

TEACHING IN THE COLLABORATIVE VIRTUAL LEARNING ENVIRONMENT
OF SECOND LIFE:
DESIGN CONSIDERATIONS FOR VIRTUAL WORLD DEVELOPERS

A Thesis

by

DANIEL LEE POGUE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

December 2011

Major Subject: Computer Science

Teaching in the Collaborative Virtual Learning Environment of Second Life: Design

Considerations for Virtual World Developers

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Approved by:

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ABSTRACT

Teaching in the Collaborative Virtual Learning Environment of Second Life:
Design Considerations for Virtual World Developers. (December 2011)

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Chair of Advisory Committee: Dr. Richard Furuta

Educators are seeking ways to better engage their students including the use of collaborative virtual learning environments (CVLEs). Some virtual worlds can serve as CVLEs as the advent of Second Life has created particular interest within the education community. Second Life, however, was not initially designed to facilitate education alone. I propose that as a CVLE, Second Life may be failing educators' expectations of its initial, ongoing, and future use as a system for supporting education.

In order to determine how Second Life may be failing educators, I conducted a case study with a group of university-level educators that examined their reasons for and against adopting Second Life as a CVLE, the affordances they explored, the barriers they encountered, and how these affordances and barriers affected student learning and the participant's future use of Second Life and future virtual worlds in education.

I then compare their use of Second Life to that of traditional groupware systems. As a result, I propose and detail the development of a rich integrated development environment, application programming interface, more flexible privacy policy, and more robust community tools for educators based on these comparisons.

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1. INTRODUCTION

Educators seek ways to better engage their students. To facilitate this, teachers have employed various approaches, curriculum, and pedagogy in order to appeal to the vast array of students and what their different motivations are learn. The theory and practice of student engagement is a popular subject [Stipek 1998; Gray and Madson 2007].

One way to engage distributed students is through the use of collaborative virtual learning environments (CVLEs). Virtual worlds such as *There* or *Whyville* can serve as CVLEs, but the advent of the three-dimensional virtual world of Second Life has created a particular interest with educators boasting more than 700 educational institutions with educators from many different disciplines holding sessions, demonstrations, lectures, and entire classes within its virtual borders [Linden Research 2011b].

Second Life, however, was not initially designed to facilitate education alone. While Second Life encourages users to live out a “second life” within its borders, it may also have overlapping design features and requirements that encourage its use as a CVLE. The extent of overlap could have potential implications for the educational community. To what extent is the feature overlap beneficial to educators and where is it a detriment to the educational process? As time goes on, some educators are committing more and more resources into establishing their curriculum in Second Life, but is it time well spent?

This thesis follows the style of the *Journal of the ACM*.

I propose that as a CVLE, Second Life may be failing university-level educators by not meeting their preconceptions and expectations of its initial, ongoing, and future use as a system for supporting education. Certain issues could be hindering their ability to teach, and consequently, could be inhibiting their students' ability to learn. These failures could also lead to a diminished use of Second Life or abandonment altogether. This could potentially generate a ripple effect within the education community, causing more and more educators to abandon Second Life, leading to a total failure of the system as a CVLE.

In order to determine how Second Life may be failing university-level educators I examine how educators have actually used Second Life in their instruction. While I am interested in looking at the benefit that Second Life has on students pedagogically, I am more focused on the source of the learning: the educator. This approach is different from single course studies in that by examining how educators adopt and use Second Life as a CVLE over time, I will be able to understand both immediate and potential future technological and pedagogical design implications virtual worlds face in an educational setting. Since the educator's perception and engagement with the virtual world ultimately affects student learning through their curriculum development, designing virtual worlds with the educators as primary stakeholders is paramount to a successful implementation as a CVLE.

I believe that university-level educators desire to adopt Second Life and are not required to use it by their educational institution. This resembles how users would adopt groupware or a computer-supported collaborative work system (CSCW). Educators

perceive potential affordances and barriers when using Second Life as a CVLE, and must decide whether Second Life suits their needs as a software system for educational platform. In this study I examine how university-level educators have been using Second Life as a CVLE for multiple semesters, what affordances they have identified and explored, and what barriers they have encountered. By comparing how educators are using Second Life as a CVLE over time to design issues encountered with developing groupware in a more enterprise setting, I draw parallels to groupware design aspects that will aid virtual world developers in better understanding and developing their systems for these prospective users. This will in turn allow educators to efficiently and effectively employ Second Life and future virtual worlds as collaborative virtual learning environments in the classroom.

2. BACKGROUND

Educational uses in Second Life share a common background with many technological approaches such as groupware or computer-supported collaborative work (CSCW) systems, computer-supported collaborative learning (CSCL) systems, and collaborative virtual learning environments (CVLEs). Research into other virtual worlds is also relevant, especially educational virtual worlds, as there may be common approaches to those used in Second Life. In addition to common areas, I also examine the existing literature regarding educational experiences in Second Life.

2.1 Literature

Groupware or CSCW systems, as their names imply, are technological systems that service a group in order to help them accomplish some goal. Ellis et al. [1991] provided a taxonomy of these systems by categorizing systems based on how users in the group interacted. These categories are divided by space (users are located together or distributed) and time (users interact simultaneously or asynchronously) forming four generalized areas of interaction. Ellis noted that there are different design considerations for each category and that some groupware systems, in our case Second Life, fit into multiple categories.

Later, Grudin [1994] analyzed the successes and failures of various groupware systems of the time. Grudin examined how groupware systems are designed, developed, marketed, and used in corporate situations. He then looked at how they compared to

single-user and organization-level information systems. From this he illustrated eight challenges that groupware developers must overcome in order to create successful groupware systems in the workplace. He then compared these challenges to single-user and organizational-level systems and subsequently suggested methods for developers to address these challenges.

Groupware systems are no strangers to education. A subset of CSCW is computer-supported collaborative learning (CSCL). Early approaches such as CLARE [Wan and Johnson 1994] or DreamTeam [Roth and Unger 1998] sought to support learning as knowledge construction. Later, Soller et al. [2005] reviewed and characterized a subset of current CSCL technologies in order to lay a foundation for knowing which technological approach is appropriate for a specific learning situation. Within CSCL, collaborative virtual learning environments (CVLEs) are a subset of technology to benefit learning situations in distance education. Redfern and Naughton [2002] describes CVLEs as computer-enabled, virtual spaces in which users can come together to interact, share ideas, and learn. Redfern and Naughton noted that CVLEs are appropriate tools for distance education, but that the current collaborative virtual environments of the time had not reached their full distance education potential.

Virtual Worlds can serve as form of CVLE. Examples such as Ondrejka [2008] and Hayes [2006] looked to see how education could benefit from the use of virtual worlds. Bouras et al. [2008] outlined eight important design principles that CVLE designers must adhere to in order for their systems to be successfully used as learning tools. These principles would later be used by Tsiastos and Konstantinidis [2009] when

they compared how two virtual worlds, Second Life and Croquet, could support cooperative learning scenarios. Their evaluation of scenarios developed in both worlds concluded that Second Life was the superior option at the time due to a more intuitive interface and more stable system platform.

2.2 Teaching in Virtual Worlds

Teaching in an environment like Second Life is not a 1:1 analog of real world teaching methods. One example of this difference was a study done by Crosier et al. [2000] where they first compared traditional teaching methods and teaching in virtual reality in a secondary school science setting. While computer use and technology may be more pervasive now, the study illustrated the importance of how virtual reality is presented and used during teaching and learning, especially in a secondary school setting.

In order to effectively use a virtual world as a learning environment, educators need to understand the potential benefits and hindrances of virtual worlds. Work done by Chodos et al. [2009] revealed that a virtual world's ability to create virtual thematic spaces, have a programmatic behavior, and allow users to role-play gave it distinct advantages as a tool to support simulation-based learning. Esteves et al. [2009] also noted that the visual nature of Second Life was a more preferable implementation than data-oriented exercises in supporting problem-based learning in computer programming. The collaborative benefits of virtual worlds were explored by O'Connell et al. [2008]. Their research revealed that digital natives [Prensky 2001] were more apt to collaborate

in a virtual world when given the opportunity, and that users performed better in a virtual world scavenger hunt collaboratively than when they worked alone.

Not all students are suited for learning in a virtual world. Herold [2009] hypothesized that all modern students were digital natives and would have had exposure to navigating virtual worlds like Second Life. This exposure would lead to a more intrinsic understanding of its use and create a greater desire to use it educationally – more so than current educators would have, being digital immigrants. This was not the case as system and usability issues were almost universal among the study populace. This created barriers to exploring and understanding as students took more time than expected to learn the required actions and environment. While some students enjoyed the virtual world, others had major misgivings or negative biases about Second Life. This, coupled with the previous issues, negatively impacted their virtual world learning experiences.

Loureiro and Bettencourt [2009] took a more reserved approach, stating that digital natives are more socially and technically connected than current real world learning environments allow. They concluded immersive environments such as Second Life bridge the gap between real-world learning and other digital environments. They also stated it was necessary to understand and develop best practices for both teaching and learning in virtual worlds. Mon [2009] had similar findings by examining how librarians and educators provided information within Second Life. The results showed that the type of information offered had an impact on learning and what questions are

asked. She also discovered that the physical appearance of information workspaces provided much more information compared to their real-world counterparts.

These are just a few of the many examples of using virtual worlds like Second Life as educational tools and collaborative virtual learning environments. They stress that virtual world usage in education should be situational; educators must consider the benefits of using a virtual world and weigh them with potential issues they may encounter. These affordances and barriers were broken down and categorized [Warburton 2008a; Warburton 2008b; Warburton and Perez-Garcia 2010] and summarized [Warburton 2009]. In addition to assessing the pros and cons of virtual worlds, educators must also understand how to best represent information and how it will affect a student's overall learning experience, as virtual worlds like Second Life are but one of many available tools. Activities such as those categorized by Kay and FitzGerald [2008] can help serve as a starting point for educators in understanding the best practices for teaching and learning in Second Life.

3. STUDY

3.1 Protocol

To understand how Second Life may be failing educators as a collaborative virtual learning environment (CVLE), I performed a qualitative case study. This study was aimed at examining how university-level educators have used Second Life initially, how that use has changed over time, and how they perceive future use of Second Life or other virtual worlds as CVLEs. This study was designed as a collective, instrumental case study as outlined by Creswell et al. [2007].

3.1.1 Participants

Six university-level educators participated in the study. The participants were identified as educators who had used Second Life for educational purposes for an extended length of time. Educators were required to have used Second Life in some way within college courses for more than one academic semester, allowing time to develop and alter teaching strategies over time. Participants were all located within universities across the United States and had taught courses at the collegiate level for more than a year. The participants taught in a variety of disciplines, though most participants came from art and education disciplines. While this may potentially create an inclination towards certain experiences within Second Life, I believe that these university-level educators, while having diverse backgrounds and disciplines, experience the same

affordances and barriers of Second Life, but at varying degrees of each depending on their situations.

By limiting use of Second Life to college professors, curriculum design has more freedom as compared to K-12 educational design. In addition to a more flexible curriculum, this helps create a baseline for their student population's age as Second Life's virtual world experience is designed for those 18 years of age or older.

3.1.2 Interviews

Each participant was asked the same series of nine open-ended questions to assess their use of Second Life as a Collaborative Virtual Learning Environment. The nine questions were as follows:

1. What were your reasons for adopting Second Life for educational purposes?
2. What reasons, if any, did you have against adopting Second Life for educational purposes?
3. What has Second Life afforded you as an educator and how have you explored these affordances during your use of Second Life?
4. Have these affordances altered your teaching methodologies, pedagogy, curriculum, and/or instruction? If so, how?
5. Have these changes to teaching affected your students learning, and if so, how?

6. What barriers, if any, have you faced in using Second Life as an educator and how have you overcome these barriers, if at all?
7. Have these barriers inhibited your students learning, and if so, how?
8. Have these barriers deterred you using Second Life, or a future system like Second Life, more for education, and if so, why?
9. What features, tools, or mechanisms do you think are important and/or necessary for Second Life or a future system like Second Life to include in order to better facilitate you as an educator and in order to better facilitate learning?

These nine questions were designed to provoke reflection of an educator's use of Second Life over time, and the questionnaire was projected to take approximately one hour to complete. Participants were encouraged to take as long as they wanted answering the questionnaire with as little or as much information as they liked.

3.1.3 Data Collection

Questionnaires were sent out via secure e-mail communications to publicly available academic addresses. Communications were kept confidential and each participant was corresponded with individually. Responses were stored locally by assigning a number to the questionnaire that was then used for subsequent response coding.

3.2 Results

While individuals may have unique situations and reasons for adopting Second Life to use as an education tool, there are common themes among them. One of the most prevalent ways that participants are introduced to Second Life as a collaborative virtual learning environment (CVLE) was through a “word-of-mouth” style of advertising. These introductions were done in a number of ways. One participant acknowledged that discussions with a colleague had revealed Second Life’s possibilities as a teaching tool. Another educator noted that he was first exposed to Second Life while he was enrolled in an education course as a graduate student. It is important to note how the spread of Second Life within the educational community appears to come more from the bottom level of the educational institution hierarchy. Here educators must convince their superiors as well as their colleagues of the validity of virtual worlds as CVLEs. This is similar to how groupware systems must operate within an organization. Grudin [1994] notes that “an organization may adapt to a large computer application, but a [groupware] application must adapt to the organization, fitting into existing work patterns and appealing to everyone who must support it.” Here Second Life is a system that must fit into existing pedagogy and curriculum in order to successfully appeal to the entire educational community. By looking at educators’ initial reasons being for or against adoption of Second Life and how they have actually employed Second Life as a CVLE, I can view their use within a groupware context. This allows certain conclusions to be made to aid developers of current and future virtual worlds in effectively creating and supporting a sound pedagogical experience as a CVLE.

3.2.1 Affordances and Barriers of Second Life in Education

Warburton [2009] identifies eight affordances Second Life has for facilitating innovations in pedagogy in addition to eight categories of barriers educators must overcome in order to use Second Life in education (Table 1). Participants in this study also identified the possibilities and potential problems Second Life could have as a CVLE. In order for developers of virtual worlds to have their software used as CVLEs the desire to employ these affordances must outweigh the hindrances of the barriers. Having a strong initial “buy-in” is an important factor in getting educators to use the system, but examining their use of Second Life over time after the novelty fades is equally important. If educators do not feel Second Life is meeting their expectations, then they and their students will stop using it. Both adoption and retention of educators in Second Life is important and their experiences can help design and shape future virtual worlds as CVLEs. I compare participants’ responses to Warburton’s affordances and barriers to see if educators are actually encountering them, and if so, how this is affecting teaching and learning over time.

3.2.2 Affordances

Second Life presents several opportunities for educators as a CVLE. These opportunities can be readily apparent drawing the attention of educators to the platform. Other opportunities may only be fully realized once an educator starts using Second Life. How these affordances are perceived initially and over time allows virtual world

developers to attract and retain more educators over time by promotion of said affordances.

Table 1. Warburton's Affordances and Barriers of Second Life [Warburton 2009]

Affordances	Barriers
1. Extended or rich interactions	1. Technical
2. Visualization and contextualization	2. Scaffolding persistence and social
3. Authentic content and culture	discovery
4. Identity play	3. Culture
5. Immersion	4. Collaboration
6. Simulation	5. Time
7. Community presence	6. Economic
8. Content production	7. Standards
	8. Identity

According to Warburton, Second Life's affordance of **visualization and contextualization** allows the (re)production of content that may be "historically lost, too distant, too costly, imaginary, futuristic, or impossible to see by the human eye." With the ability to quickly and easily construct objects in Second Life as compared to the real world, it allows people to quickly view information and different perspectives rapidly. This was readily identified as a reason to adopt Second Life for educational purposes initially and was explored over time. One participant mentioned that Second Life

provided an effective means of teaching Utopian versus Dystopian architectures. The ability to visualize juxtaposed example structures allows a pedagogically efficient way to learn this type of material – something that would be more difficult to accomplish in other environments.

Another initially identified affordance similar to **visualization and contextualization** was that of **simulation**. Warburton differentiates these two by describing **simulation** as a modeling or reproduction of an existing system that can be created more easily in a virtual world by overcoming real-world physical constraints. Creating simulations can greatly benefit many fields of study including the natural sciences by being able to recreate processes that are too time consuming or difficult to view in a real-world context such as biological reactions. One participant, who teaches undergraduate Chemistry, identified this affordance as one of the very reasons for adopting Second Life. The potential to help students better understand three-dimensional molecular structures through a three-dimensional virtual environment led to the creation of learning modules utilizing Second Life's ability to simulate these structures in its three-dimensional environment. At the time of writing, the participant was conducting a pilot study to evaluate these modules and to determine if this method was superior to traditional curriculum within a lab space.

In addition to recreating artifacts from the real world, people are also allowed to create new and unique interactions not only between each other, but also with virtual objects. In Second Life the physical boundaries are relaxed and users are able to create their own **authentic content and culture**. By utilizing the medium of Second Life,

educators can create their own content that would be next to impossible to recreate in the real world. Participants not only identified these possibilities initially but also actively explored this affordance as they used Second Life. Explorations of this affordance, for example, had students think about virtual service such as contributing to virtual memorials or social projects such as the *1001 Journals Project* [One Thousand and One Journals 2011]. Participants also let students discover Second Life's public culture and ecosystem through experiential fieldtrips. One participant describes such a field trip:

[I] discuss art in the SL environments, or as environments. I am inspired by the practices of contemporary artists as sources for exemplary aims, content, pedagogy, and outcomes in conceptualizing art education classrooms as experiential investigations of interrelationships of self and the world through sensory and augmented interaction with the environment. Some artists use the medium of Second Life for their art. I introduce students to these contemporary artists.

This **authentic content and culture** not only exposed students to new forms of art, but also allowed them to learn the meta-impact the virtual world medium on it. This ability to create unique objects and interactions has huge possibilities for education especially in the arts and social sciences, but not all of the content and culture within Second Life is desired as discussed in section 3.2.4.

In a similar vein to **authentic content and culture**, Second Life also provides a means of **content production**. Educators are able to make visualizations, simulations, or virtual content through Second Life's building interface. Educators can not only create virtual objects, but also script interactions between those object and with avatars. This

allows educators to make materials for their curriculum and allows students to create artifacts in Second Life for assignments. This affordance was described as another initial attraction and shares commonality with previous affordances. **Content production** identified by participants includes the previously mentioned Chemistry learning modules, virtual research symposiums, presentations, and machinima (animated movies using an existing virtual engine like Second Life). The ability to create and own things within Second Life appears to be one of the most important factors in choosing and using Second Life as a CVLE as it allows educators seemingly unbounded creativity in the virtual environment.

The ability to feel part of the virtual world was also a very alluring effect. Virtual worlds like Second Life allow a varied form of presence and create an all-encompassing experience. This quality of **immersion** allows users a sense of place (relative identity) and space (spatial proximity) in a similar manner to the real world. This allows educators and their students to feel like they are a part of the environment. Several participants noted that the immersive qualities of Second Life drew them to the virtual world. One educator mentioned it as a way to “bring distance education students onto campus, even if virtually” or a way to empower the disabled. Over time one educator denoted that it allowed a means to provide “provoking conversations” between like-minded students from different departments by setting up parts of virtual campuses in close spatial proximity to each other – departments that are much further apart in the real world. Another participant had created a virtual space for students to attend a weekly review session hosted every Sunday when they were unable to participate physically.

One immersive aspect of Second Life is that with avatars, users have the ability to alter their appearance quickly and easily. This **identity play** allows both educators and students to take on different personas individually or collectively. This allows for deeper social interactions and role-playing opportunities for students compared to real world scenarios. While not mentioned as a reason for adopting Second Life as a CVLE, participants did explore this affordance once they started using the system. One participant mentioned an assignment that uses avatar creation to explore identity and how having integrated avatar pedagogy in a curriculum can encourage diversity in a virtual environment. While this identity play may not be relevant to all curricula, it can be a powerful tool that allows educators to abstract identity from perception.

Educators also explored deeper communications with others through Second Life. These **extended and rich interactions** allowed educators to bring together students and peers from geospatially distant locations together in a virtual setting. This allowed for a more diverse range of discussions and opinions than would usually be possible in a single physical location. Participants also explored the rich interactions afforded them by Second Life such as in-world chat. Utilizing these different communication channels, participants were able to provide meaningful meta-analysis of their dialogues with and between their students.

Participants also felt a sense of belonging once they got into using Second Life as a CVLE. This **community presence** has allowed educators to interact, share ideas, and learn from each other. Communities such as the *Educators Coop* have allowed educators to come in contact with other like-minded individuals. This is extremely important in the

success of Second Life as a CVLE because it promotes user retention. Having a growing community provides incentive and aids in continued use while also helping new educators become acclimated to their environs. This sense of belonging is also important in groupware systems. If there are not enough users the groupware faces an issue of critical mass – a problem when not enough users are using the system to make the viable. Any barriers that educators face when attempting to use Second Life as a CVLE can cause some educators to defect, making it harder to justify its usefulness as educational software.

The responses that participants gave identify and exemplify all of Warburton's affordances of using Second Life in education. Most of the affordances were identified as key decision points in adopting Second Life as a collaborative virtual learning environment and were actively pursued and explored once participants started using the virtual world. The other affordances of **identity play**, **extended and rich interactions**, and **community presence** sprang forth over time as seemingly emergent affordances that educators were able to see and explore only after using Second Life. How these explorations of affordances have impacted educators' teaching and conversely their students' learning is discussed next.

3.2.3 Changes in Teaching and Learning

Though all participants have described ways in which they have used Second Life as a collaborative virtual learning environment (CVLE), there has not been a sweeping, massive change in their teaching methodologies. Like groupware, CVLEs are

meant to augment existing methods and practices. This is not to say that Second Life is not benefitting education, but that its integration into teaching has been selective and reserved in order to better cement its usefulness in pedagogy.

The biggest way that Second Life as a CVLE has impacted teaching is through the various forms of content creation, visualization, and simulation. Participants noted that they have altered their curricula to incorporate this artifact creation. One participant mentioned that in certain graduate level courses, a final project is set to create a virtual presentation hosted within their campus' virtual research symposium. This presentation is different from their traditional research symposium, as the virtual symposium attracts a more diverse, global audience. Students are required to use less discipline-related jargon and must be more clear and concise in order to relate to the more varied audience. The participant noted that this has gone a long way in helping students better explore their research material and develop life-long skills for writing grants or job applications. Other participants noted that they were starting to incorporate more content creation through Second Life in their curriculum, but additional time was needed to see if they were to be permanent changes. In addition to content creation, other participants used other affordances to alter their teaching methods.

The immersive nature of Second Life has also led to some interesting changes in pedagogy. One participant remarked how in their dance pedagogy class the use of the virtual world of Second Life has led students to question what makes a dance live. The participant remarked, "These questions have led to some very lively conversations; conversations that open up assumptions we did not know we even had!" This has

allowed students to think how their work (dances) will be viewed in different venues rather than depending on traditional means. Also students have discovered new ways of thinking and this has helped better understand their field.

The incorporation of identity play has also aided teaching and learning. While it was not mentioned to alter methodologies or pedagogy, it has created a different learning environment for students. One participant noted that being outspoken, comfortable in physical appearance, and confident in the real world seems to lose its advantages within Second Life. This allows chances for others without this advantage to speak and participate in discussions and events within the virtual world. Rather than being a more passive, reserved observer in the real world, these students can learn more by feeling less awkward asking questions thus helping them better understand the material.

The rich interactions that Second Life's communication layers afford have also allowed educators to be more analytical with their curriculum. One participant has improved their process in teaching pre-service teachers in Second Life and in the real world by reviewing chat logs. By performing a meta-analysis of chat logs in class, their students had more potential to better facilitate dialogue with their future students. This analysis is something that is more difficult to do in a face-to-face environment, given that someone must take notes as opposed to having an archived log of verbatim text. It has also helped students become more reflective in their participation in discussions. With these logs, students were also able to reflect on the conversation as a whole before the next class, allowing for a more aware contribution in the discussion.

The community presence within Second Life has also led to how educators think about technology in education as another participant was more motivated to integrate Second Life in to the curriculum based on work others have done within the community. These changes have been very selective, and only when it will appropriately serve an existing concept to be learned. This has also benefited students, as the exposure to virtual world technology in a learning environment has better prepared them for the challenges of teaching those who have grown up in the digital age.

Through the use of Second Life as a CVLE, educators have been slowly changing the way they teach. This can be seen through their use of Second Life in their curriculum and pedagogy. These changes have had a positive impact on learning, though it appears that this is through slow, careful, selective uses of the medium rather than a wholesale one. Why have educators been reserved with their uses of Second Life as a CVLE? One reason may have been the barriers they and their students have encountered while trying to use the virtual world.

3.2.4 Barriers

While Second Life boasts several opportunities for education, there are some downsides to adopting and using the system. Since its inception, Second Life's ecosystem has grown, but this growth can bring both positive and negative aspects. This coupled with other use-related deterrents can cause educators to be more hesitant when using Second Life as a collaborative virtual learning environment (CVLE).

One major common concern initially is what Warburton identifies as the **technological** barrier. There are several forms of technological issues, but all limit the use of Second Life as a CVLE. The only form identified as a barrier to begin using Second Life was computer hardware. In order to run Second Life smoothly, Linden Lab recommends a 2 GHz processor, 1+ GB of memory, and a relatively recent discrete 3D graphics card [Linden Research 2011c]. While more modern systems are able to account for these things, educators who wish to upgrade their current computer for a smoother experience must spend money, sometimes their own, in order to reach that bar. The start-up costs weighed on participants' decisions to use Second Life as a CVLE. This barrier would continue to hinder educators when their students also lacked sufficient hardware to run the software smoothly. Also, in some instances open access computers on campus were unable to run the software due to lack of security privileges. Finally, technical infrastructures such as slow network speeds when collaborating with other universities would cause more headaches during attempted use. One participant tried to make assignments in Second Life extra credit when 25% of their students could not get it to work. That too was ultimately abandoned. Other participants also had to abandon opportunities, especially with larger classes. While Second Life is not a new system, future systems that want to incorporate highly visual and immersive three-dimensional virtual worlds for education could have requirements proportionally as high, making this technological barrier an ongoing one.

Another initial concern was the **time** it would take to learn how to use Second Life. While learning to navigate and interact within the world may be relatively simple,

designing and developing teaching activities within Second Life can require a major time commitment. Educators just starting out in a virtual world like Second Life must be proficient enough to aid students in addition to learning how to construct their teaching objects. This later part may have a steep learning curve as educators may need to understand things like scripting in order to realize their designs. In Warburton's barrier of **time**, he mentions that the "design, implementation, and practice overheads in [Second Life] often require educators to develop multiple skills to deal with them." [Warburton 2009] This makes participants shy away from using Second Life in education, initially and over time. One participant said that while they were comfortable with building and developing a Second Life space, they were fortunate to have a graduate assistant to assist them. The perceived amount of work an educator must do to develop these spaces may, in some cases, outweigh the perceived student benefit. Grudin mentions this disparity as one of his eight challenges for groupware developers. An educator does not receive direct benefit of their work in Second Life, the students do. If educators perceive that their students are not benefitting enough then they may choose to leave Second Life behind for alternative means. This will be covered further in the discussion section.

The last barrier in initial adoption is what Warburton defines as **culture**. It was also the most cited reason against adopting Second Life as a CVLE. This barrier was identified in two forms – "griefing" and pornographic content. Mulligan and Patrovsky define griefing in online environments such as virtual worlds as "purposefully engaging in activities to disrupt the gaming experience of other players" [Mulligan & Patrovsky

2003]. While Second Life is not an online game with a set of goals, it does have some similarities with Massively Multiplayer Online Role-Playing Games (MMORPGs) and the educational experience of students can be the target of griefing; however, one participant said that this has become less of an issue. This could be because the popularity of Second Life in the public eye has diminished, or that griefing has become more tolerable within the online community. The second cultural issue, pornography, also was a cause of concern. Participants felt they were accountable if they exposed their students to inappropriate content. One participant mentioned in their blog that they have had students under the age of 18, and that the potential issues that pornographic exposure could cause kept Second Life use optional within their courses. Educators must continue to face this issue, especially if they want to expose their students to the positive cultural aspects of Second Life. Unfortunately, the only way participants mentioned overcoming this barrier was through the use of private spaces where only a select few are allowed to go. This unfortunate turn of events may be a failure of intuition on part of the developers, similar to Grudin's groupware developers. The permissions for adult spaces may be too limiting for educator's to fully realize Second Life's authentic content and culture. Developers of Second Life and future virtual world systems can learn from their mistakes and suggestions for more robust controls will be discussed later.

Once educators started using Second Life as a CVLE, they encountered even more difficulties. One such difficulty was in the creation and maintenance of their educational presence in Second Life. While the cost of creating an avatar and actually logging in to Second Life is free, creating and maintaining teaching spaces is not. As of

December 31, 2010 the cost of owning a private island in Second Life stands at \$1000 US and almost \$300 in monthly fees [Linden Research 2011a]. Previously, educators and non-profit organizations had a more affordable rate; though one participant mentioned even this rate put a strain on funding. One method of overcoming this barrier was to band together and cooperatively share a private island, thus sharing costs. This was done by either forming separate non-profit organizations or by coming together under academic institutions. The **economic** barrier may vary for different platforms and Second Life's model appears to be more targeted institutionally rather than a group level. Anticipating how the system is adopted and used can provide insights to how economic models should be structured, and the affordability of owned spaces is extremely important for educators to implement their curriculum. One educator tells the story of the events that led them to stop using Second Life as a CVLE:

I was looking for a platform from and on which to launch as assessment research and development project. I wasn't able to do that as I could not attach an outside platform/software/or data management tool to SL. Consequently, I did greatly enjoy what my students and I did in SL and on the island, but the economy took a tumble as you know and so....well...I did try and rent part of the island...That worked for about a week until [a colleague] went to visit the bar that my renter built on the island and discovered the pornographic implications and so.....I shut the bar down and then foreclosed on the island. This is not to say that I won't go back to the virtual world...I certainly plan to. But, for now I am working on the original research project through software development.

This interesting anecdote demonstrates encounters with what Warburton refers to the **standards** and **identity** barriers. Without being able to interface with tools that might be able to measure and share metrics, teachers may have difficulty in assessing student performance, thus making it more difficult to see their work's benefits. Grudin also describes this as a difficulty in evaluation in groupware systems, and interoperability between Second Life and other educational platforms can help assess if its use as a CVLE validates the pedagogy it facilitates. While trying to overcome the economic barrier, the participant unfortunately came into a misrepresentation of identity and reputation. With anonymity allowing for accountability to be shunted, educators take an avoidance stance. This tends to coincide with aforementioned barrier of culture and makes for a more private, isolated experience – potentially limiting beneficial experiences.

The last two barriers that Warburton discusses deal with **collaboration** and **social discovery**. Warburton calls for scaffolding cooperation and community so that educators can more readily find each other to build trusted, authentic connections. Participants belong to communities and groups, newsletters and listservs, and some have blogs and personal web sites that allow them to search, contact, and collaborate with one another. All of these things are external to Second Life as participants merely side-stepped these issues with other traditional forms of media and communication. That is not to say that these are not barriers with Second Life, but that these barriers are diffused into the time, effort, and economic viability of an entire ecosystem that may be required by educators when using Second Life. This can be a shared burden with other parts of

the curriculum that do not explicitly require Second Life and be advantageous to educators by reducing redundancy. Grudin mentions that groupware must have unobtrusive accessibility, and that it cannot adversely impact other processes with its features. Developers of virtual worlds can take note of this observation and move to a design that can incorporate it.

The final barrier encountered by educators when adopting or using Second Life as a CVLE was not mentioned by Warburton: the acceptance of Second Life as a legitimate teaching tool. Participants noted that they had to advocate the use of Second Life to their peers and superiors. Some individuals have a negative bias against Second Life, often calling it a video game. This perception hints that anything that takes place within the virtual world is for fun and not to be taken seriously. The only way educators are able to overcome this barrier is by slowly changing this bias. This issue of **legitimacy** draws upon issues of critical mass as well as interrupting in-place curriculum development. Those in positions that dictate over-arching curricula may not be sufficiently motivated to consider Second Life as a CVLE due to a lack of perceived benefit compared to other, more traditional methods. The acceptance of Second Life as a CVLE is a slow process and virtual world developers can take note in how to help this issue by drawing parallels to groupware systems.

3.2.5 Inhibition of Learning and Future Use as a CVLE

When asked whether the barriers they had encountered had negatively impacted their students learning, participants' responses varied based upon the context in which

they used Second Life as a CVLE. One barrier that did impact student learning was that of technology. This effect varied based on the number of total students that educators were trying to incorporate in the virtual environment at a time; the more students there were, the more of a negative impact the educators perceived. Larger class sizes would mean educators were more likely to encounter a significant enough sample of students that could not use Second Life due to their own system limitations. This posed a significant frustration on behalf of both students and educators, which was only exacerbated by administration. In order to make the use of Second Life cost effective, large numbers of students must be present simultaneously, which puts a strain on connectivity of the current infrastructure. Another technological limitation to learning is that Second Life is poised to be an alternative learning format. Some students are technophobic, and require more face-to-face interactions in order to overcome discomfort in a purely virtual world. Though this technophobia may diminish as technology becomes a larger mainstay, face-to-face interaction will still probably be preferred by some as the major means of collaborative learning. With that being said, participants felt that this technological barrier did not deter them from using Second Life or future virtual worlds as a CVLEs and that embracing and integrating technology will be key to the 21st century classroom.

Another way students' learning was inhibited was by the biases students had with the medium of Second Life. Similar to how students perceived Second Life in [Herold 2009], participants' students did not look at Second Life seriously. Sensationalism in the media often puts Second Life in a negative light, such as [Hutcheon 2006] or [Dibbel

2008], showing the most educationally undesirable aspects and highlighting the very worst the virtual world allows for students. On top of these negative portrayals, virtual worlds are more commonly associated with video games, such as World of Warcraft. Yet through advocacy of educators, these prejudices are being overcome. Though the issue of educational legitimacy may be interfering with student learning, it does not seem to deter educators from using Second Life as a CVLE. One participant firmly believes that while students are first reluctant, they almost always warm up to Second Life once they use it, and that this will only improve with time and exposure in the future.

An issue that did impact learning was time. One participant noted that there were many potential learning possibilities, but the sheer amount of time it would take to prepare the right venues to utilize them, the right environments for participation, and the right times for people to come together virtually was extremely daunting. Students also must become accustomed to the controls and conventions of Second Life, especially if they are new to virtual worlds. This preparation time deters educators from using Second Life and future virtual worlds more because the perceived work – benefit imbalance.

The biggest deterrent in educational use and learning was the undesirable aspects of the Second Life culture. Participants note that explorations of the authentic content and environments within public space in Second Life had to be carefully planned and executed in order to avoid these seedy aspects. This forfeits valuable material for students to take in, and if students do encounter the less admirable qualities of Second Life's culture, it can hinder and distract them from the learning process. As such, one

participant had to rein back the use of Second Life in order to more appropriately address potential encounters face-to-face with students. The feeling of moral responsibility for students takes precedence the learning opportunities that can be found Second Life's public space, and as such, deterred participants from future Second Life use in education.

4. DISCUSSION

With all of Warburton's affordances and barriers being encountered by such a small sampling of university-level, it leads me to believe that educators, at least at the university level, are able to easily identify and explore the educational opportunities that Second Life provides but also quickly encounter the issues with its use as a CVLE. Second Life is a good start, but I would say that most of its use educationally is through early-adopting educators. In order to cross Moore's proverbial software adoption chasm [Moore 2002], addressing the barriers of entry and retention will be key for Second Life and future virtual worlds if they are to continue as effective CVLE options.

4.1 Managing Work vs. Benefit - Reducing Development Time

Educators are less inclined to spend the additional work to design and develop lessons and assignments in Second Life if they feel like the students will not receive any additional benefit from it than traditional teaching means. In order to address the disparity of this work versus benefit, Grudin suggests that reducing a non-beneficiary's work is a means of addressing this issue. With the use of Second Life as a CVLE, educators are the primary non-beneficiaries since their students are the primary beneficiaries. Educators identified that the amount of time to practice and develop educational materials within Second Life was a major barrier in its use as a CVLE. The work to develop these materials does take time, but reducing the time and difficulty to create materials also reduces the perceived workload of the educator. Virtual world

developers can reduce this time and effort through a robust development platform for educators. Some features of this platform are described next.

One part of this platform would be an Integrated Development Environment (IDE). An IDE is an important tool for software developers and some developers release their IDE to the public such as *Epic's Unreal Engine*. In the case of educators, virtual world developers could offer a system that would allow them to privately design, iteratively develop, and test their modules before releasing them into the virtual world. This system would be tailored to be a simpler environment when compared to traditional programming environments, streamlining the interactions to primarily feature the base visual and interactive elements educators need to effectively construct their virtual objects, allowing for more advanced use through options and modules.

In addition to an IDE, the scripting language needs to be abstracted down to more basic features. Educators should not need an advanced understanding of programming theory in order to reliably script interactions between their objects. Due to a virtual world's visual nature, a Visual Programming Language (VPL) may be the most logical solution. VPLs such as *Kodu* or *3DVIA Virtools* allow for certain aspects and relationships of the program to be described as visual elements such as arrows, colors, and lines. This could be advantageous to educators as this approach could easily integrate with the visual elements of their virtual objects. By having a linking mechanism in the IDE along with an intuitive visual drag-and-drop approach to programmatic elements, educators would spend less time learning how to use the tools, and more time could be utilized in designing their pedagogy in the virtual world.

The final approach to reducing development time is through the use of templates. Educators can reduce the time it takes to effectively create learning modules and situations by using template-based learning. Teaching methodologies such as Inquiry-Based Learning have utilized template-based learning in other environments such as the web [Davis 2006] [WebQuest 2005]. By providing a means to abstract the learning methodology from the actual material, educators would have a reusable technique to potentially apply, modify, or expand upon without having to start from nothing. This could also benefit the educational community by allowing educators to share approaches and methods without explicitly attaching contextual content to the template, allowing other educators to benefit from each other's pedagogical work and spend less time deconstructing a finalized product.

This integrated development platform aims to help educators with Warburton's barrier of time. By addressing the upfront cost of educational development, virtual world developers can reduce educators' workloads, thus reducing the disparity of their pedagogical development work versus the benefits their students have learning in a virtual world.

4.2 Towards an Integrated Ecosystem

Second Life is but one of many virtual worlds that can be utilized as Collaborative Virtual Learning Environments (CVLEs) and CVLEs are but one of many tools educators have at their disposal. While it has the potential to be a standalone platform that can service many forms of education, the ability to interoperate with other

tools, services, and platforms will be a more powerful approach towards acceptance and awareness of Second Life in education.

4.2.1 Standardization

Warburton discusses the issues of standardization in terms of locked investment in a single platform – in this case Second Life. By standardizing elements of Second Life such as avatars or contact lists, they can be easily portable to new platforms. This is an interesting approach, but it may be too narrow of a scope when we look at the educational ecosystem as a whole. Educators have endless ideas on using technology in the classroom. Whether it is a virtual learning environment like *Blackboard* or a web service like *Flickr*, educators are integrating and utilizing several different forms of technology in the classroom in addition to Second Life. To a hammer everything is a nail, and to a virtual world everything can be done virtually. Virtual world designers envision that everything can be done in the virtual world, but the fact is that Second Life is currently an infrequently used tool in the educator's toolbox. This is evidenced by the scenarios participants use Second Life for as they teach over time – small, intimate situations or supplemental experiences. By contextualizing Second Life as a groupware system, we can see that Grudin identifies this as a challenge of **designing for infrequently used features**. In the workplace, groupware or collaborative features are used infrequently in the greater scheme of things. In this way, Grudin suggests that the integration of groupware features into existing successful applications may be a better

approach than a freestanding application. While a virtual world may still need to be freestanding, a heavily integrated approach may be possible.

With ecosystems like *Web 2.0*, services and applications are highly interoperable with each other. Participants in the study also revealed a desire to be able to integrate with these services. Efforts have been made to integrate Second Life with learning environments such as SLOODLE [SLOODLE 2011] or the Blackboard Greenhouse Project for Virtual Worlds [IDIA 2009]. This is an excellent start but to create true interoperability, Second Life and other virtual worlds need to assess what information will be valuable to outside educational systems and construct an application programming interface (API) based around those artifacts. This API would need to be constructed using standardized libraries in languages like *Ruby*, *PHP*, or *Python* or by standardized protocols such as *REST*. These APIs would also be integrated as visual elements in the visual programming language of the aforementioned development environment, allowing educators easy interfaces to and from other platforms.

The interactivity these APIs would help educators with their **difficulty in evaluating** Second Life as a CVLE. Grudin notes that in groupware group-oriented interactions and tasks are much more difficult to evaluate compared to single user applications. The variability of individuals in the group, the influence of the environment, and the less precise evaluation methods contribute to the overall effectiveness of the groupware. Second Life faces a similar issue with most experimental methods being more difficult to create, more difficult to collect data, and more difficult to reproduce results. Grudin suggests that by formulating definitive studies and then

disseminating the results to others so that they may reproduce them with their own unique situations and groups, groupware developers can better evaluate the effectiveness of groupware products or platforms. Virtual world developers can stand to benefit from this approach since the ability of their users to more easily evaluate the virtual world's use and disseminate their results leads to the success of their software.

The use of these integrated APIs within the development environment would allow educators to more easily attach collection software or collect metrics of their own. These mechanisms are necessary on multiple levels within the educational system. The ability to quantitatively collect metrics allows teachers to more easily verify the effectiveness of a particular educational approach. Like a research environment, these metrics collected help determine the validity of an approach to particular audiences in the short term as well as see how evolving an approach influences learning over time. These standardized metrics can then be shared and curriculum can be reproduced to verify the results of other educators. This not only aids educators in the development of sound pedagogy in virtual worlds, but helps to reinforce the **legitimacy** of Second Life as a CVLE by showing clear concise results to those in the community.

By backing up the use of virtual worlds in education with solid, reproducible data, educators have a stronger platform to help motivate those with biases with using virtual worlds as CVLEs or those in positions critical to its continued use. Evaluation and adoption will encourage more evaluation and adoption, ultimately aiding the virtual world in achieving a critical mass of educators without disrupting existing educational processes.

4.2.2 Promoting Third-Party Development

In addition to an interaction layer with APIs, virtual world developers should also look to promoting an application development community. Second Life features a marketplace, where developers and builders can market their objects, scripts, and augmentations for free or a price. If a seller markets their goods for a price, a sale of the produce nets Linden Lab a portion of the proceeds and the remaining amount goes to the seller. Other development communities have thrived on this model such as *Apple's App Store*. A shift from private development to more off-the-shelf products allows third-party developers to more easily design and market reusable widgets. Having more users buying a product allows developers to offer their goods at lower prices while potentially making more money due to wider market penetration. Secondly, this helps educators out by increasing the availability of products they can use educationally within the virtual world while simultaneously making it less expensive due to lower prices per widget and also reducing the reliance on custom development. Finally, it helps the company or developers responsible for the virtual world, as the percentage fees can go towards company profits. This creates a revenue stream for the company that may allow them to reduce pricing for users, such as reduced land ownership costs or decreased costs to upload textures. All of these things help to reduce the **economic** barrier educators must face when using Second Life as a Collaborative Virtual Learning Environment.

4.3 Promoting the Virtual World Experience

Participating in the virtual world is a unique experience both individually, and collaboratively. Many aspects that have grown and flourished within the virtual world of Second Life provide invaluable educational scenarios that the real world is incapable of reproducing. If developers are to encourage sound educational experiences within their virtual worlds like Second Life, they must consider the individual and group experiences both inside and outside of the virtual world.

4.3.1 Maintaining Both Culture and Education

As revealed in the study, a major benefit of Second Life being open to everyone is that it allows the formation of its own authentic content and culture. Artists are able to express themselves in a new medium, communities can form, and members can form social practices outside the normal boundaries of real-world society. The study also revealed that this freedom can work in a less desirable manner as well with pornography, grieving, and deception. The main approach of educators use to combat these negative elements is seclusion, but doing so also isolates them from the positive aspects of this freedom. While it may be difficult to eliminate all of the elements educators do not want to expose their students to, there may be a way to filter them.

The manner in which educators and their students need to interact with Second Life is a slightly different manner from the normal interaction scenario. Their interaction with the virtual world is more restrictive than the general adult user. The problem is that Second Life's permission policies are not robust enough to encounter the different situations that

educators want. Currently educators are able to restrict access to land and objects they own. The accessibility of these things is fairly simple such as white and black lists for users, selective group access, and public access. There are two problems with this approach. One is that tightening access to a smaller set of users starts to limit spontaneous discovery and collaboration with others. The second problem is that this does not protect students when they venture into public areas on “field trips.” This design approach is similar to a groupware’s inability to foresee and **handle exceptions** to workflow practices in the workplace. Grudin suggests that in order to help facilitate exceptions in the process, allowing tailorable systems is an effective step towards flexibility. In order to help educators facilitate spontaneous communication and collaboration as well as protect students, especially those under 18, a flexible, inclusive visibility policy should be included.

In the study, educators felt responsible for their students’ wellbeing and felt morally obligated to protect their students from negative aspects of Second Life. There is a process to verify age and identity in Second Life, allowing users a level of authenticity and accountability for their interactions in the virtual world. This verification is only voluntary, and even with this verification, the issues of trust building and relationship forming is still arbitrary since users are not required to obey real-world societal norms within the virtual environment in both their actions and content. With an inclusive visibility paradigm, educators can become a filtering mechanism allowing their students to only see others’ communication and content. This would work in tandem with the current permissions in order to provide a more collaborative community.

This inclusive policy would work at the user or user group level. Educators would form a group with their students, with the educator being the head of the group in order to manage the permissions. This part of the process already exists now, giving students access to private educational regions in order to have access to the educator's material. In addition to this access policy, a visibility policy can also be in place.

Educators can add other users to the visibility by varying amounts of granularity:

1. Individually
2. Group
3. Public - Identity Verified
4. Public - General

When a user is placed on the visibility list, students are able to see that user's avatar, see their communications in chat channels, and view the content that particular user has created. Users not on the visibility list are not rendered to the students, nor are their communications or objects. This allows educators to become the filter in which their students view the virtual world. The following example illustrates how this would work using a real-world analogy:

An educator wants to take her students on a field trip to a museum. It's a well-respected museum with some of the finest exhibits in the city. The only problem is that it's located in the middle of the red light district. On the date of the field trip the educator programs special goggles for each of her students to allow them to view only the museum, its exhibits, and the tour guides. These goggles block out all other negative things from the

area including the surrounding buildings, graffiti, and individuals. This allows the educator to keep the focus of the field trip on the material and the learning experience.

This may seem a little farfetched in a real-world situation, but in a virtual world we can ignore certain physical restraints. This inclusionary interaction allows educators to show what they want to show. This has two major benefits.

One benefit is that it does not isolate students from the positive authentic content and culture that grows within the virtual world. By relegating students to private walled spaces within the virtual world, educators limit the possibilities afforded by virtual cultures altogether. This new permissions policy allows unhindered formation of a virtual world's culture and content, allowing it form naturally. At the same time it has the power to let educators protect their students from elements of the culture they do not feel is appropriate for the learning environment.

The second benefit is that it allows educators and educational institutions to be more open with their virtual spaces. A more public environment allows others to explore and interact with educators and can lead to more spontaneous interactions. If an educator is giving a lecture on their virtual campus, a less stringent access policy might allow a fellow educator from another virtual university to sit in and listen to the topic. Sitting in on this topic would not disrupt the student's learning because the visibility policy would hide that avatar's presence and communication from the students. Afterwards the educators could share thoughts, information, or materials pertaining to the lecture with one another opening a new collaborative effort that would not have been possible if the lecture space was limited to only the students.

Another result may be a secondary benefit. Depending on its implementation, the visibility policy could actually ease the technological requirements for students. While the technological barrier would not be eliminated entirely, the visibility could ease both graphical and bandwidth requirements for students. As long as the policy was handled on the server-side, objects and communication that were blocked by the policy would not be graphically viewed on the client, effectively cutting down on the amount of polygons and textures that would have to be downloaded and rendered. While this may vary from situation to situation, it might be another way to keep a baseline user experience among students the same.

By adding this flexible and powerful inclusionary visibility policy, virtual world developers are able to harness a tailored interaction scheme that handles interaction paradigms that are an exception to their normal designs. This policy allows for educators to create custom interactions with both objects and people while also staying open to those wishing to shape its culture freely. This aims to help educators overcome the perceived negative cultural barriers as well as let them act as a filter for students, allowing them to better account for the influences and interactions others have within their learning environment.

4.3.2 Scaffolding Collaboration and Persistence

Educators in the case study revealed that they had side stepped the barrier of collaboration by using pre-existing tools for collaboration such as blogs, but they also indicated that they would like to have a common area to communicate ideas and

interests. This leads me to believe that while communities exist externally to support interactions and collaboration within Second Life, these communities may be isolated from one another. The communities may exist in the form of a forum to a topical blog, a newsgroup, or academic organization, but these communities may not overlap and as such, may not be aware of one another. The discovery of and interaction with a different community may be difficult for an individual or group of educators.

Part of this difficulty may arise from the obscurity in which different communities exist. A quick search for groups within Second Life revealed several in-world groups related to education, but the context is sparse with little more information on the group than a mission statement and a member roster. The link between a group within Second Life and an associated collaboration mechanism like a blog, website, or forum is little more than a hyperlink. The opposite is true of finding communities through non-virtual world means as well. The social discovery of individuals and groups between both environments remains relatively isolated. Warburton hints that part of this is due to the relative isolation avatars have in the virtual world. Avatars and their activities exist only within the virtual world and when the user is not present in world, collaboration and communication is limited. While Warburton indicates that some sites are moving to support virtual world groups, Second Life developers could take a similar approach to avatar persistence that massively multiplayer online role-playing games (MMORPGs) do.

In addition to the communication layers present in MMORPGs, several game developers host a means of social discovery external to the in-game world. Games like

Final Fantasy XI allow in-game communities to be searched for based certain qualifiers or browse communities based upon how each group categorized themselves into a subset of game activities. Here users are able to collaborate externally to the game and are able to communicate with each other as well as view each other's avatar. This provides a more platform specific approach to avatar and social persistence that allows people to communicate and collaborate with each other outside the confines of the virtual world. Developers of virtual worlds that wish to have their worlds used as collaborative virtual learning environments can take a similar approach to avatar persistence and group collaboration. By allowing access to robust avatar profiles, users can interact with each other outside the confines of the virtual world medium, allowing them to find and communicate with each other more easily. While community goals in Second Life may differ from game goals in MMORPGs, they have the potential to be categorized or tagged to allow for a more efficient discovery mechanism.

Another mechanism that MMORPG and other online communities possess is self-maintainable avatar profiles through third party widgets. A common collaboration environment outside of a game is a forum or message board. Here users are able to customize their community profile with unique signatures that can be appended to each post. Users in MMORPGs such as *World of Warcraft* often use their signature space to post avatar statistics such as levels, equipment, or affiliations. This creates a manual form of avatar persistence outside of a MMORPG's official means. Some sites also collect user's avatar information and store it in databases and allow users to update information periodically. These sites are able to generate custom images or embedded

frames so that users may put them in multiple forum signatures across the Internet. This portable avatar persistence allows users to link their identity to that of the game world. Virtual world developers and educators can take this approach to help tie virtual identity and community to other collaborative tools. This form of avatar persistence allows for groups to socially discover each other while providing a certain degree of virtual presence. While virtual worlds like Second Life may not be as goal-driven as MMORPGs, their communities form goals of their own and can behave similarly to that of a game's community.

4.4 The Technological Conundrum and Knowing Your Audience

The three-dimensional virtual world and technology are tightly coupled. Striking visuals and online collaboration demand a high price in both computational power and networking potential. If a designer creates the virtual world for a homogenized, low technology experience, there will be those that dislike the system for not being sharp enough or being too slow. Make the specifications too high, and the audience will not be able to run the program. Deciding on what the common ground is will likely be a persistent problem for virtual worlds now and in the future because when the next newer virtual world is released it will have probably have a higher set of requirements to run it than Second Life does today in order to satisfy the needs of some users.

There may be no right answers to how low or high the technological bar should be, but developers should always bear in mind how their target audience will adopt and use the system. Developers must take into consideration that their software is to be used

by groups of individuals that have different situations, but still want to have a uniform experience. By understanding and envisioning how virtual worlds will best fit into the educational environment, developers can better design for their prospective users.

Educators must also effectively understand the scenarios in which virtual worlds can be used as Collaborative Virtual Learning Environments. Educators must also know their students' audience, and a virtual world may not work in all situations either technically or educationally. By careful selection and use of virtual worlds in education, virtual worlds like Second Life can become a versatile tool in pedagogy.

5. CONCLUSIONS AND FUTURE WORK

Second Life's use as a collaborative virtual learning environment holds a great deal of potential, but its current state of use is just the tip of the iceberg pedagogically. By examining how educators are currently using Second Life initially and over time, I have seen how they are using the virtual world in education and what issues they have encountered as well. Since educators appear to be adopting Second Life similarly to how users may adopt a groupware system, I have drawn parallels to design challenges that groupware developers must face and suggested features that should be incorporated into virtual worlds by developers so that they may be better used in education.

One suggestion is the inclusion of an easy, simple to use integrated development environment (IDE) that features a more accessible scripting language such as a Visual Programming Language (VPL) as well as the ability to create and modify learning modules or templates that can be easily share and reused within the community. This IDE would help effectively reduce the disparity in the work educators must do versus the perceived benefit that their students would receive as well as help to reduce the time it takes to develop lessons and educational object within the virtual world.

Another suggestion is through the creation of a standardized application programming interface (API). This API would allow educators and third-party developers to more easily integrate virtual worlds into other educational platforms and integrate other tools and applications such as evaluation software more easily into the virtual world. Through this standardization, educators can also help legitimize virtual

worlds in education through the establishment of evaluation metrics. Finally, through the establishment of a robust API, virtual world developers can better encourage third party developers to create applications for their world allowing for another avenue of monetization and potentially reducing the economic burden on educators through the use and re-use of these third-party widgets.

In order to encourage independent virtual culture growth as well as protecting the educational experience with these cultural artifacts, a visibility policy should be implemented in addition to current accessibility rules. This visibility policy would allow unfettered growth of the online community while simultaneously allowing educators to protect their students by filtering out unwanted aspects of said culture. This has the benefit of allowing educators and students to experience aspects of the virtual world that are educationally valuable as well as allowing educational experiences to be undisturbed by outside interaction.

Finally, virtual world developers should take steps towards avatar persistence similar to approaches taken by other video games such as World of Warcraft. By providing an official collaboration tool with integrated avatar usage, educators would be able to more easily discover other groups and individuals that share similar interests. In addition to this tool, developers can allow for the inclusion of avatar profiles on other external collaborative tools such as forums. These profiles allow educators to carry and share their virtual identity and information wherever they go. This would aid in the discovery of other communities and new collaborative avenues.

In the future, researchers should explore what features virtual world developers need to consider to create usable integrated development environments and application programming interfaces for educators and how these tools may be used to help educators create, share, and collaborate on educational materials inside and outside of virtual worlds. Future studies should be conducted by interviewing educators for requirements gathering and feature extraction. These results can be compared to other types of IDEs to help create a full-featured IDE to work with virtual worlds like *OpenSim*. From this IDE we can test whether a simplified development environment will help teachers more easily create learning artifacts and be able to create them in a shorter amount of time.

Virtual worlds have a great deal of potential as CVLEs, and with careful design and implementation they may eventually become common place within education. Second Life marks a starting point to mass adoption of virtual worlds in education, and once educators discover what it can be best used for pedagogically, we may see the acceptance of virtual worlds as a valuable tool to teach digital natives of the future.

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