006). Qualitative studies have used flow to explore potentials and barriers in school administration (Safier, 2004), marriages (DuPree, 2007), online driver education instruction (Belchior, 2007), and crocheting and knitting activities (Blood, 2006). Although flow has been shown to be effective in a large variety of content areas, scarce research can be found that tests its effects in a more sophisticated technology environment such as 3D environments.

Flow in Computer Mediated Environments

Student engagement has been associated with important learning outcomes including performance, satisfaction, and retention (Chen, Gonyea, & Kuh, 2008), and technology has often been seen as a possible facilitator of engagement (Lightner, Sharon, Bober, Marcie J, & Willi, Caroline, 2007).

As mentioned in Chapter One, research using Flow theory is plentiful and many have found positive user experiences with regard to computer use, including increased exploratory behavior and learning. Flow has been studied in conjunction with the Technology Acceptance Model to understand consumer engagement and shopping potential in technology-based consumer settings (Koufaris, 2002; Venkatesh & Davis, 1996). Researchers have studied flow with computer-mediated mathematics (Sedig, 2007) and general Web activity (Chen 2006; Chen et al. 1999). As the theoretical foundation for exploration, play, and online engagement, flow has

been studied in the hypermedia-learning environment (Konradt et al, 2003), online search experience (Mathwick & Rigdon, 2004), online behaviors (Chen, 2006), and effective digital game-based learning design (Kiili, 2005).

One study examined the computer-mediated environments as being a potential inhibitor of flow if the technology was too complex. Finneran & Zhang (2003) separated two main facets of flow – the task flow and artefact flow. Task flow is the potentially available state of engagement due to the content; artefact flow focuses on the engagement potential as a result of technology efficiency. This distinction becomes an important consideration when designing instruction for use in computer-mediated environments (Pearce, Ainley & Howard, 2005). Computers, applications, peripheral hardware, and complex navigation may inhibit a person's ability to immerse in the content (Finneran & Zhang, 2003).

The aforementioned research studies all indicate a positive relationship between flow and the transference of flow into computer-mediated settings. Still, no empirical research has been found assessing the relationship of flow to engagement and to achievement within virtual worlds.

Flow in Virtual Worlds

Dede (2009) has done extensive research in the area of engagement and learning, particularly with immersive interfaces. Studies have shown that immersion in a digital environment can enhance education in at least three ways: by allowing multiple perspectives, situated learning, and transfer. Dede's research suggests that these increasingly prevalent types of media, such as virtual worlds like Second Life, can aid in designing educational experiences that build on students' digital fluency to promote engagement, learning, and transfer from classroom to real-world settings.

As previously mentioned, 3D environments offer much to be studied because of their unique characteristics. The use of avatars may lead to an increased sense of identification; 3D visualization capabilities may lead to a greater sense of immersion; and direct manipulation of objects may lead to an increased sense of control (Stammberger, 2005). All of these are underlying dimensions of Flow theory. Further exploration investigating the potential relationship between 3D virtual environments and learning, as well as the relationship of factors leading to engagement in a virtual setting, becomes necessary. Both of these questions are investigated in this research and a discussion of flow dimensions follows.

Flow Dimensions

Flow theory (Csikszentmihalyi, 1975, 1990, 1997) posits nine dimensions, and researchers have explored the relationships among the various dimensions. This becomes important with regard to design because different researchers have approached flow differently. Some have inspected flow as a process, and some studied it as a state (Skadberg & Kimmel, 2004; Sedig, 2007). Some have utilized all nine dimensions (Marszalek, 2006); others focused on a subset (Koufaris, 2002; Shernoff et.al., 2003). In several studies, some dimensions of flow were used as predictor variables (Kiili, 2005; Leong, 2006). In other studies, different variables were manipulated to see the effects on flow (Ghani & Deshpande, 1994). Still other researchers studied flow through the characteristics of additional factors such as motivation, satisfaction, and creativity (Danehy, 2006; Mathwick & Rigdon, 2004). Yet others have insisted that because of its complexity a subjective, exploratory approach is best (Csikszentmihalyi, 1987; Chen, 2006).

Chen (2006) observed that flow dimensions could be categorized into three stages: *antecedents, experiences,* and *consequences*. In his study, antecedents were found to be clear goals, potential control, immediate feedback, and loss of place. The second stage, *experience*,

was found to be time distortion, concentration, and loss of self. The final stage, *consequences*, was found to be positive affect and enjoyable experience, possibly suggesting a feeling that the activity becomes worth doing for its own sake.

Many researchers including Csikszentmihalyi (1975, 1990, 1997; Csikszentmihalyi & Csikszentmihalyi, 1988) agree that the strongest contributor, and thus a prerequisite to attaining flow, may be the balance of skill and challenge. Figure 7 depicts the relationship between skill and challenge with respect to flow. The graph is divided into three regions *anxiety*, *boredom*, and *flow*. Individuals may feel anxious if they perceive that they are not capable of the task before them. Individuals may experience boredom if their skill far exceeds the challenge. Flow is then represented by the experience where the perceived challenges are equal to the perceived skills. Furthermore, flow is likely sustained when challenge is slightly greater than skill.

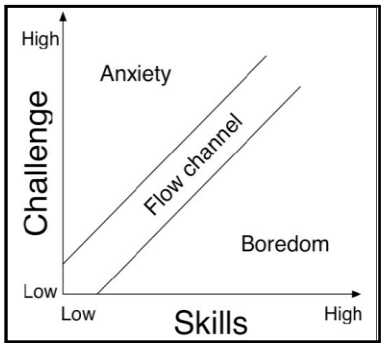


Figure 7: Csikszentmihalyi's 3-channel flow model.

Because of the potential complexity of flow dimensions, the question of dimension significance arises. As mentioned, researchers have constructed various models and relationships between these dimensions. Researchers have also varied in their suggestions about which dimensions may contribute more significantly towards overall flow states. This becomes of particular interest for emerging platforms where empirical data, particularly on engagement, are still scant.

Current literature suggests that each dimension plays a positive role towards a meaningful and enjoyable experience. The following provides evidence from current literature supporting the importance of each dimension.

Challenge-Skill (CSHSK): Challenge-skill balance is posited as a primary factor (Csikszentmihalyi, 1975, 1990, 1997), and challenge must peak slightly above skill for learning to occur (Pearce et. al., 2005).

Clear Goals (GOAL): Sedig (2007) indicated that in operationalizing flow designs must be goal-directed, with well-defined rules, arguing for the need to balance rules with choices.

Feedback (FDBK): One factor found to influence engagement positively is reinforcement history, or the degree to which behavior is being rewarded or praised, and reinforcement in the direction of the task (Shernoff et.al., 2003).

Loss of Place (LPLC): Spatial presence was found to be a precursor of student engagement in 3-D immersive environments (Hornik, 2008).

Loss of Self (LSLF): The immersion of oneself into an enjoyable experience is typical of play and is inherent in flow experience (Csikszentmihalyi, 1997).

Concentration (CTRN): Engagement can be seen as a student's deep interest in and involvement with the learning task (Lessiter, Freeman, Keogh, & Davidoff, 2001).

Control (CTRL): Hood (2007) found flow present due to a sense of personal control while focusing on instructional reading.

Loss of Time (LTIM): Student engagement is associated with increased time on task, resulting in better classroom performance (Hornik, 2008).

Autotelic (AUTO): It has been found that personal satisfaction in digital games, for example, is based more on engagement rather than winning (O'Connell et.al., 2009).

The above suggests that each flow dimension can offer value towards the flow experience. This evidence leads to the inquiry of how each dimension may be interrelated in a 3D flow experience. This question becomes valuable for researchers, content designers, and instructors, and thus, it became an exploratory question for this research. Therefore, the exploration and analysis of each dimension for their significance in contributing towards flow as experienced within a 3D learning activity will be examined later in this study.

Instructional Design

The instructional framework used in this study was modeled after a well-defined, empirically-proven, inquiry-based design, utilizing web resources migrated into Second Life.

WebQuests

A WebQuest, created by Bernie Dodge at San Diego State University in 1995, is a learning activity used by educators in which students learn by gathering information from various web sites. WebQuests are an inquiry-based approach to addressing standards that place emphasis on motivation, authentic assessment, and the development of independent readers and writers. The activity combines quality Internet resources and effective technology tools with web applications (Dodge, 1995).

The WebQuest design follows an Introduction, Task, Process, Resources, Evaluation, and Conclusion format with each of these objectives typically presented on their own web page. This instructional framework was designed to engage learners in motivating activities that promote deep thinking and creative communications (Dodge, 1995).

WebQuests have been created for a wide range of instructional settings including reading and writing, art and music, and business and economics. WebQuests also reach a wide audience, ranging from kindergarten to adult (Dodge, 1995).

One award-winning WebQuest, *Searching for China* (ATT, 2008), used role play and action investigation as strategies for developing motivation and engagement in its learners. The WebQuest also used a performance-based measure of assessment rather than a test or multiple choice quiz. Upon completion, the learner is required to put together a report based on their investigation findings. This inquiry-based framework using role play, exploratory investigation, and project-based products for assessment may suggest a strong opportunity for learning success and is the instructional design used in this research.

VWQuest

Taking the WebQuest instructional design from 2D to 3D seemed natural. Following the proven construct of a WebQuest, a Virtual World Quest, or VWQuest, was designed. It follows the same Introduction, Task, Process, Resources, Evaluation and Conclusion format as a 2D WebQuest.

A VWQuest design nicely supports a learner's curiosity and self-directed exploration, and it maintains empowerment over time, pace, and direction. In virtual worlds, basic exploration is a common first desire for most residents new to an area (Ondrejka, 2007). The idea of becoming familiar with novel ideas or environments is a learning process. Oftentimes, establishing 'familiar territory' requires an investment of time – independent, self-driven, exploratory time. The VWQuest design supports these characteristics. Further detail about the VWQuest design appears in Chapter 3.

Other educators have already taken the WebQuest into virtual space. One language acquisition instructor from Bolivia (Victors, 2007) saw the potential and created his immersive WebQuest, named *SurReal Quests*, which works toward creating immersive and challenging opportunities where a wide range of language skills can be developed and practiced. SurReal

Quests combine the social and communication aspects of Second Life, mimicking face-to-face communication, conversation skills, and social interaction which accompany conversation. Similar to the award-winning *Searching for China* WebQuest, this quest used learner-developed products – podcasts and videocasts – as its assessment.

Design Benefits

As previously mentioned, virtual worlds support many pedagogical strategies that have been suggested as effective for learning. These strategies include identity and community through collaboration, flexibility due to the distributed format, and learner empowerment via self-directed strategies and exploration/visualization. These pedagogical strategies can be found in the VWQuest design, suggesting the design may be well suited for 3D environments. At the core of these strategies, thought to be well-leveraged in a VWQuest, is its learner-centered design. Its specific design has four elements worth mentioning including self-directed learning, independent exploration, 3D interactivity, and short bite-sized tasks.

The first instructional benefit in this VWQuest is the self-directed learning approach. The activity is learner focused, allowing students to move through the activity at a pace that is best for them. Free to explore repeatedly, students are responsible for their pace, frequency, and content mastering.

VWQuests allow the learner to work independently. Boland's (2009) research revealed that regardless of whether they worked together or alone, participants did experience knowledge gains and reductions in their anxiety about using Second Life for learning. Those who did work alone performed better than their counterparts who worked in groups in regard to both learning gains and anxiety reductions. Individuals can also access a VWQuest from a convenient physical

location and at a convenient time. The anyplace/anytime teaching model offers learner flexibility and requires no classroom, report time, travel, nor other participants.

Because of the nature of Second Life, VWQuests naturally incorporates elements of 3D modeling and visualization. They incorporate scavenger hunt-like tasks in which the learner will explore and interact with 3D space.

Finally, VWQuests are designed to be a collection of small elements of instruction. Sometimes referred to as chunking, this method is thought to help keep the learner's attention and works well in media rich environments (Lambert, Gong. & Cuper, 2008). Digital natives seem to be predisposed to multi-tasking (Prensky, 2005). Because of this predisposition, consuming small quantities of content appears to be more manageable for the learner. When it comes to electronic content, brief is best (KZERO, 2008).

The instructional design in this research uses a VWQuest, allowing the learner to become active participants in their learning process. According to KZERO Research (2008), "the secret to building youth market loyalty to educational virtual worlds lie in the processes, experiences, and interactions that virtual worlds bring alive." The VWQuest in this research project aims to accomplish that goal.

Design Simplicity

As previously mentioned, technology can be an impediment to learning if the challenges of mastering the technology are significant (Pearce et.al., 2005). This becomes an important consideration when designing instruction for use in computer-mediated environments (Pearce et.al., 2005). Navigational experiences alone may prove to be worthwhile in assessing levels of engagement in complex environments. This research design, because of the relatively new and

complex platform of Second Life, addresses nothing more complex than basic technology exploration and navigational content.

Conclusion

Technology has fundamentally transformed society and business, and it continues to transform education in the 21st century. Education methodology may be at a major crossroad. On one side technology is fundamentally transforming how society works, plays, and lives. On the other side, technology is simply automating traditional processes. Rethinking ways to teach using transformational tools like virtual world platforms can provide the necessary power to engage and catapult the future effectiveness of our educational system.

O'Driscoll (2008) summed transformational impact up nicely:

There is an old adage that says that the diffusion of innovation follows a predictable path: A scientific discovery, informs the creation of a new technology, which ushers in a new set of business opportunities that end up reshaping the structure of industries and organizations.

There is another adage which suggests that for change to occur there is a precondition that learning takes place. With all the change that has happened in society and business due to the arrival of the internet, and more significantly in the wake of Web 2.0 and 3D internet experiences, I believe it is safe to say that individuals and organizations will have more than their fair share of change to deal with in the future. This is particularly pertinent for education. So the real question is how to work with that change. Innovators in the education business recognize the huge opportunity that lies before them and can begin to redefine what education should look like 'in the era of the first-person interface – the immersive, engaging, alluring virtual world' (O'Driscoll, 2008).

In conclusion, current educational technology can take advantage of the power to integrate visual, aural, and textual materials, to provide access to source materials, and to encourage learners to take an active role in knowledge production. Educational technology seeks to expand the boundaries of instruction to include multiple media and critical practices (Stamps, 1998). This research focuses on the exploration of such elements.

Virtual worlds, such as Second Life, are redefining the idea of 'being there.' These global 3D immersive environments attract people from all over the world to interact with one another in real time, as well as to explore, manipulate, and visualize the environment. As such, virtual worlds have been labeled as a transformative development that will perhaps change the way we use the Internet during the next decade (Wyld, 2008). Educational interest in this technology for teaching and learning is already profoundly evident. It is expected that this disruptive technology holds significant impact potential on student engagement, inquiry, achievement, and performance. Empirical exploration is in order.

CHAPTER THREE: METHOD

Chapter three presents the design and method of this study. The chapter is divided into six main sections: (1) participants, (2) materials, (3) research design, (4) procedure, and (5) data preparation.

Participants

The research participants were individuals who were using Second Life and affiliated with education in some capacity. This included students, instructors, administrators, and educational researchers who were current Second Life residents and who were perceived to be a desirable population for two reasons. First, this study focused on educational related research. Second, participants were taken from within Second Life, rather than using real life educational audiences, because they already had access to the virtual world, had successfully logged on, and had basic navigational skills mastered. This could be assumed because the sample was drawn from sources that could ensure those requirements to a great degree.

Sample

The research participants were from the educational community within Second Life. Participants had to be 18 years of age; this was a requirement for both this study and of Linden Lab, the owners of Second Life. Participants were required to have the necessary hardware to access Second Life, an established avatar, and mastery of basic navigational skills. Further details explaining the requirements for participation can be found in the *Solicitation for Participants* section of the Project Plan (Appendix A).

Volunteers were solicited in the following manner. Among the educational Second Life resident population, an email solicitation was sent inviting interested residents to participate in a study. Specifically, participants were taken from two global educational resources – one online

and one in-world. An email was sent from *UCFSLResearch@gmail.com* to the following email distribution lists: *vw-research@utlists.utexas.edu, slrl@list.academ-x.com,* and *educators@lists.secondlife.com*. A request for participation was also sent to the following in-world groups: *Real Life Education in Second Life*, *Second Life Library 2.0*, and *ISTE Educational Technology Association*. An online registration web site was used to log interested participants.

Approval for conducting solicitations was obtained in two ways. First, the study received approval from the University of Central Florida Institute Review Board (IRB) (see Appendix B) for a period of December 2008 through December 2009. Second, approval was obtained from the moderators of the email distribution lists and in-world groups indicating it was appropriate to use the lists for solicitation. A copy of the *Informed Consent* form was enclosed as an attachment in the solicitation email.

There were no anticipated risks and the participants were free to withdraw their consent and discontinue participation at any time without consequence. Participants were offered U.S. $20 for their participation in the exploration activity. Ten percent of those who participated were selected and offered an additional $5 for their interview time. Participants were offered payment in Second Life dollars (Lindens) or via electronic transfer (PayPal). Participants' responses were analyzed and reported anonymously to protect their privacy. The description of the instruments used to collect these data follows.

Materials

Data were collected through quantitative instruments including the registration questionnaire, the engagement survey, and the in-world knowledge check quiz. An interview

question template was used for the interviews, and a performance rubric was developed to evaluate the photo packages. The instruments are described below.

Registration Questionnaire

The registration questionnaire contained volunteer profile information, including demographic and technology skill level questions. Specifically, it contained questions regarding perceived computer and Second Life skill levels; gender, age, ethnicity and origin; prior experience with the Second Life activity area; and sign-up times. It also contained consent of voluntary participation. A copy of the questionnaire can be found in the *Registration Questionnaire* section of the Project Plan (Appendix A).

The registration questionnaire was made available via a public web-based survey site. Interested participants from the solicitation sources mentioned above completed the questionnaire and indicated their participation time preferences. The web-based survey site collected the responses in a data repository. After submitting the questionnaire, participants received an email with a link to the Second Life location where the VWQuest kiosk resided and a time window on when to participate.

Engagement Survey

Engagement was measured using the Flow State Scale (FSS-2) survey. The instrument was developed by Dr. Susan Jackson (2002) and has been tested across many domains (Marzelak, 2006; Wrigley, 2005; Connolly, 2007; Dorland, 2006; Levine, 2006; Mendelson, 2007; McCune, 2006; Mugford, 2004; Saville, 2006; Skaer, 2006; Vasquez, 2005).The instrument has been validated and tested for reliability (Jackson & Ecklund, 2002; Jackson& Marsh, 1996). The survey was a 36-question, Likert-scale, subjective instrument containing

questions that targeted the nine dimensions of flow four times each. A copy of the questionnaire can be found in the *Engagement Questionnaire* section of the Project Plan (Appendix A).

The survey was made available via a public web-based survey site. Participants were asked at the completion of the VWQuest activity to complete the survey. The survey contained 36 questions requesting personal opinions regarding their experience. The web-based survey site collected the responses in a repository and the data were downloaded for analysis after the activity was completed by all the participants.

Knowledge Check

An 11-question, multiple-choice quiz was used to assess the volunteer's mastery of the activity. The quiz focused on declarative knowledge based on participation, specifically facts about the area and the activity. The quiz was administered within Second Life and was offered as part of the VWQuest at the end of the exploration. Results were automatically scored and emailed to a confidential email address with the avatar's name, answers, and percentage of correct responses. The email data were aggregated and entered into a spreadsheet for analysis after the activity was completed by all the participants. A copy of the quiz can be found in the *Evaluation* subsection of the *VWQuest Activity* section of the Project Plan (Appendix A).

Performance Photo Packages

Although not an instrument, photo packages were another material used in the data collection process. Throughout the activity, participants were asked to take specific in-world snapshots of their experience. A participant's collection of photos was referred to as his or her photo package. Photo package scores were used to determine an overall performance score. A detailed account of this process is located in the *Procedure* section of this chapter.

A rubric for assessing all participants' photo packages was developed. Five elements were used as criteria for evaluation. Two core criteria were quality and adherence; these were assessed on a five-point scale. Evidence of quality and adherence were expected from the participants. Additional points were attainable for creativity, extra content, and additional photos; these were assessed on a three-point scale. This assessment carried less weight because those criteria were perceived as additional evidence of performance. Innovative packaging credit was also available, worth a single point. This element was added during the rubric revision process. It was observed that, largely because of technological creativity, this criterion should be addressed, albeit only to a small degree.

Participants were asked to email their photos to a specific email address during their exploration. The photo data were aggregated and submitted to external evaluators for scoring. After the activity was completed by all the participants, responses were entered into a spreadsheet for analysis.

Interviews

Open-ended interview questions were used to gather qualitative data in order to cross validate quantitative results obtained from participants and to provide possible explanations for any inconsistent or unexpected data. At the end of their sessions, participants were asked if they were interested in participating in a brief interview. A small sample (ten percent of those who participated) was interviewed; the interviews lasted approximately 15 minutes each. A stratified sample was obtained, using three participants who had low engagement scores; four who had scores in the average range, and three who had reported high engagement. The intent was to obtain a range of responses to support possible explanation of participants' performance based

on different levels of engagement. A copy of the interview questionnaires can be found in the *Interview Questions* section of the Project Plan (Appendix A).

Research Design

This study used a combination of quantitative and qualitative data. The design focused primarily on quantitative data, supplemented with interview data for qualitative support. It also purposefully examined two methods for assessing learning potential. The first method, the knowledge check, queried for fact and content retention, targeting the declarative domain through recall and recognition. This score represented their achievement level. The second method employed an open-ended performance-based deliverable; examining less direct aspects of learning potential including quality of work, creativity, innovation, and the ability to follow directions. This score represented their performance level. Assessing and measuring across two learning domains allowed for a more comprehensive examination of individual attainment.

The research questions specifically examined the relationship if any, between levels of engagement and achievement, and levels of engagement and performance. The research looked at relationships between variables and sought to identify the amount of variance in dependent variables that are accounted for by overall flow. Thus correlation testing was employed to address the hypotheses.

The following two hypotheses were examined.

Hypothesis 1: There is a positive relationship between learners' level of engagement as measured by Flow theory and achievement in the 3-dimensional virtual learning environment of Second Life.

Hypothesis 2: There is a positive relationship between learners' level of engagement as measured by Flow theory and performance in the 3-dimensional virtual learning environment of Second Life.

Exploratory analysis was also conducted to determine which factors of flow explained the greatest amount of variance in determining the level of learner engagement in the 3-dimensional virtual learning environment of Second Life. Additionally, factors including age, skill, and culture were explored to determine what, if any, influence those factors had on learner engagement.

A second exploratory research question followed, examining the factors that contributed to engagement to see which, if any, contributed significantly to the greatest amount of variance towards overall flow. Confirmatory factor analysis was chosen as the statistical test based on the design methods described in Campbell & Stanley (1963). All participants took part in the treatment; control and treatment groups were not used.

Follow-up interviews were conducted as a qualitative data measure to support and further explain quantitative findings.

Procedure

The procedure consisted of participants who completed a registration questionnaire, an exploration activity, and a post-activity survey. A small percentage of participants took part in an interview following the activity. As previously mentioned, participants were solicited from Second Life educationally-affiliated online resources. Interested participants completed the registration questionnaire and received a time and date to participate in the activity. Participants were scheduled in intervals in an effort to reduce the risk of burdening Second Life resources, to minimize intrusion on the land, and to reduce the chance of learners interfering with one another.

As mentioned in Chapter Two, the activity was taken from the 2D WebQuest instructional design; a self-directed, resource-ready, exploratory activity that contained a goal and specific objectives to accomplish, along with tasks to complete. This VWQuest used the same format as a WebQuest: Introduction, Task, Process, Resources, Evaluation, and Conclusion. The activity was expected to take about an hour to complete, yet learners were informed to spend as much time exploring as they preferred.

Participants began at the VWQuest Kiosk as shown in Figure 8. The kiosk explained how to get started and detailed the activity. The activity was presented in the form of a role play. Participants were asked to gather information about a new technology-rich instructional area in Second Life named Huffman Prairie Omega. Huffman Prairie Omega, shown in Figure 9, was designed by the U.S. Air Force as a region developed to support scalability assessments and sustainability analysis for educational technology innovations (Strickler, 2009). It proved to be an area rich for exploration and experimentation.

Figure 8: Huffman Prairie Omega Virtual World Quest Kiosk

Figure 9: Huffman Prairie Omega in Second Life

Participants began the activity at the kiosk where they received a navigational tool that displayed at the top of their Second Life window, as shown in Figure 10. This tool helped them navigate the VWQuest activity. The participant was encouraged to proceed through each section sequentially, yet each section was available for previewing in any order and as often as necessary. Each section was self-explanatory, enabling the participant to begin, explore, and complete the whole process without intervention. Additional details can be found in the *VWQuest Activity* section of the Project Plan (Appendix A). The Introduction button of the VWQuest prompted the beginning of the activity, and set the stage for role play.

Figure 10: VWQuest menu with Introduction, Task, Process, Resources, Evaluation, and Conclusion learning modules.

In the role play, each volunteer acted as a student in a traditional high school. The introduction included a video in which the school principal greets the subject and refers to the Provost of a technology-rich university with an invitation to visit the campus. The principal asks volunteers to investigate for him. Participants were asked to explore the campus - the Huffman Prairie Omega Second Life Island – to find specific items and to go to specific locations, take snapshots of their exploration, experience the various activities, and read posted content. The goal was to gather information about the area and return with photos of what the university had done. After exploring, participants took a knowledge check quiz to determine whether they felt confident about returning to their school and reporting what they learned to the principal. The quiz served as the achievement assessment. Upon completion of the knowledge check, they watched an exit video and were directed to complete the online engagement survey. At the end

of the survey, they were asked whether they were interested in participating in a brief interview. There were no penalties if the participants declined. This satisfied the participant's obligation. Interviews were conducted in-world using Second Life recorded audio and chat text.

Prior to going live, the study included a pilot test. To pretest the activity, seven participants were randomly selected from students participating in interdisciplinary graduate studies focused on Second Life. They provided feedback on the technical functionality, structure, and content of the procedure. The instruments, activity, and instructional process were updated according to the formative feedback.

Data Preparation

Once all data types were collected (profile questionnaires, photo submissions, knowledge checks, engagement questionnaires, and interviews), they were transcribed, sorted, and analyzed. The registration questionnaire, which collected demographic data, was extracted and sorted and used as descriptive statistics. The results of the knowledge check, which collected achievement data, were sent to an email account where the data was extracted and aggregated. The post-activity engagement survey, which measured dimensions of flow and overall level of engagement, was extracted, sorted, and tallied. Photo packages were assessed as the performance measure and required external evaluation in order to guarantee unbiased data. The evaluation process underwent several revisions in order to achieve the inter-rater reliability rating mentioned earlier. Details follow.

Rubric Reliability

Originally the rubric was created considering individual photos, rather than a single package. Although this worked during the formative evaluation, it soon proved to be unmanageable during evaluation. The rubric was revised the first time because some participants

took considerably more or less photos than requested. The second revision focused on the photo collection package as a whole, and while this was more manageable for assessment, it proved too subjective. A third and final revision of the rubric was created that proved to be manageable, reliable, and valid. Inter-rater reliability between evaluators was met.

External evaluators were chosen based on familiarity with instruction inside Second Life, either as a student or an instructor. Five evaluators originally participated: a doctoral-level instructor in Second Life; an instructional designer and doctoral candidate conducting research in Second Life; and three doctoral students who had taken at least one class in Second Life. During inter-rater reliability testing, one doctoral student withdrew from participation due to school workload constraints. Later, during a revision of the rubric and reliability testing, it became apparent that one rater's assessments were consistently different from the other three. When the one rater's scores were removed, inter-rater reliability went up significantly. The rubric was finalized after four revisions and the doctoral instructor, the instructional designer, and one doctoral student conducted the final photo package evaluations.

As shown in Figure 11, the overall reliability of the performance rubric is rated 'substantial' (k=.72), based on Cohen's Kappa statistical test for inter-rater reliability. Cohen's Kappa measures the agreement between the evaluations of two raters when both are rating the same object. A value of 1 indicates perfect agreement. A value of 0 indicates that agreement is no better than chance. Cohen's Kappa is best suited for tables in which both variables use the same category values and both variables have the same number of categories (SPSS, 2004).

Criteria		Rater Comparisons 1 vs 2	1 vs 3	2 vs 3		
Quality	(% Match)	0.60	0.80	0.80	P(A)	0.73
	(% Scale)	0.20	0.20	0.20	P(E)	0.20
		0.50	0.75	0.75	K	0.67
		Moderate	Substantl	Substantl		Substantl
Adherence	(% Match)	1.00	1.00	1.00	P(A)	1.00
	(% Scale)	0.20	0.20	0.20	P(E)	0.20
		1.00	1.00	1.00	K	1.00
		Perfect	Perfect	Perfect		Perfect
Creativity	(% Match)	0.60	0.80	0.80	P(A)	0.73
	(% Scale)	0.33	0.33	0.33	P(E)	0.33
		0.40	0.70	0.70	K	0.60
		Fair	Substantl	Substantl		Substantl
Additional Content	(% Match)	1.00	1.00	1.00	P(A)	1.00
	(% Scale)	0.33	0.33	0.33	P(E)	0.33
		1.00	1.00	1.00	K	1.00
		Perfect	Perfect	Perfect		Perfect
Additional Photos	(% Match)	1.00	1.00	1.00	P(A)	1.00
	(% Scale)	0.33	0.33	0.33	P(E)	0.33
		1.00	1.00	1.00	K	1.00
		Perfect	Perfect	Perfect		Perfect
Innovative Packaging	(% Match)	1.00	1.00	1.00	P(A)	1.00
	(% Scale)	0.50	0.50	0.50	P(E)	0.55
		1.00	1.00	1.00	K	1.00
		Perfect	Perfect	Perfect		Perfect
Total	(% Match)	0.60	0.80	0.80	P(A)	0.73
	(% Scale)	0.06	0.06	0.06	P(E)	0.06
		0.57	0.79	0.79	K	0.72
		Moderate	Substantl	Substantl		Substantl

Interpreting K	
0	Slight
0.2	Fair
0.4	Moderate
0.6	Substantl
0.8	NearPrfct
1	Perfect

Figure 11: Inter-rater reliability scores between three external evaluators.

The total reliability score (k=.72) and each of the criteria scores -- quality (k=.67), adherence (k=1.0), creativity (k=.6), extra content (k=1.0), additional photos (k=1.0), and innovative packaging (k=1.0) -- received a 'substantial' rating or higher. A copy of the final performance rubric can be found in Appendix C.

Details describing the selection of external evaluators follow.

Variables

For the research questions hypothesizing a relationship between engagement and achievement and/or performance, the independent variables were engagement (ENGT) as measured by flow scores. The dependent variables were individuals' achievement (ACHT) as measured by knowledge check scores, and performance (PERF) as measured by photo package

scores. For the exploratory research question, the nine dimensions of flow served as independent variables. Total engagement scores were the dependent variable. Additional data including Second Life skill level (SLSL), and demographic data such as age (AGE) and ethnicity (ETHY) were also used as independent variables to explore any relationship between those data and achievement and/or performance. In those cases, engagement score was the dependent variable.

Details on the analysis and discussion of the research findings follow in Chapter Four.

CHAPTER FOUR: FINDINGS

Chapter four presents the results of testing the research hypotheses through quantitative methods and interview responses from the participants of this study. In addition, the results of the exploratory analysis between flow factors and other variables are presented. The chapter is divided into five main sections including: (a) descriptives, (b) the research hypotheses, (c) the exploratory research questions, and (d) the interviews.

Two hundred participants registered for the activity. Of them, 112 finished the activity. Of those112 participants, exactly 100 participants completed and submitted all of the requested data - registration questionnaire containing demographic data, knowledge check containing achievement data, photo packages containing performance data, and the flow survey containing engagement data. The sample of 100 cases was input into the statistical software package, SPSS.

For the hypothesis analysis, the independent variables were total engagement and the supporting interview data. The dependent variables of this study included the achievement scores and performance scores. For the exploratory analyses, the independent variables were the nine dimensions of flow, Second Life skill level, age, and ethnicity. The dependent variables were the achievement scores, performance scores and overall engagement.

Descriptives

As mentioned, a total of exactly 100 volunteers participated in the activity. Their demographics based on gender, age, ethnicity, country of origin, educational affiliation and Second Life skill level are provided in Table 1.

As shown in Figure 12 below, participants ranged in age from 18 to over 60. The median age range was 40-49 with the most participants in the age range of 50-59. The majority reported they were not students.

Table 1
The Demographics if the Participants (N=100)

Demographic		Percent
Gender	Male	40
	Female	55
	Prefer Not to Answer	5
Age	18-29	20
	30-39	20
	40-49	26
	50-59	28
	60+	5
	Prefer Not to Answer	1
Ethnicity	White	84
	Black	5
	Multiracial	3
	Asian	2
	Hispanic	2
	Other	2
	Prefer Not to Answer	2
Educational Affiliation	Instructor	30
	Student	30
	Other	26
	Researcher	7
	Administrator	5
	Prefer Not to Answer	2

Demographic		Percent
Country of Origin	USA	65
	Canada	7
	United Kingdom	5
	Poland	4
	Germany	3
	Finland	2
	France	2
	New Zealand	2
	Argentina	1
	Australia	1
	Denmark	1
	Ireland	1
	Netherlands	1
	Portugal	1
	Russia	1
	Sweden	1
	Prefer Not to Answer	2
SL skill Level	Newbie	3
	Novice	15
	Skilled	15
	Proficient	39
	Expert	28

The majority of participants were white and from the United States. Still, Second Life's global influence can be seen in the fact that respondents from 16 countries participated as well as the ethnicity diversity, with participants reporting White, Black, Hispanic, Asian and multi-cultural.

The median and mode report for Second Life skill level was 'Proficient' suggesting that that requirement for mastery of basic navigational skills was likely met.

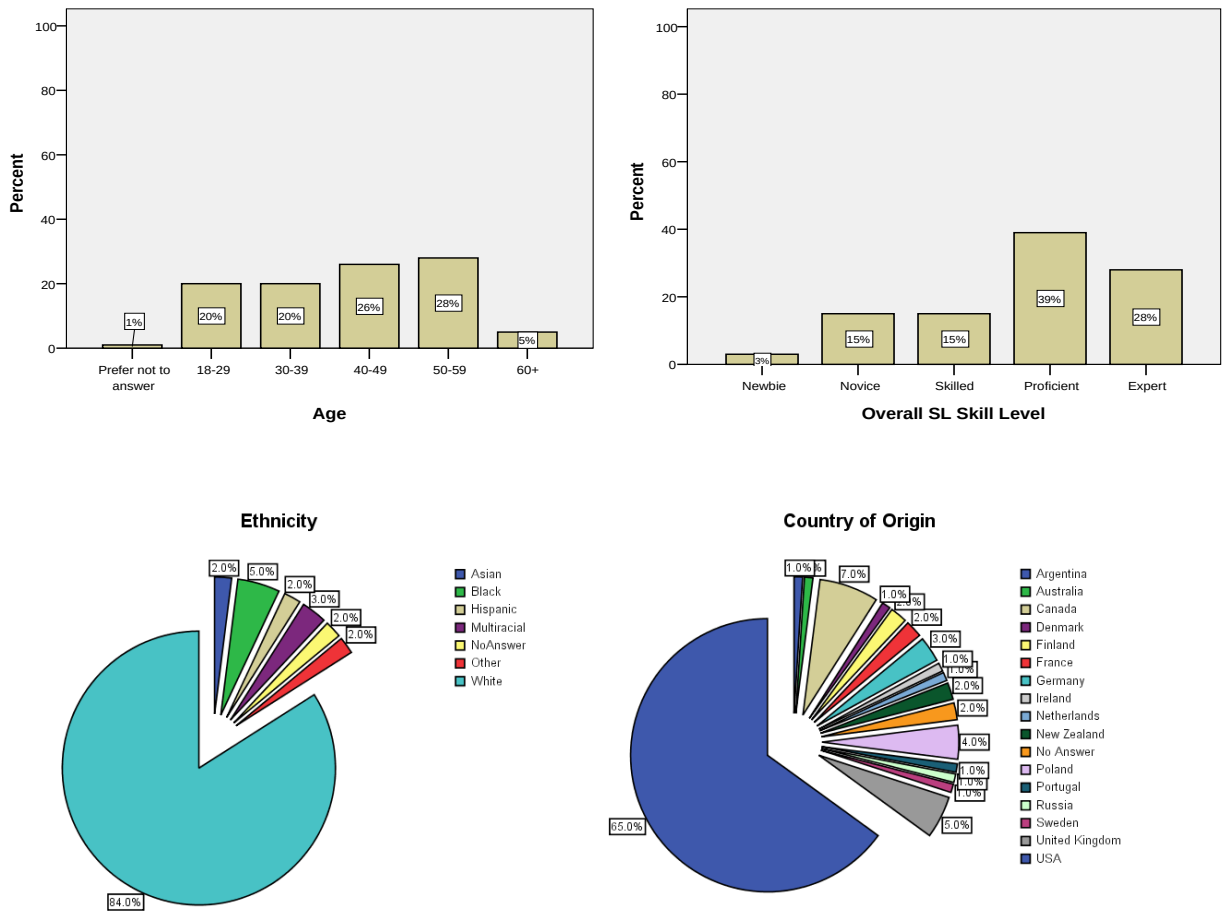


Figure 12: Demographics of Participants Based on Age, Overall Second Life Skill Level, Ethnicity, and Country of Origin.

As described in Chapter three, engagement was measured by flow scores, individuals' achievement was measured by knowledge check scores, and performance was measured by photo package scores. The data associated with engagement, (M=68.29, SD=14.11, N=100), achievement, (M=78.82, SD=14.74, N=100) and performance, (M=54.33, SD=17.43, N=100) are depicted as percentages in Table 2.

Table 2
Descriptive Statistics for Engagement, Achievement and Performance (N=100)

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Engagement (percent)	68.2917	14.10619	-.046	.241	-.617	.478
Achievement (percent)	78.8197	14.73551	-.610	.241	-.320	.478
Performance (percent)	54.3332	17.42976	.234	.241	-.583	.478

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Engagement (raw)	.079	100	.132	.987	100	.439
Achievement (raw)	.181	100	.000	.918	100	.000
Performance (raw)	.110	100	.005	.971	100	.025

a. Lilliefors Significance Correction

The graphs displayed in Figure 13 visually depict the distribution of the raw scores for engagement, achievement, and performance. Tests for outliers and normality indicate that there were no outliers and normality of the data can be assumed.

Hypotheses

The following hypotheses were investigated.

Hypothesis 1: There is a positive relationship between learners' level of engagement as measured by Flow theory and achievement in the 3-dimensional virtual learning environment of Second Life.

Hypothesis 2: There is a positive relationship between learners' level of engagement as measured by Flow theory and performance in the 3-dimensional virtual learning environment of Second Life.

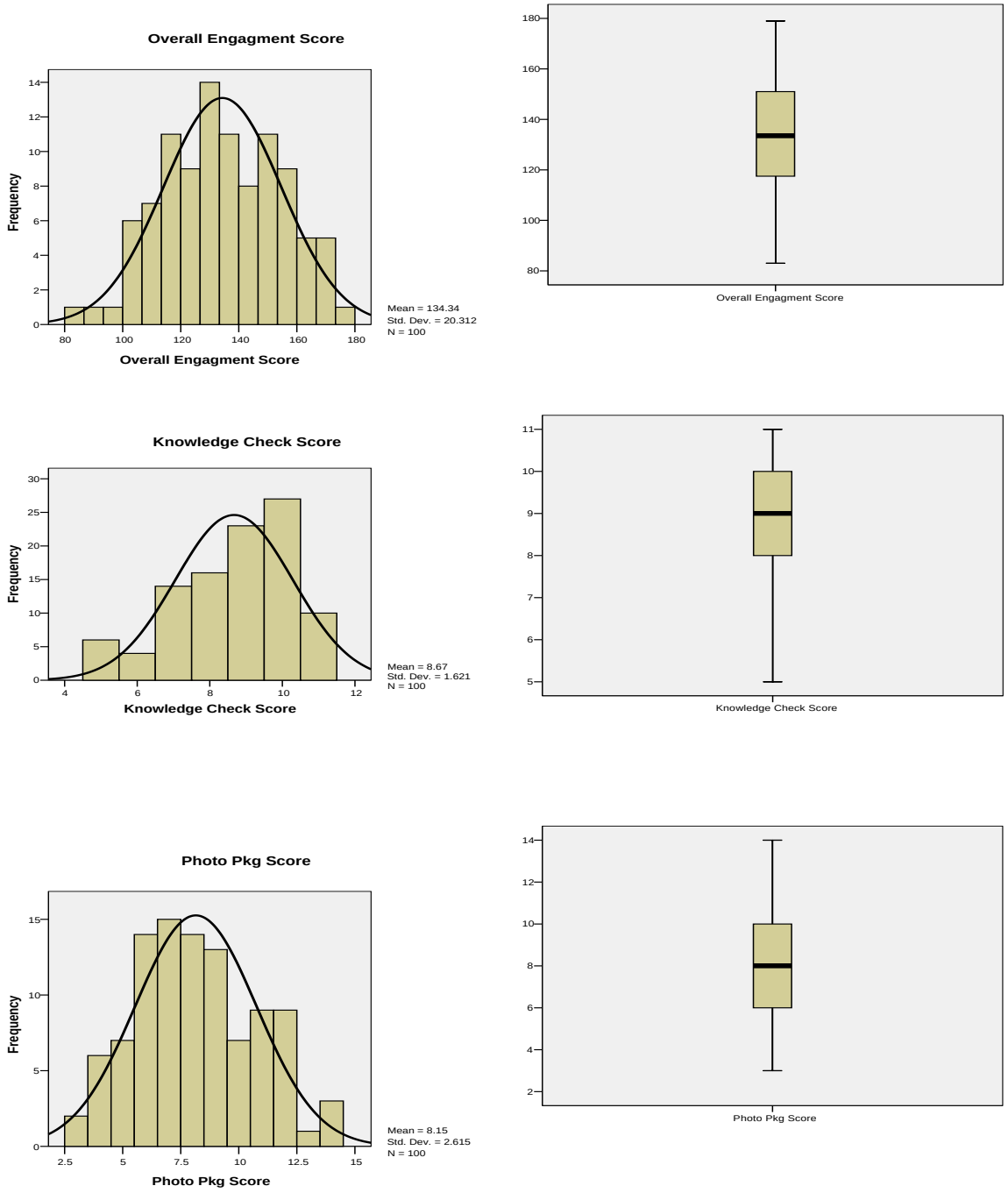


Figure 13: Outlier and Normality Tests for Engagement, Performance and Achievement data.

The standard statistical test for a relationship between two variables is a correlation. If two variables are correlated, then knowing the value of one variable will help predict the value of the other variable. Regression is an extension of this principle (Brace, Kemp & Snelgar, 2006).

Therefore, a simple regression was selected as the statistical test in examining both hypotheses because the aim was to potentially predict a relationship between a continuous dependent variable based on an independent variable. All tests for significance were set at the .05 level.

Hypothesis 1

As a result of a regression test, hypothesis 1 was not supported. That is, there was not a statistically significant relationship, F (1,98)=2.1, p>.05, between learners' level of engagement and achievement within the learning activity in Second Life as shown in Figure 14. The adjusted R Square equaled .011 which means only 1.1% of the variance in score could be accounted for by engagement. In practical terms, this suggests that for this study's activity, an individual's overall level of engagement was not able to statistically predict an individual's ability to achieve.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.144[a]	.021	.011	1.612	.021	2.065	1	98	.154

a. Predictors: (Constant), Overall Engagement

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.367	1	5.367	2.065	.154[a]
	Residual	254.743	98	2.599		
	Total	260.110	99			

a. Predictors: (Constant), Overall Engagement

b. Dependent Variable: Achievement

Figure 14: Regression Analysis of Achievement on Overall Engagement

Hypothesis 2

Testing for engagement as a predictor of performance, hypothesis 2 was supported. That is, there was a statistically significant relationship, F (1,98)=14.17, p<.01, between learners'

level of engagement and performance within the learning activity in Second Life as shown in Figure 15. The adjusted R Square equaled .117 which means 11.7% of the variance in performance could be accounted for by engagement. In practical terms, this suggests that for this study's activity, an individual's overall level of engagement is a statistically significant predictor of that individual's ability to perform.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.355[a]	.126	.117	2.456	.126	14.174	1	98	.000

a. Predictors: (Constant), Overall Engagement

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	85.510	1	85.510	14.174	.000[a]
	Residual	591.240	98	6.033		
	Total	676.750	99			

a. Predictors: (Constant), Overall Engagement

b. Dependent Variable: Performance

Figure 15: Regression Analysis of Performance on Overall Engagement

The fact that hypothesis 2 was supported suggests that having an engaging experience while learning in an immersive 3D environment such as Second Life may in fact contribute to an individuals' ability to perform better.

Remembering that engagement is measured by the nine elements defined in Flow theory, the question regarding the contribution of each of the individual flow dimensions towards explaining the variance in performance became relevant. Multiple regression was chosen. The advantage of using multiple regression over several correlations is that multiple regression corrects for the correlations among predictor variables (Brace, Kemp & Snelgar, 2006). That is, a correlation between two variables may be partly due to another predictor variable's influence.

Figure 16 illustrates the statistically significant dimensions of flow that contributed to explaining variance in performance. Two of the dimensions were statistically significant: *Control* and *Loss of Time*. As figure indicates, the analysis determined Control to have the greatest statistical significance, F (1,98) =11.405, p<.01. A second regression indicated that *loss of time* had statistical significance, F (2,97) = 9.232, p<.001, contributing to the next greatest amount of variance that could be accounted for in performance.

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	70.546	1	70.546	11.405	.001[a]
	Residual	606.204	98	6.186		
	Total	676.750	99			
2	Regression	108.221	2	54.111	9.232	.000[b]
	Residual	568.529	97	5.861		
	Total	676.750	99			

a. Predictors: (Constant), sense of Control

b. Predictors: (Constant), sense of Control, temporary Loss of Time

c. Dependent Variable: Performance

Figure 16: Regression Analysis of Performance on Flow Dimensions

Additional Findings for Performance

Although engagement using flow constructs had been examined, there remained a significant amount of unexplained variance in the performance data. It seemed possible that other factors had contributed. For example, it seemed plausible that a participant's ability to become engaged was dependent on their skill level. To confirm this possible relationship, performance and engagement were regressed on Second Life skill level. As Figures 17 and 18 indicate, skill level was found to be a statistically significant a predictor of engagement, F (1.98) = 5.336, p<.05. Yet skill was not a statistically significant predictor of performance, F (1,98) = 1.289, p>.05. Engagement was previously found to be a statistically significant predictor of performance. That is to say that for this study, skill helped predict engagement (S → E);

engagement helped predict performance (E → P); but skill did not contribute to predicting performance directly (S /→ P). Therefore, engagement was found to be a mediator between skill level and performance.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.227[a]	.052	.042	19.882	.052	5.336	1	98	.023

a. Predictors: (Constant), Overall SL Skill Level

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2109.192	1	2109.192	5.336	.023[a]
	Residual	38737.25	98	395.278		
	Total	40846.44	99			

a. Predictors: (Constant), Overall SL Skill Level

b. Dependent Variable: Overall Engagement

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	118.868	6.987		17.013	.000
	Overall SL Skill Level	4.137	1.791	.227	2.310	.023

a. Dependent Variable: Overall Engagement

Figure 17: Regression Analysis of Engagement on Second Life Skill Level

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.783	1	8.783	1.289	.259[a]
	Residual	667.967	98	6.816		
	Total	676.750	99			

a. Predictors: (Constant), Overall SL Skill Level

b. Dependent Variable: Performance

Figure 18: Regression Analysis of Performance and Engagement on Second Life Skill Level

Exploratory Analyses

This study used the nine dimensions collectively as a single measure of overall individual engagement. Knowing that each of the dimensions contributed differently, it became important to understand how each of these flow factors contributed to explaining the variance seen in engagement. It is also important from an instructional perspective to understand which factors contribute most significantly as they may have the greatest design implications.

Confirmatory factor analysis was chosen because the goal was to identify factor structure. A rotated varimax factor analysis was selected.

As mentioned, the instrument contained 36 questions, each targeting one of the nine flow dimensions. The dimension measured in each question is represented in Figure 19. Analysis of the data indicated that all four of the variables for each factor clustered together. The loadings helped confirm the notion that the instrument FSS-2 (Jackson & Ecklund, 2002) was indeed appropriate for these data and for this study.

The only factors that loaded slightly different were *clear goals* (GOAL) and *immediate feedback* (FDBK). These factors loaded together for this study. One possible explanation would be that participants perceived having or not having goals clearly defined closely associated with perceiving feedback on their progress. That is to say, if a participant knew their goals, he or she could tell if they were doing well or not. If a participant wasn't clear about his or her goals, they were not able to tell how well they were doing. For this independent, student-centered activity, the explanation is both feasible and plausible, and is supported in the interview data.

Rotated Factor Matrix[a]

	Factor							
	1	2	3	4	5	6	7	8
GOAL1	**0.621**	-0.010	-0.054	0.211	0.227	-0.001	0.033	0.106
GOAL2	0.496	0.172	0.177	0.168	0.133	0.071	0.138	**0.518**
GOAL3	**0.709**	0.223	0.059	0.132	0.216	0.083	-0.022	0.507
GOAL4	**0.571**	0.252	0.121	0.165	0.092	0.123	-0.023	0.283
FDBK1	**0.734**	0.102	0.245	-0.028	0.143	-0.003	0.158	0.134
FDBK2	**0.737**	-0.017	0.189	0.147	0.159	0.033	0.138	-0.033
FDBK3	**0.819**	-0.015	0.284	0.119	0.133	0.112	0.131	-0.107
FDBK4	**0.839**	0.036	0.267	0.140	0.049	0.117	0.007	-0.169
AUTO1	-0.012	**0.864**	0.020	0.081	0.083	0.052	0.170	0.005
AUTO2	0.093	**0.826**	0.107	0.048	-0.058	0.243	0.116	0.094
AUTO3	0.084	**0.832**	0.085	0.203	0.125	0.129	0.156	0.057
AUTO4	0.102	**0.888**	0.068	0.084	0.063	0.233	0.136	0.019
LSLF1	0.174	0.141	**0.670**	-0.082	0.119	0.059	0.161	0.378
LSLF2	0.173	0.001	**0.701**	0.068	0.044	0.088	0.069	-0.050
LSLF3	0.038	-0.047	**0.632**	0.057	0.281	0.105	-0.013	0.213
LSLF4	0.212	0.062	**0.828**	0.098	-0.105	0.190	-0.030	-0.016
CTRN1	0.058	0.095	0.078	**0.817**	0.082	0.212	0.171	-0.007
CTRN2	0.111	0.119	0.184	**0.557**	0.301	0.006	0.373	0.152
CTRN3	0.304	0.085	0.147	**0.734**	0.139	0.056	-0.061	0.010
CTRN4	0.208	0.148	-0.026	**0.888**	0.083	0.082	0.045	0.042
LPLC1	0.168	-0.087	0.066	0.277	**0.635**	0.187	-0.024	-0.120
LPLC2	0.143	0.185	-0.126	0.183	**0.365**	0.329	0.261	0.189
LPLC3	0.246	0.017	0.127	0.162	**0.710**	0.154	0.131	0.240
LPLC4	0.362	0.232	0.185	0.073	**0.660**	0.074	0.104	0.029
LTIM1	-0.115	0.110	0.069	0.182	0.038	**0.754**	0.277	0.112
LTIM2	0.176	0.225	0.162	-0.019	0.028	**0.681**	0.058	0.045
LTIM3	0.194	0.268	0.262	0.203	0.034	**0.484**	0.096	-0.127
LTIM4	0.059	0.109	-0.030	0.078	0.246	**0.720**	-0.037	-0.025
CHSK1	0.016	0.221	-0.038	0.121	-0.128	0.209	**0.593**	0.156
CHSK2	0.164	0.204	0.291	0.114	0.207	0.082	**0.673**	0.009
CHSK3	0.329	0.149	0.387	0.103	0.281	0.126	**0.407**	-0.154
CHSK4	0.125	0.286	0.146	0.076	0.344	0.153	**0.530**	-0.241
CTRL1	0.255	**0.300**	0.235	-0.067	0.273	-0.029	0.257	0.071
CTRL2	0.261	0.228	**0.470**	-0.014	0.352	-0.110	0.381	0.108
CTRL3	0.378	0.214	0.441	0.001	**0.445**	-0.038	0.304	0.032
CNTL4	0.151	0.113	**0.517**	0.114	0.043	-0.068	0.130	-0.134

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

[a] Rotation converged in 11 iterations.

Figure 19: Rotated Factor Matrix Table using the Flow Factors

Table 3 displays the loading results as a result of factor extraction using Principal Axis Factoring. As indicated in the table and as mentioned above, eight factors emerged.

Table 3
Total Variance Explained using Flow Factors

Factor	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1 (GOAL/FDBK)	4.976	13.823	13.823
2 (AUTO)	3.781	10.503	24.326
3 (LSLF)	3.576	9.933	34.259
4 (CTRN)	2.843	7.898	42.157
5 (LPLC)	2.645	7.347	49.504
6 (LTIM)	2.366	6.571	56.075
7 (CHSK)	2.133	5.924	62.000
8 (CTRL)	1.186	3.295	65.294

The factors contributing most in explaining variance in engagement were *clear goals/feedback* (GOAL/FDBK = 13.82%), *autotelic experience* (AUTO = 10.5%) and *temporary loss of self* (LSLF = 9.93%). Cumulatively they explained 34.259% of the variance. The next highest loadings were *intense concentration* (CTRN=7.9%), *temporary loss of place* (LPLC = 7.35%) and *temporary loss of time* (LTIM = 6.57%). The *balance of challenge and skill* (CHSK = 5.92%) and *feeling of control* (CTRL = 3.3%) contributed the least in explaining the variance accounted for in overall engagement. The total amount of variance explained in engagement using flow factors was 65.294%.

Demographic Exploratory Analysis

Because the primary interest of this research involved understanding the dynamics of engagement, an analysis of engagement with the demographic relationships, specifically age and gender, was conducted. Analysis of ethnicity was not pursued because the demographic distribution for ethnicity indicated that there was not enough representation in all of the categories (White=84, Black=5, Multiracial=3, Asian=2, Hispanic=2) for analysis to be meaningful.

Engagement and Gender

An independent t-test was conducted using Gender (Male N=40; Female N=55) as the grouping factor to determine if there was a statistically significant mean difference between males and females, and levels of engagement. As Figure 20 indicates, no statistically significant mean difference was found between gender and levels of engagement, t (1,90.9) = .454, p>.05.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Engagment (Overall)	Equal variances assumed	4.611	.034	.442	93	.659	1.902	4.300	-6.637	10.441
	Equal variances not assumed			.454	90.879	.651	1.902	4.186	-6.413	10.218

Figure 20: Mean Comparison between Engagement and Gender

Engagement and Age

The distribution of age fell into five categories (18-29, 30-39, 40-49, 50-59, 60+). Because there was such small representation in the last category (60+N=5), the data were merged with the adjacent category (50-59) making a total of four categories (18-29, 30-39, 40-49, 50+). With these data and groupings, an Analysis of Variance (ANOVA) was conducted to determine if there were statistically significant mean differences between age groups and levels of engagement. As Figure 21 indicates, no statistically significant mean difference was found between age and levels of engagement, F (3,95) = 1.79, p>.05.

ANOVA

Engagment (Overall)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3928.175	5	785.635	2.000	.086
Within Groups	36918.27	94	392.748		
Total	40846.44	99			

Figure 21: Mean Comparison between Engagement and Age Ranges

Interviews

The purpose of the interviews was to cross validate the quantitative data results and to help identify causes or explanations for such effects. The sample obtained was ten percent of the total participants, yielding ten interviews. A range of engagement responses - participants who had reported low, medium and high levels of engagement – were used. Questions were in the "Tell me…" format. This was deliberate because although each interview followed a specific list of questions, each were left open-ended so participants could comment on additional aspects of their experience that may not have been covered in the questions. All interviews were conducted in-world using voice chat. In additional to interview conversations, data was extracted from emailed comments that were sent, completely self-initiated, from several of the participants. A copy of the interview questionnaires can be found in the *Interview Questions* section of the Project Plan (Appendix A).

The major themes that emerged as a result of qualitative data transcription and analysis were overall engagement experience, technical difficulties, time related comments, perception of presence in Second Life, and the activity's level of challenge relative to participants' capability. Interesting to note is that of the flow dimensions, emergent themes evolved from the *loss of time*, *loss of place*, and *challenge/skill balance* dimensions. Table 4 categories these themes from each of the interview participants.

Table 4
Overall Experience of Major Themes in Interview Data

	Overall Experience		
	Positive	Neutral	Negative
Overall Engagement	9	0	1
Technical Difficulties*	8	0	2
Goals	8	1	1
Loss of Time	10	0	0
Loss of Place	5	5	0
Challenge and Skill	7	2	1

*Many reported technical difficulties to some degree, but only one participant reported it inhibited their overall experience.

Overall Engagement

Despite the fact that the sample was selected based on the range of engagement survey responses, only two interviewees reported not having an engaging experience at all.

Most conversations including comments like ‘captivating’, ‘immersive’, ‘imaginative’, ‘fascinating’ and ‘thoroughly impressed’. One interviewee reported, ”This was the most awesome visit I have ever had in a Second Life sim in my whole two years that I have been here.” Another reported, “O, WOW! That was the most awesome experience I have ever had in SL.” And still another reported:

“It was truly the most amazing experience I have ever had in Second Life. The detail in the builds was remarkable. After a while, I stopped using a map and just explored. At times I got lost and probably went in some areas visitors shouldn't be, but it was awesome.”

Another comment referred to the level of design detail, “the intricately designed architecture absolutely fascinated me!” and “Riding through the tunnel…the attention to detail was everywhere. There was even a little water fall in the tunnel.”

These data suggest support for the overall activity being an engaging experience. “Overall it was enjoyable and did present a fun way to continue to increase my coordination/capabilities in second life.”

Technical Difficulties

There were two qualitative responses that were rated as having an overall bad experience due to technical difficulties:

“I never did find anything called ‘Space Ship Alpha’ which - as this is the very first task on the list - should have been absolutely dead easy to find. Since it wasn't it rather turned me off.

If I can't find the first item on the list then obviously what chance do I have of finding anything else."

The other interviewee who expressed an overall negative experience remarked,"…I could not get the telescope to work properly to view Saturn i could not see the black hole in the planetarium. i could not see any rocket and therefore did not ride it the pictures reflect these problems". The other eight responses indicated that although they had technical difficulties – "OK, that said, the only downside were some of the graphics took too long to load"– it did not disrupt their overall positive experience. Others even reported no difficulties at all with comments similar to, "Images rezzed very quickly."

It is important to note that most of the technical difficulties reported were either intermittent issues associated with Second Life or issues associated with the design of Huffman Prairie Omega – neither of which the research study could control. These are indicative of the issues often associated with pioneering technologies.

Goals

Most comments reinforced that the activity's goal, objectives, and tasks were clear. Eight out of ten reported that the VWQuest was very helpful both as an instructional roadmap as well as a reference tool. Additionally two interviewees reported that "they knew they were 'getting it'" which may be interpreted as receiving feedback. Only one person reported as not understood the activity purpose. The suspicion is that participant may not have read the introductory email or video and merely proceeded exploring, "I did not know I had to take any photos. Also I am not going to view external websites or youtube videos so please next time just put everything in to the original email or in to a single notecard." This individual reported low engagement on their survey yet still said in the interview that their experience was engaging. Overall, the high

percentage of interviewees that referred to ‘knowing what they had to do’ and ‘getting it’ as they progressed supports the notion that goal and feedback are closely related and are strong elements of engagement.

Loss of Time

All the 10 interviewees reported that they lost track of time to some degree. “I spent waaaaay too much time on Omega, but I would love to do more.”, “spent more time than I realized…” , “I actually went back the next day!”, “I spent so much time lookin’ around that I didn’t get any real work done that day.”, “I spent two to three hours on Huffman Prairie Omega.” and “…totally lost time of the clock…had work that was not getting done”.

Temporary Loss of Place

About half of the interviewees reported comments similar to, “The pods were unbelievable. I felt as though I was with Cpt. Kirk on the USS Enterprise.”, “ I had so much fun getting lost, I completely lost track of everything”, “felt like I was there” and “at times I just threw away the map and started exploring on my own…”

Challenge and Skill

Seven out of ten interviewed reported on their capability with comments such as, “easy but not boring”, “I think of me as a novice in SL but I had no trouble getting around”, “the resource map was an invaluable tool for me…used it the whole time to get around”, “easy and clear” and “good…just right…not everything worked but I knew it wasn’t me”.

Age

Lastly and interestingly, most interviewees self-reported their age and motivation for participating. The interviewee age range was between 36 and 58 with most of them reported being between 40 and 50. Nine out of ten self-reported they were educators, researchers, or

faculty that were curious about the kinds of research being done in Second Life. They participated for the experience and research design knowledge, not the money. This data supports the demographic data found across total participants. Moreover, this helps support the notion that may have been a more serious, willing audience which in turn may help support the quality of the data.

The themes from the interview data support the existence and contribution of flow dimensions, the demographic data distribution, and the challenges of working with pioneering technologies. A discussion of these and all the findings including theoretical and practical implications follows next.

CHAPTER FIVE: DISCUSSION

Chapter five discusses the research findings presented in Chapter four in light of prior research and literature characterized in Chapter two. It is divided into three major sections including discussions about (a) hypotheses findings, (b) exploratory analyses, and (c) conclusions. The first major section discusses results related to the two hypotheses. Discussion of hypothesis two is divided into three subsections: the correlation, rubric revisions, and mediating factors. The second major section is divided into four subsections. The first three are related to the exploratory research findings: the relationship between flow and performance, the relationship between flow factors and overall flow, and demographic differences. The fourth subsection included a discussion of the VWQuest as an instructional tool. The last major section summarizes conclusions and puts forth recommendations for future research.

Hypotheses Findings

This section discusses the results of two hypotheses which suggested a relationship between engagement and achievement, and between engagement and performance. Understanding the difference between these hypotheses is important, particularly since the analyses yielded different results. As mentioned, more than one assessment measure was employed to collect data. The knowledge check assessed achievement, which queried for fact and content retention. The photo packages were used to measure performance, which provided an open-ended opportunity for willingness and engagement to become evident by assessing many aspects including quality of work, creativity, and innovation as well as the ability to follow directions. Collectively, each participant had an opportunity to create a diverse portfolio of attainment by targeting more than more aspect of their abilities.

Hypothesis 1

Prior research offered evidence that more engaged students may recall and remember more while learning, and subsequently, increased learning would be reflected in their achievement scores. Therefore, the first research hypothesis proposed that higher levels of engagement would be positively correlated to higher levels of achievement, and lower levels of engagement would correlate to lower levels of achievement.

The analysis found no statistically significant relationship between a participant's perceived level of engagement and his or her achievement. There may be three possible explanations. Some participants reported a break in their flow experience, some participants reported purposely seeking out knowledge check answers, and the activity on occasion, had intermittent technical difficulties.

Prior research suggests that the flow experience may not be an overall state; that it may, in fact, be a state that individuals can experience off and on while in an activity (Pearce et al., 2005). Therefore, a break in flow might not be enough to explain the lack of relationship. Yet, purposely seeking out answers may help explain the finding. Although participants were requested to complete the knowledge check when they were finished exploring, many reported that if they didn't know an answer they left the knowledge check quiz, found the answer, and then returned to answer the question. The process of 'finding' the answer while in mid-assessment may in fact have skewed the results. While learning isn't limited to a particular time while exploring, seeking out the correct answer may have skewed the natural distribution of high-to-low achievers. Therefore, the interruption to the learning sequence may serve as one possible explanation for the lack of relationship between engagement and achievement.

Another explanation for the lack of relationship might be the fact that the Second Life land -- Huffman Prairie Omega -- was not owned by the researcher and thus posed a few challenges. Although efforts were fully coordinated with owners and while issues were rare, a few items were hard to consistently control like slow load times, missing content, or exposure to additional content during a participant's activity. This is consistent with prior research in which technology issues were found to have a significant impact on learner interest. As an example, the quality of multimedia assets is a key factor in the design and development of technology instruction (Jones, 1998). Also consistent with current literature on immersive environments, is that technology complexity is inherent of virtual worlds (Hayes, 2006; Helmer & Light, 2007).

Hypothesis 2

This section is divided into three subsections. First is a discussion of the suggested correlation between engagement and performance. Second is a discussion of the revisions of the photo package rubric. Last is a discussion of the analysis of mediating factors.

Engagement and Performance

The second research hypothesis suggested that more engaged students may participate more, which would then be reflected in their performance scores. Therefore, higher levels of engagement would be positively correlated to higher levels of performance and lower levels of engagement would correlate to lower levels of performance.

The findings indicated a statistically significant relationship between participants' perceived level of engagement and their performance level. The fact that the second hypothesis was supported suggests that having an engaging experience while learning in Second Life may in fact contribute to an individual's ability to perform better. Prior literature supports the suggested relationship. Quinn (2005) suggests that learning can be engaging and the learner is inclined to

perform better when instruction is goal-oriented, contextual, interesting, challenging and interactive – consistent with elements of the flow experience. Kiili (2005) suggests the rewards of flow are obvious, including a positive impact on creativity, critical thinking, learning and attitudes. The learning activity and instructional framework used in this study is consistent with the desired skills cited in existing literature, and further promotes the positive relationship found between engagement and performance.

Rubric Revisions

Having observed the wide range of participants' performance responses, this relationship is particularly interesting. Early in the research design, a performance rubric was developed to measure the range of photo packages expected. Photo packages were expected to closely match that of the directions: to take photos in-world, to take ten photos, email them to a designated address, have a subject on the email that reflects the contents of the photo, and optionally add additional text explaining the photo.

The first rubric was structured to assess participants' performance on a per-photo basis instead of as a whole package. Inter-rater reliability was achieved, and during the pilot test the rubric served well. That is, all pilot participants, while varying in performance, scored well within the measures of the rubric. During the actual experiment however, a completely unexpected range of results was received. First, though participants were asked to locate and take photos of ten events, responses ranged from four to 74 photos per individual. Some were very proud of all the photos they had taken of all the additional things they had experienced. Second, some took photos with other avatars in-world. Third, while some emailed their photos as directed, others saved them locally to their computer, compressed them, and forwarded one compressed file. Still others created videos and other multimedia presentations using their photos

and forwarded an attachment file. One participant even created a video from all the photos and uploaded it to a public video-presentation web site. That participant emailed only a link to the public site. Fourth, while the directions indicated the activity should take approximately an hour, participants reported spending hours and days at the location. Many reported staying much longer than they had planned and returning on their own time more than once. Last, although the activity was designed using an extrinsically motivating incentive – a dollar amount for participation – it became apparent that many participants became intrinsically motivated, as it was evident in their creative output, repeated visits, and off-hour participation. Being intrinsically motivated is additionally interesting because the change from extrinsic to intrinsic focus supports the autotelic experience user's often find as a result of flow (Csikszentmihalyi, 1990, 1997). The autotelic experience, as it pertains to this study, is discussed in further detail in the exploratory research findings section.

Because of the unexpected range of responses, it quickly became apparent that the original rubric was not designed to capture the range of performances. A first consideration was to discard all records that did not follow directions. However, two issues dismissed that option. First, if all non-conforming records were removed, less than 25% of the records remained. This would leave a less than sufficient sample size. More importantly however, though following the 'letter of the law' was different from following the 'spirit of the law', the spirit of the law did uncover new performance discoveries which needed to be understood.

As a result, the rubric underwent four revisions before it accurately measured the varied responses as well as achieved inter-rater reliability among photo package evaluators. The fourth and final rubric (refer to Appendix C) assessed each participant's photo package as a whole, and included measures of quality, adherence, and creativity. Additionally, it was determined that

extra credit should be available for those who took the time and effort to add additional photos or comments, as well as extra credit for innovative packaging. Updating the photo package rubric was a lengthy, iterative process so that all aspects of performance that should be identified and taken into account were, in fact, assessed. The process of re-examining the elements and perspectives of the data, as well as the evolution of the rubric itself, turned out to be one of the more powerful, albeit unexpected, findings of this study.

The effect of quality, time, and effort on the performance part of the activity was completely unexpected and indeed a new finding for this study. Current literature suggests that a good instructional design for self-directed learning is one in which learners have latitude with free thinking and acting, free navigation, and flexible timing (Konradt et al., 2003). Ghani (1995) found increased creativity contributed to increased learning as a result of flow. Collectively this is believed to support and significantly further existing literature on the unlimited potential of learners in creative and innovative student-centered learning activities.

Mediating Factors

Although engagement using flow constructs had been examined, there remained a significant amount of unexplained variance in the performance data. It seemed possible that other factors had contributed. For example, it seemed plausible that a participant's ability to become engaged was dependent on their skill level. The analysis revealed that engagement was a mediator between skill level and performance. Technology skill level as a precursor to engagement is logical and is supported in existing flow literature (Venkatesh & Davis, 1996; Finneran & Zhang, 2003; Pearce, Ainley & Howard, 2005; Chen, 2006). The interview and electronic correspondence data supports this relationship as well, suggesting that in an immersive

environment, adequate skill level is a key requirement for a learner to be able to become engaged sufficiently enough to perform better.

Summary

Hypothesis two examined the relationship between engagement and performance. These findings – the correlation, the need for multiple iterative revisions of the assessment instrument, and mediating factors – collectively suggest that open-ended and creative opportunities to perform may in fact yield levels of creativity, engagement, and innovation available in immersive platforms such as virtual worlds, that are unexpected and far beyond that of traditional instructional settings.

Both measures of evaluation continue to be critical in assessing learning comprehensively. While engagement did not correlate to achievement and did correlate to increased performance, both methods have value, depending on the desired learning outcomes, and focus on different learning domains. Standardized, multiple-choice testing may be most appropriate when probing the cognitive domain for factual material. Open-ended, portfolio assessments may be most appropriate when seeking creativity, innovation, and other less-direct measures of learning attainment. In practice, a combination of assessment methods, including others not mentioned, may provide the most comprehensive portfolio. In the end, the desired learning outcomes are the primary driver when selecting the most effective tool or tools.

Exploratory Findings

This section is divided into four parts. First is a discussion of flow dimensions and their relationship with performance. The second section is a discussion of flow factors and their relationship to overall flow (engagement). The third section is a discussion of the demographic

findings as a result of the exploratory analyses. Last are comments about the transference in-world and effectiveness of the VWQuest.

Flow Dimensions and Performance

It was observed that some flow dimensions may contribute more significantly to learners' ability to perform better than others. Because performance was found to be positively correlated to engagement, an examination of the specific flow dimensions that contributed most significantly to explaining overall performance was conducted. Three exploratory research questions were explored. The first focused on the relationship between the flow dimensions and performance. The second considered flow factors and their relationship to overall engagement. The third analysis examined the relationship between participants' age, culture, and educational affiliation.

The analysis identified the flow dimensions of *control* and *loss of time* as statistically significant contributors. Experiencing a temporary loss of time is consistent with prior findings. In a prior study utilizing a technology environment, loss of time was found to support overall user enjoyment (Chen, Wigand & Nilan, 2000). Interview data for this study also supports loss of time as a key dimension because all the interviewees reported losing track of time, most of them happily, and at times to a considerable degree.

Prior literature also supports the importance of control. Control was found to have a positive impact of the user's learning experience. In one study, students reported being more engaged and having a more positive mood when experiencing high versus low control over learning situations (Shernoff et al., 2003). Mathwick and Rigdon (2004), while studying flow in a web environment, found control, among other factors, to be important in contributing to the

quality of a user's experience. Ghani and Deshpande (1994) also reported that being in control contributed to the experience of flow, and subsequently overall enjoyment.

The loss of time and sense of control as significant findings make a contribution to the existing literature on flow, and to educational audiences. These dimensions can help guide instructors to design more effective, immersive learning environments. If designers focus on empowering the learner with autonomous and independent choices as they create instruction, there may be more opportunity for learners to perform better. Additionally, if instruction in immersive settings can be created without time constraints, there may be a greater opportunity for enhanced performance. This is consistent with current learning models as most are designed for asynchronous use (Smith et al., 2008).

Flow Factors and Engagement

As an exploratory inquiry, it was suspected that some flow elements may contribute more significantly to learners' overall engagement state. The flow factors contributing most significantly to explaining variance in overall flow were examined. Flow factors *clear goals*, *immediate feedback*, and *autotelic*, contributed most to the overall engagement experience. The relationship between *clear goals* and *immediate feedback* becomes important because the learning activity had both an independent, student-centered design, and because the technology was a complex and potentially challenging one. Because the two flow factors loaded together, their relationship suggested that if participants understood their goal, they could tell how well they were doing. Conversely, if participants didn't know their goal, they couldn't tell how well they were doing.

The strong relationship between *clear goals* and *immediate feedback* supports findings in prior research on flow. Chen (2006) used a web environment and created an independent, self-

paced activity. His study's findings emphasized the importance of immediate feedback and clear goals, indicating the importance of clear and immediate feedback in a technology networked environment.

The flow factor *autotelic*, representing a personally-driven, positive experience, loaded the next highest as a result of the factor analysis. Chen (2000) found the autotelic experience to have positive affect on the user's experience and on learning. Skadberg and Kimmel (2004) reported that enjoyment was an element that contributed to increased learning. Enjoyment is closely related to an autotelic experience because an individual desires to participate for his or her own sake. Increased enjoyment supports existing literature in that the autotelic experience may contribute to more increased learning and a more pleasurable learning experience.

Demographics

The demographics of the participants proved to be particularly interesting, especially with regard to Second Life affiliation and age.

The invitation to participate in this study was distributed to educational communities. The responses indicated that a large percentage of volunteers delivered instruction or taught in Second Life in some capacity. Demographic data indicated that 30% directly reported being instructors; another 30% reported being neither students nor administrators. Qualitative data supported having a large instructor sample. First, email correspondence indicated that professors and teachers had participated to 'take ideas forward' and 'checkout the instructional design' and 'learn about assessments'. Second, the median age of participants ranged from 40-49 with most participants in the age range of 50-59. Third, seven out of ten interviewed self-reported they were or had been teaching in Second Life. Finally, serving as evidence that the sample was not predominantly students, the following is one response from a student:

> I know that a lot of students don't necessarily like using SL, it gets to be a hassle to juggle in with the other two programs we use for homework….also they might possibly be studying. Also, a lot of students probably heard that $20 payment from completing this activity and signed up in excitement then got lazy. Most of the students in this age range don't want to work for money, just want it handed to them, even if it only requires a simple (and in my opinion) fun activity. By all means I don't think this activity was too hard at all. The instructions were clearly stated and the GPS system made it very easy.

Although participants self-reported as mature, research-focused educators, there is no indication from the data or analysis that these findings are limited to an older audience.

Collectively, the demographic results serve as evidence that the sample majority may have been a more serious, perhaps research-oriented, collection of teachers, faculty, and instructors. These findings are consistent with Ondrejka's (2007) suggestion that educators are the real trailblazers in virtual environments.

VWQuest Tool

Although not formally part of the exploratory research findings, a few comments about the VWQuest are in order. As mentioned the VWQuest is an author-created tool, and is modeled after an empirically-tested, web-based, instructional tool, the WebQuest. It was expected that the tool could successfully be transferred from a 2D web setting to a 3D immersive setting without losing educational value. While there were differences because of the platform change, the instructional purpose was believed to have transferred in-world successfully.

First, there were some specific functionality differences between the two tools. The VWQuest was inherently more complex to build, to deploy and to use than the WebQuest. To a learner, the buttons in a WebQuest would be a simple click. The VWQuest's buttons required

additional skill specific to manipulating objects and navigating teleports. Additionally, there occasionally was lag – a period of a few second's wait – in order for objects or buttons to appear. The disparity was due to maturity differences between the web and virtual worlds. Despite complexity differences, the inherent purpose of the VWQuest tool transferred in-world and was believed to have served well.

There were many important educational aspects that remained consistent between the two quests. Consistent with the WebQuest, the VWQuest was inquiry-oriented and learner-centered. Participants were autonomous while navigating the activity. They could choose to progress sequentially or revisit any part of the activity at their discretion. The VWQuest had no time constraints. Though participants were told the activity was expected to take approximately an hour, they were free to spend as much time exploring as they wished. And similarly to the WebQuest, the VWQuest was able to incorporate other multimedia components seamlessly. The knowledge check quiz was scripted in-world, and test scores were calculated automatically and emailed to a given address. Videos were embedded and launched with a few clicks without leaving the activity.

The creation and transference of the WebQuest into a 3D immersive environment did preserve the tool's inherent purpose. For this reason, the VWQuest is believed to be a viable instructional tool to facilitate learning in an immersive environment. However and more importantly, it is the instructional strategy that the tool affords and not the tool itself, that creates the learning.

Conclusions

Results of the explained analyses have practical significance to technologists, researchers, designers and educators. For those interested in understanding appropriate and effective

instruction in complex, immersive environments, this study brings together new important implications.

For educators and trainers, outcomes associated with potential engagement and performance have great value towards implementation, delivery, and integration of well-designed and delivered instructional content. Incorporating the results of this study into a lesson, course, or curriculum within an immersive environment, has the potential for yielding greater student interest, engagement, and capacity for learning.

For instructional designers, understanding both design issues associated with complex platforms like Second Life and the factors of flow can contribute positively to the instructional design process. By designing content with the most significant engagement components in mind, instructional modules have the potential for becoming powerful instructional tools. By understanding these environments, designers can create the most effective and efficient instructional designs.

For educators, instructional designers, technology engineers and researchers, the unexpected findings that were discovered, may have significance. As mentioned, the range in photo package performance varied greatly. While the majority of participants were creative, innovative, and clearly engaged – positive outcomes – they also did not adhere completely to the directions provided in the activity. The activity was unbounded in time and effort, and the results reflected this. If a learning activity requires strict adherence to its directions, it must made clear. If there will be consequences for not following the letter of the law, it must be made clear. And if imagination and originality will be credited, it must be made clear. While the focus of this study did not intent to capture those additional measures, the unexpected outcome that resulted was clearly positive and impacting. Specific to this type of learning construct, and with great

potential to immersive learning environments, unbounded performance capabilities can become evident – if those capabilities are desired. If not, clarity, performance boundaries, and time constraints, including consequences, need to be made clear.

The technology examined in this study – an immersive 3D virtual environment – is clearly both a powerful vehicle for delivering instruction (Bell, 2008; Robbins, 2007; Boland, 2009) and a topic of much interest (Wyld, 2008; AETC, 2008). Additionally, the momentum for educators desiring to understand this technology is compelling (KZERO, 2008; Levy, 2008). The impact that immersive instructional design can have on our 21st century learner is critical. Dede (2009) believes that the information technologies used by children during their formative years influence their learning strengths and preferences. It is because of the suggested importance, that this study took a prior, empirically-tested instructional design, and married it with a grounded theoretical framework. Then it tested for the transfer and experience of learning in this new platform.

Despite the perceived focus on the technology medium, a word of caution is in order. On occasion, curious new mediums can be problematic for effective instruction. It has been found in one study, that when instructors are creating e-learning materials, they are often tempted to incorporate interactive multimedia objects for affect (Pearce et. al., 2005). The motive may be to grab the attention of the learners, or to entertain or motivate learners so that content is perceived as more attractive. This may be a concern for even well-designed content offering pedagogical value, because the technology may not offer additional value to the learner, but it also might hinder the student's learning (Pearce et. al., 2005). At the core of the argument for technology use in instruction is the literacy that the technology affords, not the technology itself (Robbins,

2007). Therefore, it is important to remember that it was not the technology alone – in this study or in any study—that created an effective and engaging learning opportunity.

The results of this research are limited to the virtual world of Second Life and to measuring engagement using factors defined by Flow theory. The generalization of this study is limited to similar virtual world settings, with similar audience scope, measures, and activity constructs. Additionally, while a representative sample was sought for the educational member resources, the true total education population of Second Life is not known.

Virtual worlds are still considered a primitive technology. Despite a participant's skill level or hardware availability, intermittent Second Life performance issues may have surfaced affecting a participant's ability to succeed and/or engage. Virtual worlds are still primitive platforms, and not transparent in the instructional process. Technological advances over time as well as future research are needed before instructional designs will become truly transparent and most effective. Because of these limitations, caution must be taken prior to generalization of any of these findings.

Further research is needed to help identify additional relationships between instructional content, engagement, and potential learning attainment utilizing these attractive yet challenging platforms. This research was designed purposefully to be an independent activity for logistical reasons. In addition, the platform strongly supported independent exploration; yet further research is needed in the area of collaborative designs. Research on collaborative environments in which activities are participatory and interaction is required, and is expected to support Flow theory as well.

Research examining other instructional frameworks such as collaborative or group based activities is needed because current literature is limited in areas of 3D immersive environments

and collaboration. Further research is needed in areas of social presence and other measures of cognitive attainment as it would help support or refute current findings within this study. Additionally, further research is needed to explore how generalizable this study's findings are into other virtual worlds as effective learning environments. And, as these platforms mature and continue to incorporate additional functionality, future research is needed to determine the importance of more robust components, interoperability, and availability that immersive platforms may hold.

Virtual worlds, such as Second Life, are redefining the idea of "being there". These global, 3D immersive environments attract people from all over the world to interact with one another in real-time, as well as to explore, manipulate, and visualize. As such, virtual worlds have been labeled as a transformative development that will perhaps change the way we use the Internet to learn over the next decade (Wyld, 2008).

General William Looney, USAF, has championed the US Air Force's efforts in virtual world exploration for training and education. His message which can be extended to our entire Department of Defense is one of technological understanding and readiness, coupled with a thorough understanding of effective training and education in this new domain. To maintain our position as a respected and feared military in times of accelerating technological change, we need to be able to recruit the best and brightest young Americans – young men and women who have been living in a digital world their entire lives and are better prepared than previous generations to learn in this environment (AETC, 2008).

This empirical study examined a topic of much interest and visibility. The findings of the study offer a greater understanding of the elements that create efficiencies and enhance education and training. And though the immersive technology was found to be a powerful and engaging

medium, the quality of the instructional content and the design remain the primary factors in facilitating the most effective learning.

APPENDIX A: PROJECT PLAN

Project Plan

A Second Life (SL) learning activity supporting the examination of
the relationship between engagement and achievement.

Summary

The research exercise consists of volunteers, a pre-activity questionnaire, a learning activity, and a post-activity questionnaire. A small percentage of volunteers will take part in an interview following the activity. A $20 stipend will be offered for volunteer time.

The **volunteers** will be taken from a global educational online resource. They will be required to be familiar with basic SL capabilities (hardware connectivity and navigational skills).

The **pre-activity questionnaire** (volunteer registration information) will query their SL skill level, collect demographics, query their experience/exposure to the SL Island, and offer sign-up times. This query will also direct them to refresher videos on teleporting, taking snapshots, watching videos in-world that they can review to if necessary. The questionnaire should take approximately 5 minutes. The profile questionnaire can be found below as well as the Consent Form that precedes any questions.

The volunteers (learners) will be scheduled to begin at 1/2 hour intervals on coordinated days. This is to reduce the risk of overwhelming the island's maximum resident capability, intruding on the owners of the island, and having learners interfere with each other.

The **learning activity** is a VWQuest, taken from the 2D WebQuest concept, and designed as a self-directed, exploratory, and resource-ready, activity defined with a goal, specific objectives and tasks to follow. The activity should take about ½ hour to complete, but learners can spend longer exploring if they choose. VWQuest details are described below.

The **post-activity questionnaire** will be available via a web link immediately after the activity. It is a 36-question, likert-scale, subjective instrument inquiring about the learners' level of immersion and engagement while participating in the activity. The questions target each of the nine dimensions of Flow four times. Details on Flow theory is described in the main research paper.

The volunteers will be asked at the end of their participation if they are interested in participating in a brief **interview**. A small sample (5% of the volunteers), if attainable, will be interviewed for qualitative data support. The interview should take approximately 10 minutes. Interview questions are detailed below.

The volunteers will be offered $20 for their participation, and made available upon completion of the whole activity session. The **incentive** will be offered in either Lindens or via Paypal.

Following the collection of all of the data types (profile questionnaire, snapshot submissions, knowledge check, engagement questionnaire, and interviews) the data will be transcribed, sorted, and analyzed.

Solicitation for Participants

The following email will be send to the vw-research@utlists.utexas.edu; Slrl@list.academ-x.com; educators@lists.secondlife.com; alliancesecondlife@googlegroups.com listserv email distribution lists. It will be sent from the email address: UCF.SL.Research@gmail.com

$ Invitation to Participate in Research Study $

We are seeking participants for a study conducted by the University of Central Florida researchers. We are examining the experiences of individuals in *Second Life* (SL) using measurements of engagement and achievement.

Participation will involve 2 online surveys and a SL in-world learning activity. To participate, you must have SL loaded on your computer, basic SL navigational skills, know how to take snapshots, navigate your inventory and teleport. The 1st survey takes about 5 minutes, the activity about 30-45 minutes, and the 2nd survey about 15 minutes. Your total commitment may take about an hour, depending on your level of interest and engagement.

For participating you will receive US $20. You may elect to receive payment in Linden dollars (L$) or via Paypal.

You must be 18 years of age or older to participate.

If you are interested, please go to the following URL (http://www.surveygizmo.com/s/76381/ucf-sl-research-study) to register and sign up for a time. Sign up will be open until _____.

Thank you for considering this invitation!

Contact Information:

UCF Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, FL 32826
407.823.3778

Karen Cooper, Doctoral Candidate
University of Central Florida
UCF.SL.Research@gmail.com

Dr. Atsusi Hirumi
Advisor, Instructional Technology
University of Central Florida
Hirumi@mail.ucf.edu

Consent Form

Engagement & Achievement in Second Life
Karen Cooper, Doctoral Candidate
University of Central Florida

Dr. Atsusi Hirumi
Advisor, Instructional Technology
University of Central Florida
Hirumi@mail.ucf.edu

Dear Potential Participant:

You are being asked to participate in a research project exploring the relationship between engagement and achievement in Second Life. All participants must be at least 18 years old. Taking part in this research study will not cost you anything. Your participation in this project involves completing the enclosed survey which should take approximately 5 minutes to complete, and then participate in a learning activity in Second Life, followed by a second survey. Additionally, you may be contacted and offered a separate opportunity to participate in a short interview about your experience. Interviews are planned to be either in-world, by email or by phone.

The surveys contain items asking demographic questions and your experience in Second Life as a result of the activity. Information gathered from the survey will be sent to the researcher's database. Once all data has been collected and analyzed, the data will be destroyed.

Should you decide to participate in this study, your identity will remain confidential. Data will be reported in an aggregate form. The information collected is confidential, that is no one knows what information is from which survey respondent. To assure anonymity of responses, you will not provide your name or other identifying information on the survey other than your avatar name if you would like to receive payment in Lindens or your email address if you would like to receive payment via PayPal.

Your participation in this study is completely voluntary. You do not have to answer any question that you do not wish to answer. Refusal to participate will involve no penalty. There are no risks expected from being in this research study.

While participation in this research will provide no direct benefit to you, the knowledge gained will benefit all educators who are interested in knowing the various elements of engagement and instructional strategies using Second Life as an educational tool.

By completing the enclosed survey, you are consenting to be a research participant. If you have any questions about this study, you may contact Karen Cooper at (407) 850-9572 or at UCF.SL.Research@gmail.com.

Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board. Questions or concerns about research participants' rights may be directed to the UCF IRB office, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246, or by campus mail 32816-0150. The hours of operation are 8:00 am until 5:00 pm, Monday through Friday except on University of Central Florida official holidays. The telephone numbers are (407) 882-2276 and (407) 823-2901.

Thank you in advance for your participation.

Registration Questionnaire

Welcome and thank you for expressing interest in participating in this Second Life (SL) research study. The research will support the University of Central Florida (UCF) dissertation research.

This survey is confidential. You must be at least age 18 years old complete the survey. If you are an educator, a student or researcher affiliated with education who has been inside Second Life, you are invited to complete this survey. Once survey data has been recorded, all data will be destroyed.

Directions: Please DO NOT write your real name on this survey. Read each one carefully and answer each question as best as you can.

Consent

1. My participation is voluntary and I understand that I may discontinue the survey at any time. I also understand my answers will be kept completely confidential and no one at Linden Lab will know if I participated or how I responded. No personally identifying data will be collected or stored, and results will only be used as an aggregate. (I agree to Participate I do not wish to Participate)
2. Additionally, you may be contacted and offered a separate opportunity to participate in a short interview about your experience. Please indicate if you agree to be contacted. (Agree Do Not Agree).
3. I verify that I am 18 years of age or older. (Agree No Not Agree)

Demographic Information

1. Avatar name: _____
2. Email address: _____
3. Real life gender (Male Female Prefer Not to Answer)
4. Real life age (0-17, 18-29, 30-39, 40-49, 50-59, 60+, Prefer Not to Answer)
5. Ethnicity (White Black Hispanic Asian Multiracial Other Prefer Not to Answer)
6. Country (Country Pulldown menu)
7. Affiliation with Education (select closest choice)(Instructor Administrator Student Researcher Other)

Second Life Skills

1. Rate your overall Second Life (SL) skill level: (Newbie Novice Skilled Proficient Expert)
2. Rate your skill level in using SL notecards: (Newbie Novice Skilled Proficient Expert)
3. Rate your skill level in taking SL snapshots: (Newbie Novice Skilled Proficient Expert)
4. Rate your skill level at watching videos in-world: (Newbie Novice Skilled Proficient Expert)
5. Rate your skill level at navigation (teleporting, walking, flying): (Newbie Novice Skilled Proficient Expert)
6. Rate your skill level with media controls: (Newbie Novice Skilled Proficient Expert)
7. Rate your skill level with camera controls: (Newbie Novice Skilled Proficient Expert)

Activity Signup

1. Week preference (Week1 Week2 Week3 Anytime)
2. Time preference (SLT) – (Morning (anytime after 7am) Afternoon (anytime after 12 noon) Evening (anytime after 5pm)
3. Payment preference (Lindens PayPal)

The following are Second Life refresher links. Please review them and make sure you are comfortable with basic SL navigational skills prior to participating in the activity.

- Teleporting http://www.youtube.com/watch?v=HL5aqEERlrI
- Taking Snapshots http://www.youtube.com/watch?v=prno9o9n2ic
- Managing your Inventory http://www.youtube.com/watch?v=AULw9Oa_1Bw

You will receive an email with a date and a time to participate. Just prior to your timeslot, you will receive an email on how to begin.

Registration Questionnaire Communiqué

The following will be sent as an email to the participant. Attached will be two graphics that assist with Media Settings.

Thank you again for participating.
The following timeslot has been assigned:
Day: _____
Time: ____

If you cannot make it at that time and need to reschedule, please reply to this email requesting a new date/time.
You are also scheduled to receive your payment via:
Payment:_____.

Reminder about Second Life basic tutorials:
Teleporting http://www.youtube.com/watch?v=HL5aqEERlrI
Taking Snapshots http://www.youtube.com/watch?v=prno9o9n2ic
Managing your Inventory http://www.youtube.com/watch?v=AULw9Oa_1Bw

Just prior to your timeslot, your will receive an email containing a slurl, a map, and a brief introduction. Log into Second Life and TP to the activity location.

Thank you and we look forward to seeing you at your scheduled time!

VWQuest Activity

Taken from the design of 2D WebQuests, this activity is a self-directed, exploratory, and resource-ready, activity defined with a goal, specific objectives and tasks to follow. This VWQuest will follow the same format as a WebQuest having an Introduction, Task, Process, Resources, Evaluation, and Conclusion section. Some quests request a product at the end of the activity; some contain knowledge checks. This VWQuest will have both.

The VWQuest is set in the form of role play. The activity begins with the volunteer playing the role of a student at a traditional school. The school principal greets him, refers a conversation he had with the provost of a technology rich university, and mentions an invitation their school received to visit the technology campus. The principal asks the volunteer to investigate for him.

The volunteer (learner) will be asked to explore the campus, find specific items and locations, take snapshots of their exploration, experience the interactivities, and read posted content. They will be invited to stay as long as they wish. The island contains several buildings (Learning Repository, Visitor Center, Power Plant, Hologram Planetarium) to explore; numerous interactive objects (space rocket, elevators, space station, monorail, sky-lift cable car and telescope); and many billboards and posters.

The goal will be to gather as much information on the island as they can, and collect as many examples (snapshots) as they can. They will accomplish this knowledge of what's on the island, what a visitor can do and see, and what activities are available by exploring, touching, riding, and reading.

The learner will be asked to take snapshots to show the principal what the university has done.

After exploring, the learner will participate in a brief (10 question) knowledge check about their experience to see if they feel confident in returning to their school and reporting on what they learned.

KIOSK Display**:**

Welcome to the Huffman Prairie Omega Virtual World Quest !
Start by clicking here - Keep 'VWQuest HUD' and 'Huffman Prairie Omega Map'.
Wear HUD (see help below) and begin with the Introduction button.
Enjoy your Quest !

Introduction:

The activity begins with the volunteer arriving at Huffman Prairie Omega (HPO) an interactive learning island built in real life by a leading higher education institution. The volunteer will receive a PDA which will serve as a guide for overall task at HPO. The first button, the Introduction button, will launch a 2 minute video which explains their task. The video and/or audio sets the role play in which the volunteer learns that their boss, the Principal, Mr. Cahn Venshunal of Old School has accepted an invitation by the Provost, Dr. Innovate of Cyber University to visit the virtual learning environment they have built. During the meeting, the volunteer will receive a map of HPO.

The HUD pulldown display:

Click Go to page to watch a short video.
Then close your browser and proceed to Tasks.
The Task Button has a checklist of specific things to find.

The Video:

(The video begins with a man sitting at a desk facing you talking. His name plate says "Mr. Cahn Venshunal - Principal – Old School")(http://www.youtube.com/watch?v=FNDDiSBoZ4E)
"Welcome, welcome, I have been expecting you. I have a little business trip for you. As you know, we here at Old School have always prided ourselves on the long history with tradition.

"Nonetheless, last week, I met the Provost of Cyber University, Dr. Innovate… nice man with wacky ideas in my opinion. He explained to me his new instructional area on an island called Huffman Prairie Omega. He has invited us to spend time there, checking it out and seeing what he and his faculty

instructors have built. And well as you can see, I am too busy pushing papers to go, so I would like you to go for me. Check out Huffman Prairie Omega, take notes and pictures, and return with information about the island. Your goal is to gather as much information on the island as you can, and collect as many examples (snapshots) as you can.

"So we can learn, Dr. Innovate has invited us to walk and fly around, try out transportation vehicles they have designed and built – he mentioned a monorail, space ship, and teleporter when we spoke. Dr. Innovate also spoke of posters and billboards that contain interesting information. He welcomed us to take pictures so I would like you to take your camera so you can take snapshots of what you see and experience."

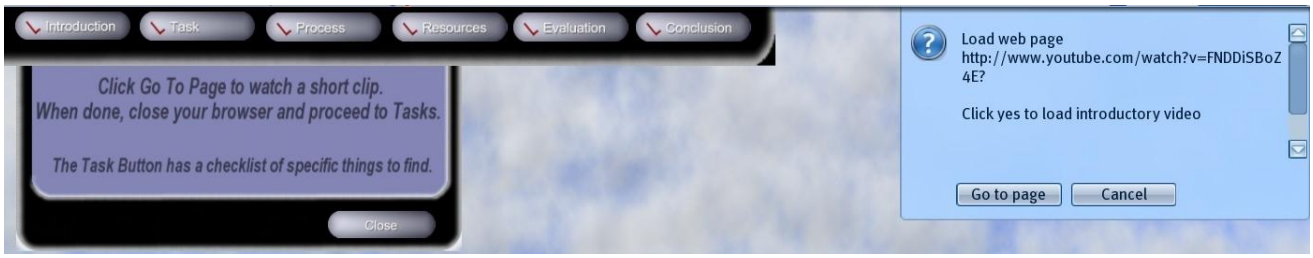
"I see you have your PDA as a navigation guide. Proceed through the buttons and you should have all your directions and details."

"At the end of your trip, before you leave, there will be a little knowledge check to see what you've learned."

"Dr. Innovate did say that Cyber University is working on three islands right now. Our focus is on Huffman Prairie Omega (HPO) and not Huffman Prairie or MyBase."

"As you begin, the Task Button on your PDA has your next instructions and details."

"Good luck and Have fun!"



Task:

The following is displayed on the PDA screen. At the top of the pulldown window it should say:

Your Goal is to investigate the Second Life island of Huffman Prairie to become knowledgeable about what has been built so that you can report back to Mr. Cahn Venshunal on what Dr. Innovate is developing.

At each of the following activities,
Take a Snapshot

for Mr. Cahn Venshunal. Send via email to

HPOfile@gmail.com

The middle of the pulldown is a 3-tabbed graphic:

Experience:
- ☑ Board Space Ship Alpha; ride it to the end
- ☑ Hop on board the MagLev monorail
- ☑ Ride the SkyLift to the other side of HPO

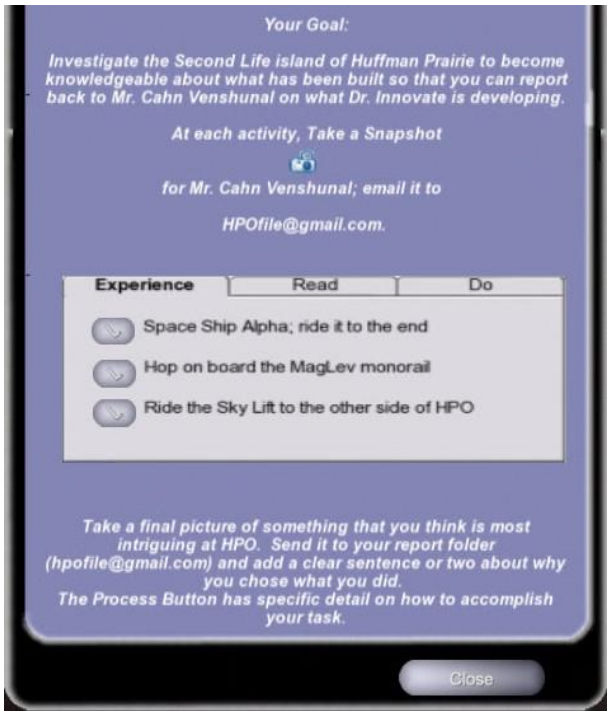
Read:
- ☑ The HPO Ann Rand Space Station Map
- ☑ The Prospect Mountain Map
- ☑ About the staff members; grab a business card

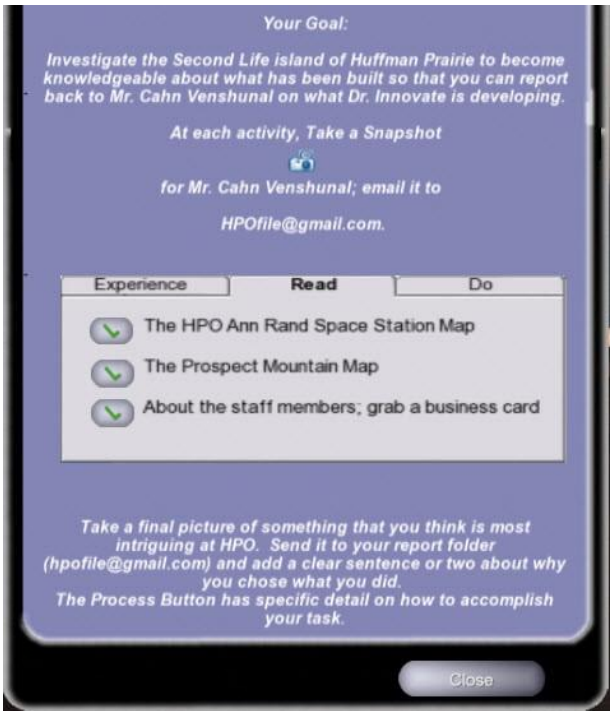
Do:
- ☑ Join the Global Learning Forum
- ☑ Find Saturn on the telescope
- ☑ Peek at the Worm Hole display at the Hologram Planetarium

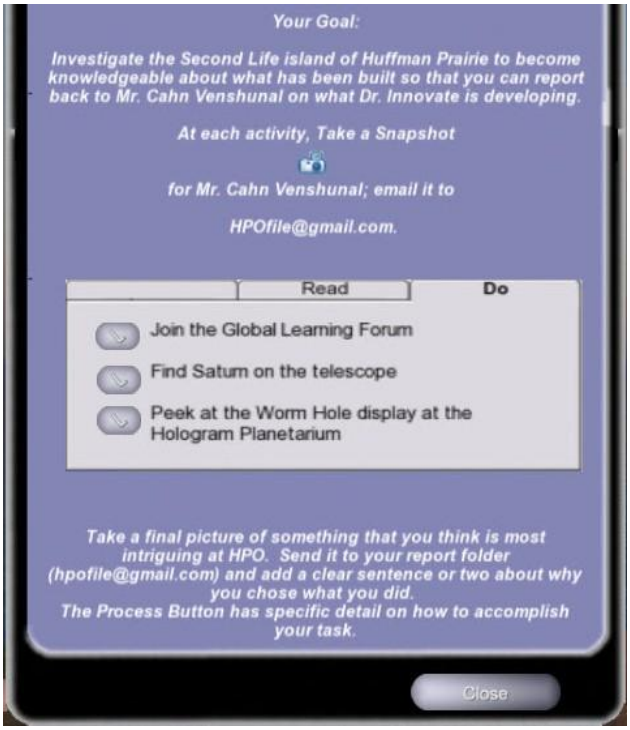
At the bottom of the pulldown, below the 3-tabbed window, it should say:

Take a final picture of something that you think is most intriguing at HPO. Send it to your report folder (hpofile@gmail.com) and add a clear sentence or two about why you chose what you did.

The Process Button has specific detail on how to accomplish your task.







Process:

The Process button displays a checklist of things for the learner to find.

- **Explore** the island by walking, flying, teleporting and reading. Observe the posters and checkout the buildings. The buildings to explore include the Visitor Center, Prospect Mountain, Ayn Rand Space Station, MagLev Monorail Exchange, and the Hologram Planetarium.
- **Experience** as many transportation vehicles and exploratory equipment as you can. The transportation vehicles include elevators, a teleporter, Space Rocket, Maglev Monorail, and Skylift. The exploratory equipment includes a telescope and a Hologram Viewer.
- **Document** what you find by taking snapshots of what you see and do. The snapshots will help inform Mr. Cahn Venshunal and he will be able to use later for a presentation to the rest of Old School.

***

At each of the activities, Take a Snapshot
for Mr. Cahn Venshunal.

Send to **HPOfile@gmail.com**

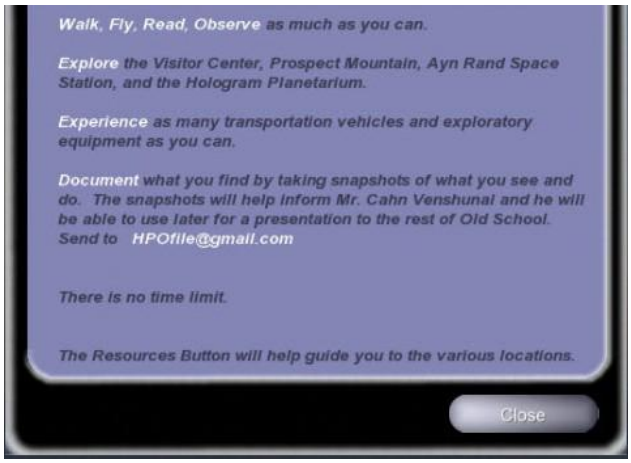
***

Explore as many of these things as you can. There is no time limit.

***

Remember that Huffman Prairie and MyBase islands are nearby but are not the focus of this activity. The information you are gathering for Mr. Cahn Venshunal is only about Huffman Prairie Omega.

The Resources Button will help guide you to the various locations.



Resources:

The Resources button displays a map with the following locations marked. The map has hyperlinks embedded in it for the learner to use to teleport to different locations.

Places:

1. Visitor Center (Huffman Prairie Omega 219, 105, 30)
2. Prospect Mountain (Huffman Prairie Omega 81, 163, 61)
3. Ayn Rand Space Station (Huffman Prairie Omega 76, 69, 955)
4. MagLev Transporter (Huffman Prairie Omega 244, 121, 28)
5. Rocket Ship (Huffman Prairie Omega 53, 73, 25)
6. Global Learning Forum (Huffman Prairie Omega 209, 76, 30)
7. Star Gazer Deluxe Refractor Telescope (Huffman Prairie Omega 90, 74, 67)
8. Sky Lift (Huffman Prairie Omega 120, 135, 61)
9. Hologram Planetarium (Huffman Prairie Omega 120,130,950)
10. Elevator (one on many) (Huffman Prairie Omega 142,191,50)

When you are done, click on the Evaluation button.

Evaluation:

The following is a sample of Knowledge Check questions. The volunteer were requested to complete the knowledge check once they begin it, and not to break out and find answers. Additionally, the volunteers are not told ahead of time that they will have a knowledge check prior to the activity. This helps promote the natural learning process that happens from experiencing.

1. How are guests referred to at the Ayn Rand Space Station?
   - Space Questers
   - Cyber Learners
   - **Imagineers**
   - Space Guests

2. Who is Ayn Rand?
   - **A Russian born American novelist, known for developing a philosophical system called Objectivism**
   - Great American Architect, his work includes offices, churches, schools, and museums
   - First female General of the Air Force
   - First female aviator making significant contributions to military aviation research

3. The Space Station Transport lift takes you to which of the following places?
   - **Ayn Rand Space Station**
   - **Prospect Mountain**
   - MagLev Monorail Exchange
   - Visitor Center

4. Which of the following is not in Prospect Mountain?
   - **Hydro Power Plant Repository**
   - Teleport access to Ayn Rand Station
   - Simulated Instructional Avatar Repository
   - Instructional Learning Objects Repository

5. At the Ayn Rand Space Station, the Ayn Rand Space Station Map shows ___ view of the station.
   - A photographic
   - **An aerial**
   - A black and white
   - A habitrail

6. Which image depicts the person highlighted by the Space Station?
   - Jim Huffman
   - Spinoza Quinell
   - Prairie Greeter
   - **Ayn Rand**

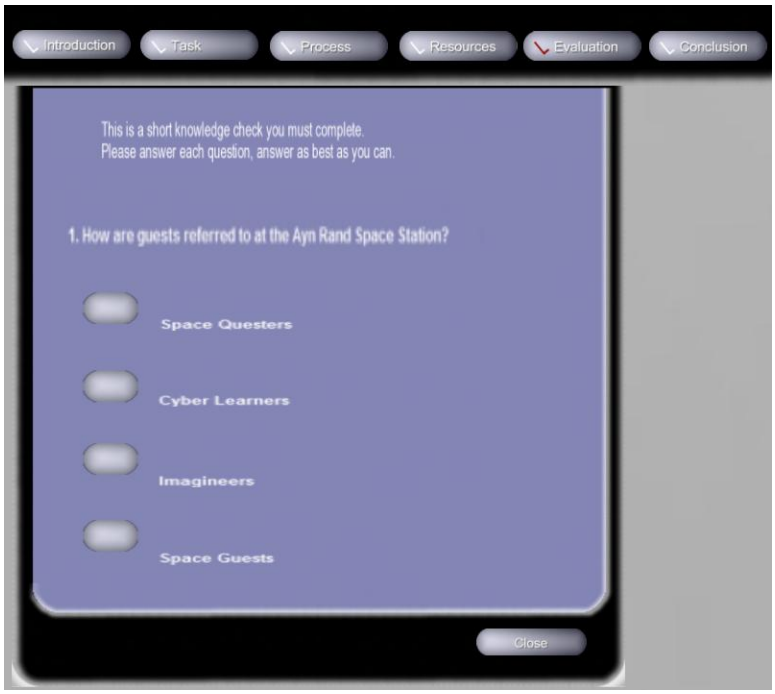
7. How long does the HPML wait once it arrives at a station?
   - 15 seconds
   - **20 seconds**
   - 25 seconds
   - 30 seconds

8. During the space rocket ride, what happens after 2 minutes?
   - You land at the Space Station
   - You land at the Hologram Landing
   - The turbo engines ignite allowing you to break through the atmosphere
   - **SSA Stage 2 is separated**

9. Where do you end up at the end of the space rocket ride?
   - Prospect Mountain
   - **Ayn Rand Space Station**
   - MagLev Monorail Exchange
   - Visitor Center

10. Throughout the island there are posters inviting guests to join a group. What is the name of the group?
    Huffman Prairie Educational Group
    HPO Discussions in Education
    Cyber Educators
    Global Learning Forum

11. Who sits at the visitor's desk and greets you as you arrive HPO Visitor's Center?
    Ayn Rand
    Jim Huffman
    Spinoza Quinell
    Prairie Greeter



Conclusion:
A video (http://www.youtube.com/watch?v=LrusQUsHEb4) appears indicating with the provost, Dr. Innovate of Cyber University saying:

"If you are finished exploring, taken all the snapshots you need for your files, and completed the knowledge check, then your experience is complete."
"Thank you for taking the time to visit on behalf of myself and the rest of Cyber University. I am eager to understand what you have learned. The knowledge check and the snapshots should serve well in putting a presentation together for my friend Mr. Cahn Venshunal. Thank you for your time!"
"But wait before you go, I need you to do one thing for me. As you leave the island, please take a moment and complete the survey. We want to hear about your experience."

The learner will be directed to the post-activity survey (http://www.surveygizmo.com/s/92750/ucf-sl-research-study-engagement-questionnaire). See questions below.

Engagement Questionnaire

Thank you for taking the time to answer the questions. Your opinion will support UCF dissertation research.

Directions: This survey is confidential. You must be at least age 18 years old complete the survey. Please DO NOT write your real name on this survey, and please answer all questions in the survey. Once survey data has been recorded, all data will be destroyed.

Please answer the following questions reflecting on your experience at Huffman Prairie Omega in Second Life. These questions relate to the thoughts and feelings you may experience while taking part. There is no right or wrong answers. Think about how you felt during the event/activity and answer the questions using the rating scale below. For each question circle the number that best matches your experience.

For each of the following 36 questions, the likert scale rating below will be available:

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

(FSS-2 Survey Questions removed. Please refer to http://www.fitinfotech.com/FST/fstadminWVU.tpl for details on use and purchasing of Flow State Scales-2.)

Prior to this activity, had you ever experienced (been to) Huffman Prairie Omega ? (Y / N)
Please confirm preferred method of payment:
Linden Dollars to Resident: _____
Paypal payment to email: _____
Would you be interested in participating in a brief (10 minute) interview about your experience? (Y / N)
An additional $5 is offered for your time.

Interview Questions

The following are draft interview questions specifically aimed at supporting the findings reported by the survey data. The interviewee and responses will remain completely confidential.

1. Tell me about your overall experience at Huffman Prairie Omega.
2. In what ways, was the experience different than doing an activity on the web?
3. Did you have any technical difficulties?
4. Was there any part of the experience that was disconnecting or frustrating for you in terms of smoothness through the activity?
5. Was the VWQuest intuitive or cumbersome?
6. Tell me about the Knowledge Check.
7. How engaging or not was the overall experience?
8. Tell me about your time. Did you loose track or did you find you kept clock watching?
9. Tell me about the activity challenge level for you in terms of your skill level.
10. Anything else you would like to add?

(Questions directed in the "Tell me…" format on purpose. Questions left open ended and adaptive in the conversations.)

APPENDIX B: INSTITUTIOANL REVIEW BOARD (IRB) APROVAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Notice of Expedited Initial Review and Approval

From : **UCF Institutional Review Board**
FWA00000351, Exp. 10/8/11, IRB00001138

To : **Karen E. Cooper** and Co-PI: **Atsusi Hirumi**

Date : **December 08, 2008**

IRB Number: **SBE-08-05917**

Study Title: **Go with the Flow: Examining the Effects of Engagement using Flow Theory and its Relationship to Achievement in the 3-Dimensional Virtual Learning Environment of Second Life.**

Dear Researcher:

Your research protocol noted above was approved by **expedited** review by the UCF IRB Vice-chair on 12/8/2008. **The expiration date is 12/7/2009.** Your study was determined to be minimal risk for human subjects and expeditable per federal regulations, 45 CFR 46.110. The category for which this study qualifies as expeditable research is as follows:

> 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

A **waiver of documentation of consent** has been approved for all subjects. Participants do not have to sign a consent form, but the IRB requires that you give participants a copy of the IRB-approved consent form, letter, information sheet, or statement of voluntary consent at the top of the survey.

All data, which may include signed consent form documents, must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Advise the IRB if you receive a subpoena for the release of this information, or if a breach of confidentiality occurs. Also report any unanticipated problems or serious adverse events (within 5 working days). Do not make changes to the protocol methodology or consent form before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at http://iris.research.ucf.edu .

Failure to provide a continuing review report could lead to study suspension, a loss of funding and/or publication possibilities, or reporting of noncompliance to sponsors or funding agencies. The IRB maintains the authority under 45 CFR 46.110(e) to observe or have a third party observe the consent process and the research.

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 12/08/2008 11:07:09 AM EST

IRB Coordinator

APPENDIX C: RUBRIC FOR PHOTO PACKAGES

Rubric for Photo Packages

INSTRUCTIONS

Using the criteria below, rate each package as a body of work based on the assignment instructions and the following scales. The first 2 criteria - Quality and Adherence - are Core Criteria - pkgs should be assessed on an expectation that a top score (4pts) could be expected. The other three criteria - Creativity, Add'l Content, and Add'l Photos - are extra credit. A perfectly compliant pkg may not have any evidence of the 'extras' at all. These crtieria assess above and beyond efforts. One additional point is available if the participant packaged their photos innovatively.

Evaluate each pkg as a whole, regardless of the number of photos and make a determination. If a criterion element does vary greatly within the pkg, make a determination based on the core 10 photos.

CRITERIA

Core	**Quality (0-4 Pts):** (1) Photo clarity (focus), framing, lighting, color saturation, angle (2 Pts); (2) photo is physically easy to see/clear as a photo (2 Pts); (3) lighting is appropriate for situation (1 Pt).
Core	**Adherence to Assignment (0-4 Pts):** (1) Photo labeled in email subject; (2) at least 5 photos present; (3) all 10 photos present; (4) a favorite photo was identified; (5) an explanation acocomapnied their favorite photo (1 Pt each).
Extra	**Creativity (0-2 Pts):** May include creative lighting; additional residents in photos; additional graphical elements that enhance the photo. The pkg has evidence of additional effort. (0-2 Pts).
Extra	**Additional Content (0-2Pts):** (1) Additional content accompanies the photo package; (2) content is relevant to activity. (1 Pt each).
Extra	**Additional Photos (0-2 Pts):** (1) Additional photos accompany the photo package; (2) photos are relevant to activity (1 Pt each).
Extra	**Packaging (1 Pt):** Creative packaging such as video or web-posting. (1 Pt.)

	Quality (0-4 Pts.)	Adherence (0-4 Pts.)	Creativity (0-2 Pts.)	Additional Content (0-2 Pts.)	Additional Photos (0-2 Pts.)	Packaging (0-1 Pt.)	To tal (0-
Pkg 1							0
Pkg 2							0
Pkg 3							0
Pkg 4							0
Pkg 5							0
							0
							0
							0
							0
							0
							0
							0
							0

REFERENCES

AETC. (2008). *On Learning: The Future of Air Force Education and Training*. Paper presented at the Federal Consortium for Virtual Worlds. Retrieved on April 27, 2008 from http://www.af.edu/sites/aetc.

Allen, E. & Seaman, J. (2007). *Online Nation. Five Years of Growth in Online Learning.* New York: The Sloan Consortium,31.

ANGEL Learning Isle Steering Committee (2008). The Power of Virtual Worlds in Education: A Second Life Primer and Resource for Exploring the Potential of Virtual Worlds to Impact Teaching and Learning. *July*, 8. Indianapolis, IN: ANGEL Learning, Inc. Retrieved July 2008, from http://www.angellearning.com/products/secondlife/downloads/-The_Power_of_Virtual_Worlds_in_Education_May_2008.pdf.

Arendtsz, A. (2007). Student engagement of lower-income high school students: The importance of autonomy, competence, relatedness, and the balance between challenge and skill. Ph.D. dissertation, University of California, Berkeley, United States – California. Dissertations & Theses: Full Text database. (Publication No. AAT 3275332).

Astin, A. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel*, 25, 297-308.

ATT (2008). *Searching for China WebQuest*. Retrieved on March 10, 2008 from http://www.kn.pacbell.com/wired/China/ChinaQuest.html.

Badger,C.,(2008). Transforming Enterprise Processes through Virtual Worlds: Recipe for Success with Enterprise Virtual Worlds. Forterra Systems, Inc. Downloaded on January 13, 2009 from http://www.forterrainc.com/index.php/resources/white-papers-a-articles.

Baker, P. (2008a, December 30, 2008). Virtual World Research, Part 1: A Place to Experiment. *LinuxInsider, 12*. Retrieved January 20, 2009 from http://www.linuxinsider.com/story/Virtual-World-Research-Part-1-A-Place-to-Experiment-65656.html?wlc=1241554066.

Baker, P. (2008b, December 31, 2008). Virtual World Research, Part 2: Reality in a Can. *LinuxInsider, 12*. Retrieved January 20, 2009 from http://www.linuxinsider.com/story/Virtual-World-Research-Part-2-Reality-in-a-Can-65673.html.

Belchior, P. (2007). Cognitive training with video games to improve driving skills and driving safety among older adults. Ph.D. dissertation, University of Florida, United States -- Florida. Dissertations & Theses: Full Text database. (Publication No. AAT 3281502).

Bell, M. W. (2008). Toward a Definition of "Virtual Worlds". *Journal of Virtual Worlds Research, 1*(1).

Blood, J. A. (2006). Non-industrial textile production as optimal experience: Applicability of the flow theory to clothing and textiles subject matter. Ph.D. dissertation, Oregon State University, United States -- Oregon. Dissertations & Theses: Full Text database. (Publication No. AAT 3236871).

Book, B. (2004). Moving Beyond the Game: Social Virtual Worlds. *State of Play 2 Conference, New York Law School.*

Boland, I.T. (2009). Efficacy of the 3D Multi-User Virtual Environment (MUVE) Second Life for learning in cognitive constructivist and social constructivist activities. Ph.D. dissertation, Capella University, United States -- Minnesota. Retrieved August 17, 2009, from Dissertations & Theses: Full Text.(Publication No. AAT 3352479).

Bowers, K. W., Ragas, M. W., & Neely, J. C. (2009). Assessing the Value of Virtual Worlds for Post-Secondary Instructors: A Survey of Innovators, Early Adopters and the Early Majority in Second Life. *International Journal of Humanities and Social Sciences, 3*(1), 10.

Calongne, C. M. (2008). Educational Frontiers: Learning in a Virtual World. *EDUCAUSE Review,* 8.

Camilleri, V., & Montebello, M. (2007). ARieL: Augmented Reality in interactive e-Learning [Electronic Version]. Retrieved March 1, 2009 from http://www.um.edu.mt/__data/assets/pdf_file/0006/51774/wict08_submission_40.pdf.

Campbell, D. T., & Stanley, J.C, (1963). *Experimental and quasi-experimental designs for research.* Boston, MA: Houghton Mifflin Company.

Caribbana Boulevard (2008). *Flesh and Blood*. Retrieved September 23, 2008 from http://slurl.com/secondlife/Flesh%20and%20Blood/98/172/23.

Cartwright, N. C. (2006). Supporting creative teacher flow: Exploring the relationship between Csikszentmihalyi's concept of optimal flow experiences and Bolman and Deal's principal leadership orientations. Ph.D. dissertation, Gonzaga University, United States – Washington. Dissertations & Theses: Full Text database. (Publication No. AAT 3234474).

Cassidy, T. (2006). The "good work" of nonprofit executive directors: An exploration of factors influencing transformational and transactional leadership strategies. Ed.D. dissertation, University of Hartford, United States – Connecticut. Dissertations & Theses: Full Text database. (Publication No. AAT 3209924).

Chen, H. (2006). Flow on the net–detecting web users' positive affects and their flow states. *Computers in Human Behavior, 22*(2), 221-233.

Chen, H. (2000). Exploring web users' on-line optimal flow experiences. *Dissertation Abstracts International, 61(7),* 2499. (UMI No. 9977961)

Chen, P. D., Gonyea, R., & Kuh, G. (2008). Learning at a distance: Engaged or not? *Innovate*, 4(3).

Chen, H., Wigand, R. T., & Nilan, M. (2000). Exploring web users' optimal flow experiences. *Information Technology & People, 13*(4), 263-281.

Chen, H., Wigand, R. T., & Nilan, M. S. (1999). Optimal experience of web activities. *Computers in Human Behavior, 15*(5), 585-608.

Clough, G., Jones, A. C., McAndrew, P., & Scanlon, E. (2008). Informal learning with PDAs and smartphones. *Journal of Computer Assisted Learning, 24*(5), 359-371.

Cohen, A. (2008, October 2008). The Second Life of Second Life. *FastCompany,129.* Retrieved on November 20, 2009 from http://www.fastcompany.com/magazine/129/the-second-life-of-second-life.html.

Connolly, C. T. (2007). Attentional strategies and their relationship with perceived exertion and flow. Ph.D. dissertation, The Florida State University, United States – Florida. Dissertations & Theses: Full Text database. (Publication No. AAT 3282591).

Csikszentmihalyi, M. (1975). *Beyond Boredom and Anxiety*. San Francisco, CA: Jossey-Bass Inc. Publishers.

Csikszentmihalyi, M. (1990). *Flow: the psychology of optimal experience*: New York: Harper & Row.

Csikszentmihalyi, M. (1997). *Creativity: Flow and the Psychology of Discovery and Invention*. New York: Harper Collins Publishers.

Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (1988). *Optimal Experience: Psychological Studies of Flow in Consciousness*: Cambridge University Press.

Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the Experience-Sampling Method. *Journal of nervous and mental disease, 175*(9), 526-536.

Danehy, T. M. (2006). Do urban elementary school principals perceive that they experience flow? Ed.D. dissertation, University of Hartford, United States -- Connecticut. Dissertations & Theses: Full Text database. (Publication No. AAT 3209925).

Dede, C. (2009). *Immersive Interfaces for Engagement and Learning.* Science. V323. Downloaded from http://www.sciencemag.org on February 4, 2009.

Dodge, B. (1995). WebQuests: A technique for internet-based learning. *Distance Educator, 1(2),* 10-13.

Dorland, J. M. (2006). Objectification theory: Examining the relation between self-objectification and flow for college-aged women athletes. Ph.D. dissertation, The University of Akron, United States – Ohio. Dissertations & Theses: Full Text database. (Publication No. AAT 3280777).

Driver, E. (2009, March 2009). *The Immersive Internet.* Paper presented at the Defense GameTech 2009, Orlando, FL. Retrieved March 14, 2009 from http://www.simulationinformation.com/Gametech09/index.php.

DuPree, W. J. (2007). Examining marriage and family therapists in non-traditional areas of application: An ecological systems theory of creativity approach. Ph.D. dissertation,

Kansas State University, United States -- Kansas. Dissertations & Theses: Full Text database. (Publication No. AAT 3259315).

Finneran, C. M., & Zhang, P. (2002). The Challenges of Studying Flow within a Computer-Mediated Environment. *Eighth American Conference in Information Systems, Dallas, TX*, 1047-1054.

Finneran, C. M., & Zhang, P. (2003). A Person-Artifact-Task (PAT) model of flow antecedents in computer-mediated environments. *International Journal of Human-Computer Studies,* Special Issue on HCI and MIS, 59(4),397-402.

Gartner Group (2007). *Press Release Media Relations.* April 24, 2007. Retrieved April 23, 2008, from http://www.gartner.com/it/page.jsp?id=503861.

Ghani, J.A. (1995). Flow in human computer interactions: Test of a model. In J. Carey (Ed.), *Human factors information systems: Emerging Theoretical Bases* (pp. 291-311). New Jersey: Apex Publishing Corp.

Ghani, J. A., & Deshpande, S. P. (1994). Task characteristics and the experience of optimal flow in human-computer interaction. *The Journal of psychology, 128*(4), 381-391.

Greenfield, P.M. (2009). Technology and Informal Education: *What is Taught, What is Learned.* Science. V323. Downloaded from http://www.sciencemag.org on February 4, 2009.

Guru, A., & Nah, F. H. F. (2001). Effect of Hypertext and Animation on Learning. *Managing Internet and Intranet Technologies in Organizations: Challenges and Opportunities*.

Hayes, E. R. (2006). Situated Learning in Virtual Worlds: The Learning Ecology of Second Life. *AERC Conference Proceedings.* Downloaded May 20, 2008 from http://www.adulterc.org/Proceedings/2006/Proceedings/Hayes.pdf.

Heinrichs, W. L. R., Youngblood, P., Harter, P. M., & Dev, P. (2008). Simulation for team training and assessment: Case studies of online training with virtual worlds. *World Journal of Surgery*, 32(2), 161-170.

Helmer, J., & Light, L. (2007). Second Life and Virtual Worlds. *Learning Light Limited*. UK. Retrieved on April 17, 2009 from http://www.epic.co.uk/content/news/nov_07

Hoefer, J. (2008). Coherence in the public school principalship: A case study on the extent to which elementary school principals' goals, values, vision, self-efficacy, and standardized test scores are linked to their daily behaviors. Ph.D. dissertation, The Claremont Graduate University, United States – California. Dissertations & Theses: Full Text database. (Publication No. AAT 3294594).

Hood, M. S. (2007). A description of the relationship of flow theory and effective teaching of reading. Ed.D. dissertation, University of Houston, United States -- Texas. Dissertations & Theses: Full Text database. (Publication No. AAT 3289797).

Hornik, S. (2008), Seventeenth Annual Research Workshop on: Artificial Intelligence and Emerging Technologies in Accounting, Auditing and Tax, American Accounting Association, Anaheim, CA, *"Really Engaging Accounting: Second Life as a Learning Platform"*, International, published in proceedings, Accepted. (August 2008).

IARPA (2009). Proposers' Day Announcement – Reynard, *Federal Business Opportunities, Office of the Director of National Intelligence,* Intelligence Advanced Research Projects Activity Broad Area Announcement. Retrieved on March 15, 2009 from https://www.fbo.gov/index?s=opportunity&mode=form&id=e5e0fa52667c7038fa056f1d47b38c25&tab=core&_cview=0.

Jackson, S. A., & Ecklund, R. C. (2002). Assessing Flow in Physical Activity: The Flow State Scale-2 and Dispositional Flow Scale-2. *Journal of Sports & Exercise Psychology, 24*(2), 133-150.

Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. *Journal of Sport and Exercise Psychology, 18*(1), 17-35.

Johnson, L. F., Levine, A., & Smith, R. S. (2007). *2007 Horizon Report.* Austin, TX: The New Media Consortium.

Jones, M. G. (1998). *Creating electronic learning environments: Games, flow, and the user interface.* Paper presented at the National Convention of the Association for Educational Communications and Technology, Houston.

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. *The Internet and Higher Education, 8*(1), 13-24.

Konradt, U., Filip, R., Hoffmann, S. (2003). Flow experience and positive affect during hypermedia learning. *British Journal of Educational Technology, 34*(3), 309-327.

Koufaris, M. (2002). Applying the Technology Acceptance Model and Flow Theory to Online Consumer Behavior. *Information Systems Research, 13*(2), 205-223.

KZERO (2008). *Virtual Worlds Markets: Key Strategies Deployed in 2008 and Predictions for 2009.* (KZERO o. Document Number).

Lambert, J., Gong, Y. & Cuper, P. (2008). Applying Technology to Learning: Is it Too Much to Expect of Pre-service Teachers in an Introductory Technology Course? In K. McFerrin et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2008* (pp. 3814-3821). Chesapeake, VA: AACE.

Last, J. V. (2007). Get a (Second) Life!: The avatars are coming. *The Weekly Standard*, October 1, 2007. Retrieved April 2, 2009, from http://weeklystandard.com/Content/Public/Articles/000/000/014/145mliuh.asp.

Leong, P. W. K. (2006). Understanding interactivity in online learning environments: The role of social presence and cognitive absorption in student satisfaction with online courses. Ph.D. dissertation, University of Hawai'i at Manoa, United States -- Hawaii. Dissertations & Theses: Full Text database. (Publication No. AAT 0388615).

Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A Cross-Media Presence Questionnaire: The ITC-Sense of Presence Inventory. *Presence: Teleoperators & Virtual Environments,* 10(3), 282-297. doi: 10.1162/105474601300343612.

Levine, C. L. (2006). Flow and motivation in male ballet dancers. Psy.D. dissertation, The Wright Institute, United States -- California. Dissertations & Theses: Full Text database. (Publication No. AAT 3231334).

Levy, S. (2008, October 29). Steven Levy on melding the digital and physical realms. *Wired Magazine*, 16.11.

Lightner, S., Bober, M.J, & Willi, C. (2007). Team-based activities to promote engaged learning. *College Teaching*, 55(Winter), 5-18.

Linden Lab (2003). "Second Life: Your World, Your Imagination." Retrieved May 24, 2008, 2008, from http://www.secondlife.com.

Linden Lab. (2009). Second Life Economic Statistics. Retrieved April 16, 2009, from http://secondlife.com/statistics/economy-data.php.

Marsh, H. W., & Jackson, S. A. (1999). Flow Experience in Sport: Construct Validation of Multidimensional, Hierarchical State and Trait Responses. *Structural Equation Modeling, 6*(4), 343-371.

Marszalek, J. (2006). Computerized adaptive testing and the experience of flow in examinees. Ph.D. dissertation, University of Illinois at Urbana-Champaign, United States – Illinois. Dissertations & Theses: Full Text database. (Publication No. AAT 3223665).

Mathwick, C., & Rigdon, E. (2004). Play, Flow, and the Online Search Experience. *Journal of Consumer Research, 31*(2), 324-332.

Means, B., (1994). "Using technology to advance educational goals" in B. Means (Ed.) *Technology and education reform* (pp. 1-21). San Francisco: Jossey-Bass.

Mendelson, N. (2007). The functional mediation of flow between achievement anxiety, academic procrastination, and academic performance. Ph.D. dissertation, Fordham University, United States -- New York. Dissertations & Theses: Full Text database. (Publication No. AAT 3255013).

Mims, C. (2007). Second Life chairman's stump speech takes us down the rabbit hole. *Scientific American Observations*, June 29, 2007.

Mugford, A. L. (2004) Flow in a team sport setting: Does cohesion matter? Ph.D. dissertation, The University of Kansas, United States -- Kansas. Dissertations & Theses: Full Text database. (Publication No. AAT 3185197).

O'Connell, T., Grantham, J., Workman, K., & Wong, W. (2009). Pedagogy, Education and Innovation in 3-D Virtual Worlds. Journal of Virtual Worlds Research, 2(1), 23.

O'Driscoll, T. (2007). Virtual Social Worlds and the Future of Learning. March 22, 2007. Multimedia video presentation. Retrieved March 12, 2008 from http://www.youtube.com/watch?v=O2jY4UkPbAc

O'Driscoll, T. (2008). Redefining Education for the 21st Century? *Learning Matters!* Retrieved December 10, 2008 from http://wadatripp.wordpress.com/2008/08/19/redefining-education-for-the-21st-century/

O'Driscoll, T., Cross, J., & Trondsen, E. (2007). *Another Life: Virtual Worlds as Tools for Learning.* eLearn Magazine. Retrieved March 1, 2009 from http://elearnmag.org/subpage.cfm?section=articles&article=44-1.

Ohio University Second Life Campus (2008). Ohio University Second Life Campus (20, 38, 24). Second Life Virtual World. Retrieved September 23, 2008 from http://slurl.com/secondlife/Ohio%20University/20/38/24/.

Ondrejka, C. (2007). Education unleashed: participatory culture, education, and innovation in second life. *The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning*, 229-251.

Pearce, J. M., Ainley, M., & Howard, S. (2005). The ebb and flow of online learning. *Computers in Human Behavior, 21*(5), 745-771.

Prensky, M. (2005). Computer games and learning: Digital game-based learning. *Handbook of computer game studies*, 97–122.

Quinn, C. N. (2005). *Engaging learning: Designing e-learning simulation games*: Pfeiffer.

Rawlinson, L. (2007). Virtual worlds: The next Facebook? *CNN.com*, August 8, 2007. Retrieved April 2, 2009 from http://edition.cnn.com/2007/TECH/08/07/virtual.living/index.html

Robbins, S. (2007). A futurist's view of Second Life education: A developing taxonomy of digital spaces in D. Livingstone & J. Kemp (Eds.), *Proceedings of the Second Life Education Workshop CommunityConvention*, pp. 27-33. Chicago Hilton: The University of Paisley.

Roberts, F., Kelley, C., & Medlin, B. (2007). Factors influencing accounting faculty members' decision to adopt technology in the classroom. *College Student Journal*, 41(2), 13.

Safier, R. N. (2004) Flow: A qualitative study into the role of optimal experience in the work lives of principals. Ed.D. dissertation, University of Massachusetts Lowell, United States -- Massachusetts. Dissertations & Theses: Full Text database. (Publication No. AAT 3122974).

Salt, B., Atkins, C., & Blackall, L. Engaging with Second Life: real education in a virtual world. *SLENZ Project for the New Zealand Tertiary Education Commission.* Retrieved April 2, 2009 from http://slenz. files.wordpress.com/2008/12/slliteraturereviewa1.pdf.

Sarvary, M. (2008). Breakthough ideas for 2008: The metaverse—TV of the future? *Harvard Business Review*, February 2008.

Saville, J. F. (2006). Correlates of flow in post-collegiate women's club rugby players. Ph.D. dissertation, Temple University, United States – Pennsylvania. Dissertations & Theses: Full Text database. (Publication No. AAT 3233469).

Sedig, K. (2007). Toward operationalization of 'flow'in mathematics learnware. *Computers in Human Behavior, 23*(4), 2064-2092.

Shernoff, D. J., Csikszentmihalyi, M., Schneider, B., & Shernoff, E. S. (2003). Student Engagement in High School Classrooms from the Perspective of Flow Theory. *School Psychology Quarterly, 18*(2), 158-176.

SimTeach (2008). *Institutions and Organizations in SL*. Retrieved September 23, 2008 from http://www.simteach.com/wiki/index.php?title=Second_Life_Education_Wiki.

Skadberg, Y. X., & Kimmel, J. R. (2004). Visitors' flow experience while browsing a Web site: its measurement, contributing factors and consequences. *Computers in Human Behavior, 20*(3), 403-422.

Skaer, N. L. (2006). The effectiveness of Flow-Specific Guided Imagery (FSGI) as a facilitator of the flow state in athletic performance: A pretest-posttest controlled research design. Ph.D. dissertation, Capella University, United States – Minnesota. Dissertations & Theses: Full Text database. (Publication No. AAT 3215956).

Smith, H.S., Smith, H.P., Samors, R., & Mayadas, A.F. (2008). Positioning Online Learning as a Strategic Asset in the Thinking of University Presidents and Chancellors. *Journal for Asynchronous Learning Networks, 12*(2).

Splitsville (2008). *Splitsville Second Life – Bowling, Music, Fun*! Retrieved September 23, 2008, from http://slurl.com/secondlife/InWorld%20Park/98/172/23.

SPSS. (2004). SPSS 13.0 for Windows Student Version [Electronic Version], from http://www.spss.com.

Stammberger, I. G. (2005). The dynamics of conceptual change: Expert and novice navigation in a multi-user virtual environment (MUVE). Ph.D. dissertation, Tufts University, United States -- Massachusetts. Retrieved June 9, 2009, from Dissertations & Theses: Full Text database. (Publication No. AAT 3167535).

Stamps.,D., (1998). Learning ecologies. *Training. (35)1, 32-38.*

Strickler, A. (2008). *Virtual World Learning… Simulation Gaming Kit for Education*. Captain Lance P. Sijan Leadership Range in Second Life – at MyBase Zeta. (received via email January 2009).

Strickler, A. (2009). Huffman Prairie Global Learning Forum: Collaboration Through Advanced Gaming in Virtual Worlds [Electronic Version]. *Global Learning Forum*, 9. Retrieved May 9, 2009.

TSJ (2008). Training & Simulation Journal, April/May 2008, *Defense News Media Group*, Army Times Publishing Co. Vol.9, No.2.

Vasquez, B. L. (2005). The effects of hypnosis on flow and in the performance enhancement of basketball skills. Ph.D. dissertation, Washington State University, United States – Washington. Dissertations & Theses: Full Text database. (Publication No. AAT 3242035).

Venkatesh, V., Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, 27(3), 451-481.

Vickers, H. (2007). *SurReal Language Quests.* Retrieved March 10, 2008 from http://avatarlanguages.com/blog.

Webster, J. (1993). The Dimensionality and Correlates of Flow in Human-Computer Interactions. *Computers in Human Behavior, 9*(4), 411-426.

Wilson, C. (2008). *Avatars, Virtual Reality Technology, and the US Military: Emerging Policy Issues*. Download on December 16, 2008 from http://www.dtic.mil.

World of Warcraft (2009). World of Warcraft Statisitcs. Downloaded on January 13, 2009 from http://www.warcraftrealms.com.

Wrigley, W. J. (2005). *Improving Music Performance Assessment.* Griffith University, Queensland, Australia.

Wyld, D.C. (2008). *"Government in 3D: How Public Leaders Can Draw on Virtual Worlds"* The IBM Center for the Business of Government, Downloaded from http://www.businessofgovernment.org/publications/grant_reports/details/index.asp?gid=322 on December 12, 2008.

Young, J. (2008). The Wired Campus, *The Chronicle of Higher Education* May 8, 2008. Downloaded June 2, 2008 from http://chronicle.com/wiredcampus/index.php?id=2983.

Zynadu (2008). *Zorkmid Zone at Aazy's Place*. Retrieved September 23, 2008 from http://slurl.com/secondlife/Zynadu/136/20/25/.