Technical Challenges and Solutions: Creating Virtual Environments for a Health Science Interprofessional Course

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ABSTRACT

Virtual interactive environments such as Second Life are emerging as innovative tools that can support and enhance learning in various educational domains. However, for the educational practitioner new to these environments, developing educational settings and activities in a virtual environment can appear to be technically complex and beyond their area of expertise. This case study describes some of the technical challenges encountered and the solutions derived during the development of a virtual world for the delivery of a health science interprofessional communications course.

INTRODUCTION

The nature of health service delivery has changed dramatically with a more targeted focus on collaborative practice involving healthcare teams.[1] For health care educators, this change means health care education must include traditional discipline-specific training but must also include training in team-based problem-solving and interprofessional communication.[2] In many health science training programs, healthcare students must demonstrate communication competency as part of their professional accreditation process.[3] As well, the CanMEDS Physician Competency Framework outlines the critical role that communication skills play in patient care for establishing rapport and trust with patients, family members, and other professionals.[4] Communication competency includes effective interpersonal interactions as well efficient procedures for recording and relaying written information. Given these requirements and recommendations, a key component of health science education must be a program that teaches communication skills, provides practice opportunities for interprofessional interactions, and assesses communication competency.[5]

Alongside this shift toward team-based practice and communication skills in health care practice, there is also an increasing trend toward the use of technology-mediated communications to facilitate patient care.[6,7] Therefore, for optimal communication to

occur in healthcare practice, health care professionals must possess a combination of disciplinary clinical skills, interprofessional team skills, and fluency with communication technology. This can be accomplished through a program that provides practice opportunities for interprofessional and team communications using various technologies. To date, the course described in this paper has made use of a synchronous on-line learning management system (Elluminate) that allows students, guided by facilitators, to conduct a patient assessment interview using a standardized patient. The system incorporates a whiteboard to share materials and audio capacity so all participants can speak to each other. Research conducted on this version of the course indicated that interprofessional team process skills can be effectively taught in a blended (online and face-to-face) instructional environment.[8]

In an effort to enrich this experience further, we have explored technologies that can provide visual as well as audio experiences for the students. One technology that is beginning to be used for educational purposes is the virtual world *Second Life®*. The advantage of virtual worlds for communication training is that clinical settings can be replicated and standardized patients with any characteristics or conditions can be represented. Also, the use of virtual worlds provides access to off-site students and eliminates the need for physical meeting spaces to be available. There are numerous virtual world applications available. *Second Life®* was chosen for its ease of development relative to other programs and ease of access for the students.

However, for the educational practitioner new to these environments, developing educational settings and activities for health science students in a virtual environment can appear to be technically complex and beyond their area of expertise. This case study describes some of the technical challenges encountered and the solutions derived during the development of a virtual world for the delivery of a health science education course.

THE EDUCATIONAL CONTEXT
We developed a virtual world using *Second Life®* for the delivery of a mock patient interview session for health science students in an interprofessional course. With the guidance of a facilitator, students planned and enacted a patient intake conference and a discharge conference *Second Life®*. Twenty-four students volunteered to participate in a blended version of the Interprofessional Communications course that all health sciences students are required to complete. Students were recruited and provided informed consent based on the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (TCPS) which describes the policies of the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council of Canada (SSHRC).[9] This project was approved by the appropriate Ethics Review Board (EEASJ - Education, Extension, Augustana and Campus St. Jean REB) of the University of Alberta.

Out of a ten week course in which the students met for three hours once a week, two sessions were devoted to Standardized Patient (SP) interviews. An SP is a real person trained to portray or simulate an actual patient. The SP performs the history, physical findings and emotional/personality characteristics of the actual patient. The SP sessions included an intake and discharge conference amongst the students with an opportunity for debriefings with each activity. For the *Second Life®* group, one of the SP sessions was executed in *Second Life®*.

Within the *Second Life®* environment, two conference rooms were created to allow two sessions to run simultaneously, each with twelve students. Within each session, the students were further divided into groups of six. One group enacted the intake conference and the other group acted as observers and provided feedback during the debriefing. These group roles were reversed for the discharge conference.

For this particular course, the value of executing the patient interview in *Second Life®* was twofold. First, because the avatars' appearance can be changed at will, the SP's could enact several different patients or family members. Second, some of our students were distance students who needed to access the class activities via some sort of on-line technology.

THE DEVELOPMENT TEAM
For the scope of this project, a number of disciplines needed to be represented in the development team. Content expertise in the field of health sciences practice was required for the coordination of the course activities, evaluation of students and the actual material covered in the SP session. We had a faculty member and a research assistant from the health science unit to cover these requirements. For the development of the educational environment, activities and assessment of the *Second Life®* environment, the project lead was a faculty member in Education assisted by two graduate students, one for developing the physical *Second Life®* environment and tutorials and one for developing the protocol for the tutorials and SP sessions. Finally, for technical requirements, we had one faculty member from Computing Science assisted by two graduate students who executed the necessary programming to create several customized mechanisms in the *Second Life®* environment.

SECOND LIFE®

Second Life® is first and foremost a free-to-access virtual environment. It is primarily accessed via the *Second Life®* viewer available at www.SecondLife.com. This can be described most easily as being similar to an internet browser such as *Internet Explorer* or *FireFox*, as it basically serves as method for interpreting and displaying the data provided by the *Second Life®* servers in the form of a graphical 3D environment populated by objects and avatars. The servers handle positioning, scripting, and presentation of the objects and avatars, while the viewer provides users the ability to not only view the information as a 3D virtual world, but also to interact with the environment via avatars. Avatars can create, manipulate, and modify the objects within the world as well as the parameters of the virtual world itself. That, however, does not fully explain the complexity of the virtual world, society, and economy that accompanies the global phenomenon that *Second Life®* has become since its inception. *Second Life®* is maintained and run almost entirely by the very users that populate it. Users are able to buy and sell virtual land, known as regions, objects that they can create, as well as clothing and accessories for avatars alike. In fact, the currency used in *Second Life®*, Linden Dollars, are actually purchased on a virtual stock exchange, and are subject to the current exchange rate compared to currencies all around the world which is ultimately determined by the market value of land and objects traded among users in *Second Life®*.

For a user to enter *Second Life®*, after installing the viewer on their desktop computer, they need only sign up for a free account, creating an avatar with a first name of their choice, a last name chosen from a series of options, and a starting avatar appearance. The only real requirement of sign-up with *Second Life®* is a valid e-mail account. Users can then customize their avatars to resemble themselves more closely, or perhaps resemble something entirely different from themselves -- the possibilities are endless and do not even need to resemble human forms (ie. robots, animals, mystical creatures, etc). From there, users are free to access the virtual environment by moving around the various regions open to them. Since regions are purchased by other users as virtual property, owners have the option to lock the general *Second Life®* public out of their regions, or, if they choose, open it whenever and however long they like. Some users try to create regions to attract people, most often in hopes of attracting customers and commerce, while others lock out everyone except for a selection of users they choose to allow, treating their region as a virtual meeting place for participants from all over the world. Since the virtual economy has basically become the basis for interaction in the public domain of *Second Life®*, the majority of the publicly accessible regions exist in the form of market places, and other similar places of commerce. However, there is also a strong presence of (real-life) organizations looking for another venue to advertise or simply make users aware of their existence. Examples range from companies such as IBM to universities from all over the (real) world.

THE ISLAND: OWNERSHIP AND MANAGEMENT
Requirements
One of the first requirements determined to be of utmost importance for this project was to acquire a virtual space to eventually hold the sessions being held for the students. This virtual space would then provide the staff and students with a place to bring their avatars to participate in the standardized patient session planned for a single evening, but would also house tutorial information for required information to be accessed asynchronously before the session began in a manner such that students could access it on their own time and not be required to login to a scheduled session. Before anything else could be considered, however, the issue of providing a truly exclusive and private place needed to be addressed. That is, the entire virtual space used for this project should only be available to those students enrolled in the course, and not the general *Second Life®* population.

Solutions
Acquiring land in *Second Life®* is relatively simple; the only real life requirement is a credit card. A region can be purchased at a varying rate, depending primarily on the size. Following that, there are also monthly "maintenance" fees to keep the region up and running, charged by Linden Labs to maintain the real-world servers that house *Second Life®*. Although the region is square in shape, the starting land arrangement is an ovular shaped island in the center of a vast expanse of water. Once the region is purchased it is owned by the user who made the purchase. This is important to note because, in our case, the head of the project became the sole owner of the region and was the only user with permission to manipulate and modify it in any way. This would obviously make working on the project very difficult; as there would be many other users involved in the project that would need the ability to manipulate and modify the environment. The solution to this issue would be through the use of a *Second Life®* *User Group*. A group, in *Second Life®*, is a way of connecting users to one another in more than just direct communication. Certainly, direct communication in *Second Life®* among users, regardless of the region any user is currently in, has its advantages, but the primary appeal of a group in our case was the ability of the members to share Linden Dollars, Objects, and most importantly, Land. Group members can also be given different permission levels that allow them to handle any communal funds the group has, additional regions owned and operated by the group, as well as memberships to the group itself. In our case, the project lead "deeded" the land to a group we created and thereby gave permission to manipulate and modify it to the

rest of the group. In essence, the group basically took on the role of a virtual corporation in *Second Life*®, since the group *itself* took ownership of the land. The members of the project tasked with creating the virtual space were then given memberships with permissions to manage funds and modify the land.

To solve the issue of privacy required by the project, a similar solution was used. A region can be "locked" from the general *Second Life*® public by simply toggling a setting in the options menu for the region. However, the project would eventually require students to visit the region, of course, and permission to do so would need to be granted to them. Initially it was thought that the best method to allow only students and staff into the region would be to add them to an "allowed residents" list offered by an option menu of the region. While this *would* solve the issue, it also added a layer of complexity, as the students and staff attending the online session would not yet have created *Second Life*® accounts, and it would likely be overwhelming to try and add them all to the list at the time of the scheduled session. Thankfully, an unexpected benefit of having a group own the region is that any user that is a member of the group could also visit the region freely. Additionally, students and staff could join the group on their own, eliminating the need to manage a list of people allowed in the region. Thus, it was decided that students and staff, upon creating their user accounts and logging into *Second Life*®, would join the group we created, allowing them to visit the region while keeping the general public out. Finally, to prevent students from modifying the region, student and facilitators were only able to sign up for a specific type of membership in the group that would not allow them to modify the region in any way.

CREATING THE VIRTUAL CONFERENCE
Requirements
Once the region was acquired, a virtual *room* was required to house the avatars used by the students and staff to represent themselves in the virtual environment of *Second Life*®. It was also determined that there would need to be virtual space available for students to familiarize and practice the skills required to control their avatars. Additionally, there also needed to be space for students to access information relevant to their upcoming live session (e.g., videos about the standardized patient scenario they would be tasked with reviewing before their session that should be available as asynchronous media, *on demand*). The need for at least two groups to meet at the same time in different locations also meant there was a requirement for some sort of virtual building to house separate rooms. Thus, the requirements for a "virtual campus" with an open tutorial and information area, accompanied by a building in which to hold the patient sessions, was deemed necessary. Additionally, since one of the overlying goals of the project was to have the standardized patient sessions in *Second Life*® mimic the real life sessions, the construction of the building and campus would need to be crafted to represent a real life setting.

Solutions
Modifying and manipulating the *physical* state of the land in a region in *Second Life*® is relatively simple. Users within the group that owned and operated our region could float around the virtual space adjusting the height and look of the major land mass by using the land editing tools provided by the *Second Life*® viewer.

The process of building the campus was a gradual one. It began with a few *test* buildings that largely resembled shoe-box designs. This is caused, almost entirely, by the process in which any object is constructed in *Second Life*®. Be it a chair or a multi-story building, all objects are constructed by combining a number of smaller objects together, known as "prims" (short for primitives). Prims exist as extremely basic building blocks, ranging from a sphere to a multi-sided prism. In fact, among those who spend a lot of time creating structures and designs in *Second Life*®, there is a saying, "it all starts with a cube." This, of course, refers to the cube prim that is created by default when a user creates a new object in *Second Life*®, which is then manipulated and modified into other forms and combined with other prims to create much larger and more complex designs. This is perhaps one of the most beneficial features *Second Life*® has to offer: it has a very strong and easy to use 3D design model that allows even the most amateur of architects to create complex designs. There are a number of tutorials available on the World Wide Web, some of which are provided by the creators of *Second Life*® themselves, that can help users better understand the tools available for creating believable designs. For instance, information about how to use the measuring tools and "grid" system for modifying and placing objects is very helpful. These tutorials were invaluable to the people in charge of creating the virtual campus for this project.

Because *Second Life*® exists primarily as a virtual representation of the real world, there are also some points of semi-realistic design that actually helped to create a better situation for student learning during the construction of the virtual building that would eventually house the standardized patient sessions. Although not terribly realistic, some of these features proved to be advantageous in and of themselves because the virtual world was not constrained by real world "rules."Most notably was the ability to create virtual walls that are 100% transparent from one direction, but completely opaque from the opposite. Since the session to be held in the virtual building involved a group of students breaking into two sub groups, the ability to create a transparent wall that allowed the observing group to unobtrusively watch the enacting group in session proved to be a useful

addition. Thus, two rooms were created for the virtual standardized patient session: A conference room, and an observation room. Following that, the two rooms were mirrored to allow two observational groups and two enacting groups to use the same virtual building at once.

Eventually, to have the virtual campus appear as appealing as possible, the entire island area was filled with a semi-realistic looking set of ground textures, stairs, benches, navigation signs, and even foliage. It should, however, be noted that the entire effort took about 50 hours to produce the entire virtual area, which was accomplished almost entirely by one person on the team, with a few others assisting for no more than a few hours during the entire process. A building was designed to house the two conference/observation rooms, complete with a lobby and working automatic and manual doors. The virtual campus was then fitted with areas to house the media screens that would display the pre-session required materials. There was also an area for students and staff to practice and learn how to use their avatars and interact with the *Second Life®* virtual environment.

DISPLAYING VIDEO IN SECOND LIFE®
Requirements
One of the early requirements deemed to be essential by the development group of the project was the ability to present videos in the *Second Life®* environment. The videos would be a combination of instructional videos as well as content videos that were required viewing for the course. Some videos would need to be available to students asynchronously, namely those of the tutorial variety, while others would be shown to the entire class of students at the same time.

Solutions
While *Second Life®* is designed to display videos via the viewer, it is not set-up for multiple persons to view them simultaneously. Videos are set one at a time, to the media selection for the entire region, and are downloaded by the user, via their viewer, when they log in to the region. An object is then created in the environment, and is given a texture known as the "media" texture, and acts as a video screen. However, only one video can be set as the current media file for the region at a time. The file can be changed, but only by an owner of the region. Therefore, the development team had a few obstacles to overcome. First, there would need to be more than one video file available for the students to watch in the region, and second, there would need to be a way of starting a given video for all of the users at the same time (for an in-session situation). To solve the issue of having multiple videos available, as well as having some of them play synchronously while other asynchronously, there were two separate solutions.

First, for videos that would be accessed asynchronously, the region would be split up into smaller regions, known as parcels. Each parcel would then have a different "media file" associated with it, and when users entered the parcel, the required video file would begin to stream. This did, however, mean that the user would need to be within the border of the parcel to correctly view the video associated with it, but this was subverted as an issue with some clever placement of walls and doorways, forcing people to navigate into parcels to even see the media screen. The media file or video that is presented to the user on the media screen is actually presented for each user as they walk up to it and activate it in their own viewer only. Thus, two users could navigate their avatar to the same virtual media screen and view the same video at different times, and it may even appear to a third user that they are not viewing anything at all if they are not in the same parcel as the other two. However, there was an added layer of complexity for setting up the region in this manner, as each parcel created for each video screen also needed to be given its own permissions for who was allowed to enter and who was not. This proved to be tedious for the development team, but not impossible.

For playing videos simultaneously in *Second Life®*, the development team was forced to create an object that would serve as a media remote for the staff facilitating the virtual standardized patient sessions. Once the facilitator was sure that all of the users were in the range (parcel) of the video screen on which they wanted to project a video, they made a selection on a virtual remote that would send a message to the parcel to begin playing the video for everyone. This proved effective, but not perfect. If for some reason a user exited the parcel or walked into the parcel late, the video would either stop playing or begin playing for them at a different point than the rest who were already watching it. Of course, there would be no way to know which user may be experiencing this issue, since the rest of the users would all be synchronized to video. Also, *Second Life®* does not offer much in the way of video control, only play, stop, and pause. Thus, it would be inconvenient for a user to have to reset a video to watch a section again, and then be unable to fast forward to the section they may be looking for.

It is also important to note that all media files are streamed to users via the *Second Life®* viewer and must already be hosted publicly on the internet already. This was not a major issue for our team, as the University allowed us ample web space to host the required videos, but is important to note, as other organizations wishing to accomplish the same results may incur further development costs if they do not already have web space available to them.

USER ACCOUNTS AND AVATAR APPEARANCE
Requirements
Everyone involved in the project, including people involved in designing the world or playing a part in the standardized patient session, needed secure access to *Second Life®*. Since the real life session they were attempting to emulate stresses professionalism, the students and staff would require avatars that represented them in a similarly professional way. This is contrary what *Second Life®* typically emphasizes, namely individuality and fairly exotic forms of avatar selections, the majority of which would be dramatically inappropriate for a session that stresses professionalism.

Solutions
Signing users up for accounts in *Second Life®* was a simple process. The only requirement for a *Second Life®* account is a valid e-mail address, and since everybody enrolled or employed at the University of Alberta is provided with an @ualberta.ca e-mail address, this requirement was met. Anyone involved with the project would login from any computer with internet access, then visit www.SecondLife.com at their leisure to sign up for an account. However, to ensure that any questions or concerns the students had were answered quickly and efficiently, it was decided that there would be a short face-to-face meeting held during the students' orientation on the first day of classes on (real life) campus at the University of Alberta. A computer lab was made available, and students were given a quick demonstration on how to sign up for an account with *Second Life®*, as well as given brief instructions on how to join the user group mentioned earlier.

To solve the issue of appropriate avatar appearance, initially, a few members of the development team were tasked with determining the likelihood of a student feasibly being able to create their own clothing for their avatars. As it turned out, making clothing that looks somewhat appealing is not a particularly easy task for someone who does not have a keen eye for 3D design, specifically texture mapping to multi-sided irregular polygons. This would also require a multitude of different programs with which even the most technically inclined members of the development team were not entirely familiar. Modifying the basic physical properties of an avatar, however, was not nearly as difficult. This is accomplished using the tools already provided within the *Second Life®* viewer. With very little instruction, it was determined that students and staff could be taught how to create fairly accurate avatar representations of themselves. Where things became difficult was the creation of clothing. Thus, it was decided that the team would, in essence, "*source out*" the creation of clothing for the avatars.

This issue then constituted the first real foray for the development team into the open market of *Second Life®*, primarily a website known as XLStreet.com. XLStreet.com began as a third party organization, separately owned from the creator/owners of *Second Life®*, Linden Labs, but has since been purchased and integrated into the *Second Life®* website, known now as the "Marketplace." Using the Marketplace, users are able to market and sell their *Second Life®* creations. Buildings, objects, accessories, and clothing for avatars, or even just scripts to run certain desired processes in *Second Life®*, are all for sale on the Marketplace. These transactions can then be carried out in one of two ways: first, by way of credit card purchase, or second by way of Linden Dollar transfers. Remembering, of course, that Linden Dollars are ultimately purchased with "real dollars" at some point in time, this really does little more than serve as a way of creating a generally accepted exchange rate or value for the objects. With this in mind, the development team scoured what was then the XLStreet.com market website, trying to find items of professional looking attire that would eventually be distributed to the students and staff for their avatars. In the end, an existing *Second Life®* user had an entire *line* of clothing that was determined to be appropriate. However, a new issue arose when it came time to purchase the items from the user. Items available in *Second Life®*, via the Marketplace or elsewhere, can be coded and created in such a way that they literally exist *only once* anywhere in *Second Life®*. This is counter to other objects that can be copied and recreated. Thus, there are three major parameters, called permissions (or perms), which are advertised along with objects for sale in the Marketplace. They are Copy, Modify, and Transfer permissions. Copy is simply the ability of the purchaser to copy the item they purchased. Modify is the ability of the purchaser to modify the item, in *any way* (e.g., shape, colour, or even the *name* of the item). Transfer, is the ability of the purchaser to transfer the item to another user (or group). Thus, the clothing items the team would purchase would be ideally be "copyable" and "transferable," while the ability to modify the items was not as important (clothing items will always fit an avatar; the only advantage to the modify permission would be the ability to change its colour). However, there are very few items available in the Marketplace with these permissions. The development team contacted the user who had created the line of clothing we desired directly and inquired about a special rate for the entire line of clothing that would include the added permissions. To be clear, the average cost of the individual items was roughly 45¢ US, and there were 25 to 30 items of interest to the team that would eventually be used for 24 students and six staff members. However, in the interest of giving as much choice for students and staff, coupled with the fact that something as simple as the number of males and females in the group being unknown before the sessions began, it would be more ideal if there was access to the entire line. Unfortunately, the user who created the items was reluctant to sell the items, at any price, with the desired permissions, so the

team purchased 10 copies of each of the items in the line, with transfer permissions only (a must, since they would eventually need to be transferred to students and staff).

While the purchase of the 20 virtual "bags" of clothing solved the problem of providing students and staff with professional attire for their avatar, it created and entirely new issue: there now needed to be a mechanism designed for distributing the clothing in the virtual world. Had the items had the copy and transfer permissions, a simple object in the region could be created that users could interact with and be given any item they desired. Having a limited number of items now available, a complicated vending system of objects and scripts was created for students to not only acquire items they desired, but also *return* items they did not for others to then use. This vending system proved to be remarkably complicated and required a large amount of scripting done by a member of the team who worked diligently to understand and use the scripting language in *Second Life*®.

It should also be noted that since this initial project was run, in preparation for an additional set of online sessions, the user who sold the clothing line was contacted again to see if they would consider an offer on the same clothing items with "full permissions." This time the user has accepted the offer, and the requirement for the complicated vending system mentioned has been eliminated. It is still important to document, however, as it is still very difficult to convince existing users in *Second Life*® to sell their creations with these permissions because they could be easily exploited. Thus, others attempting to do similar things in *Second Life*® may also face similar hardships.

Finally, students were provided with a short video tutorial available for viewing in the *Second Life*® environment that would explain to them how to acquire and wear the items of clothing we had purchased for them as well as how to modify their avatar to represent themselves more accurately. This tutorial could be accessed asynchronously and was made available on the virtual campus in an area later deemed to be the "student tutorial" area. This area turned out to be one of the more popular and enjoyable areas for students, as many of them enjoyed trying to create accurate representations of themselves as well as what was later described as "shopping" for outfits for their avatars to wear. Similar tutorials are available online via websites such as Youtube.com, but the development team decided to create our own videos that explained to students what was expected of them in these very specific sessions, something existing tutorials would obviously not cover.

USER COMMUNICATION (VOICE AND TEXT)
Requirements
For the virtual standardized patient session to be successful in *Second Life*®, communication between the staff and students was paramount. Students would need to be able to communicate with staff members that were facilitating the session as well as each other. Text-based communication was acceptable, but verbal or live voice communication is far more desirable. Moreover, because there would be multiple groups running simultaneous sessions, there needed to be a method for users to filter out the conversations, verbal or typed, that were exclusive to their session.

Solutions
The *Second Life*® viewer is programmed to accommodate text-based communication quite easily. Any user can use a bar at the bottom of the viewer to type messages that appear in the "local chat" of a region, and anyone else in the region will see the message displayed. Additionally, users can choose to join private chat sessions with a group they are affiliated with at any time, and those messages will only appear for those who are also in the group in a small window that can be minimized and opened within the *Second Life*® viewer. Naturally, this initially fulfilled the requirement for private conversations, requiring only the creation of four more groups for students and staff to join for private conversations (to be clear, a user can be a member of any number of groups, and is not limited to only one). Four groups were required to accommodate two simultaneous sessions, each with an observation group and a conference group. Thus, the naming convention that was adopted for the groups was Conference Group 1 and 2, and Observation Group 1 and 2. Course requirements outside of the *Second Life*® virtual standardized patient sessions had already dived students into multiple cohorts, so applying a number to them was a simple task. The first cohort used *Second Life*® groups that ended in a 1, and met in Conference Room 1, which was directly attached to Observation Room 1. Students could then interact with one another in the required groups, without interfering with the other session. Staff members that were facilitating the sessions were then allowed to join all of the groups to oversee the communication and aide wherever needed.

Voice communication in *Second Life*® proved to be dramatically more difficult to implement. Although voice communication is possible with the *Second Life*® viewer, it is not designed to handle multiple private conversations. Similar to typed conversations, users can choose to speak in a microphone set up with the viewer (relatively easy to set-up using the viewer's option menus) to the local area or to a private group. However, if the user chooses to speak in the local chat, his or her voice is actually projected from their avatar and heard at varying volumes by the other users, depending on their virtual distance to the avatar of the person

speaking. This is designed to mimic real life, where a person sitting on one side of the room would have trouble hearing the person on the other, but would have less trouble hearing the person right in front of them. While this idea sounds good on paper, it unfortunately does not work as well in practice. To solve this problem, users have the option of connecting to a private group voice chat where the conversation with the others in the group is not modulated based on distance, essentially treating it like a conference call for the users. However, this raised an entirely new issue since the *Second Life*® viewer only allows its users to use voice communication within one group at a time. This became problematic in the case where students tasked with observing their classmates during the session would need to hear what was going on in the conference room, but also needed to speak to one another within their observation group (without the conference room group hearing them). To solve this issue, it was decided that the observation group would simply join the conference group, and mute their microphones while the conference with the standardized patient was conducted. Later, participants would then reconnect with each other in the observation group.

As it turned out, during the session, switching groups was not always a reliable process, and many users experienced difficulty not only understanding the concept of needing to switch, but also understanding the actual technical procedures for switching. Students and staff were often ejected from their group conversations, and could not reconnect without rebooting the viewer. Moreover, this made facilitating the conversations almost impossible for staff members, since they could only listen to one conversation at a time. The students and staff managed to *work around* these issues by using typed conversations more frequently, but this remains an area the development team will be looking into developing a better protocol for in the future iterations of this project.

USER COMMUNICATION (PRESENTATION)
Requirements
As a general requirement for the course, students were required to discuss the standardized patient scenario with their cohort. This ultimately led to a perceived requirement for a method of recording information on some sort of virtual representation of a white board. It was decided that the best way to meet this requirement was a virtual "flipchart" with questions for the groups to answer paired with a method for recording their answers. The idea was for the flipchart to enable students to discuss the goals of the patient conference and to record their thoughts for subsequent analysis and reflective learning. The data presented on the flipchart would also be used later by the session facilitators to assess the students' involvement and understanding of their session with the standardized patient. The flipchart has "back" and "forward" arrows, which allow the user to flip the previous or next page of the flipchart, which contained questions they were to discuss in their groups on the header (see Figure 1).

Figure 1. Flipchart in Second Life®
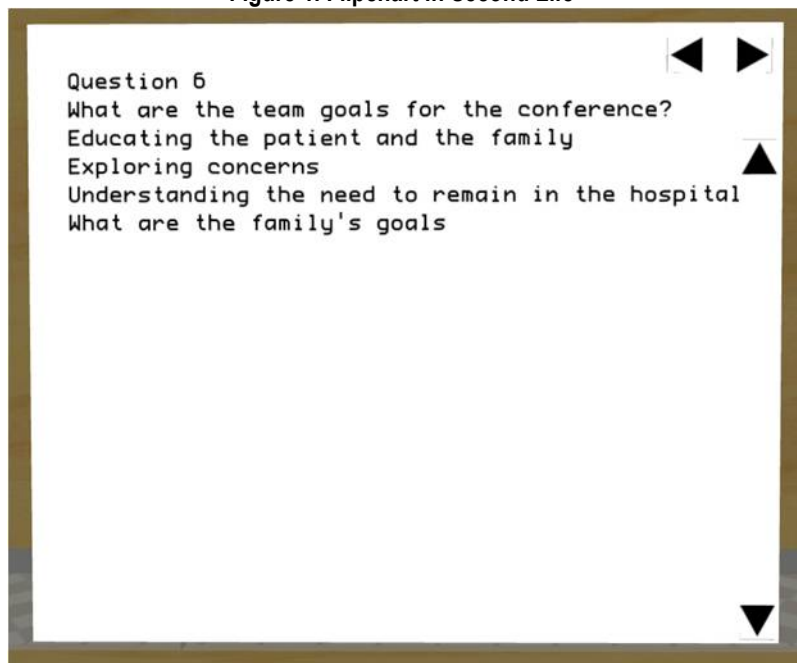
There were several key requirements for the flipchart itself: first, it needed to store the students' input in a persistent, retrievable manner, both for immediate review and editing during the student conference, as well as for subsequent educational use. Second, it needed to be usable by multiple people in a flexible, dynamic way. Finally, the flipchart needed to be easily deployable, as it was to be used by multiple groups simultaneously.

Solutions
The persistence requirement of the virtual flipchart was met through the use of a client-server architecture, where the virtual flipchart entity played the role of the client, and an online database acted as a server. In short, the flipchart sent the student's input (either writing or choosing a page to view) to a web service, which stored or retrieved the relevant information from the database (see Figure 2).

Figure 2. Flipchart Architecture
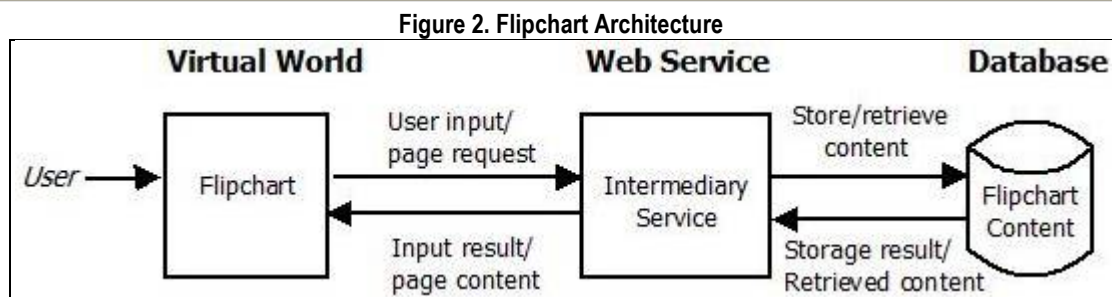
The flipchart offers the ability to record the author and content of typed conversations. It has the ability to listen to users' typed conversation, identify those users who have chosen to record their input as writing on the flipchart, and record the input accordingly. The details of this identification mechanism are described in the following paragraph.

The multiple user requirement was met by a data structure in the flipchart entity, which kept track of which users had chosen to start writing on the flipchart (indicated by clicking on the flipchart), and who had subsequently decided to stop writing (indicated by typing the word "stop"). When a user clicks on the flipchart, he or she is added to a list of active writers, and the flipchart is instructed to record their conversation. When an active writer types the word "stop," the flipchart removes him or her from the list, and stops listening to their input. To further ensure that the input of appropriate users (and only those users) is being recorded, the identity of each writer, in the form of a unique user ID and the name of the user's group are sent to the web service, along with their input. That identity is checked against a database of students who have signed up for the course, and their membership in a conference group. If the user has not properly registered for the course, their input is not recorded, and they receive a message indicating that they need to sign up before using the flipchart.

Finally, the deployment requirement was met by creating a single object that contained all of the relevant code and component pieces, and then creating copies of that object in multiple rooms. To ensure that input for the flipchart copies did not get muddled, each flipchart copy used its own channel for internal communication between component parts and for communication with the web service.

USER COMMUNICATION (NON-VERBAL)
Requirements
Since a fair amount of human interaction and human communication is done through non-verbal ways of communicating (ie. eye contact, hand movement, posture), it was crucial for the development team to design a method for students and staff, particularly the SPs, to effectively control their avatar's movements. Ideally, participants would have control over their avatar's facial expressions, movements, and posture at any given time. Naturally, the standardized patient would need to convey as many verbal and non-verbal cues as possible to the students to effectively enact patient symptoms.

This was also determined by the development team to be an effective way for students to become aware of their non-verbal communication cues, because they would consciously need to manipulate the avatar to communicate these emotions. For instance, it might be considered a good idea for the student to "lean in" during conversation to convey an expression of interest.

Solutions
To facilitate the need for facial expression and non-verbal communication avatar control, the development team returned to XLStreet.com to gather a number of tools already created by other users for similar applications. Unlike clothing, objects used for

avatar control are not nearly as protected with restrictive permissions by the users who create them. Members of the development team were able to find items that were "open source" and basically amounted to remote controls for users to click buttons that activated animations in the avatars. The most common form of avatar control is in the form of a user HUD, or Heads Up Display (see Figure 3), that appears on the main screen of the *Second Life*® viewer, much like a window for communication. The difference between the HUD and a window is that the HUD is "worn" by the avatar and is connected to them in the sense that it is in constant communication with the avatar.

Animations are also available on XLStreet.com (and now the *Second Life*® Marketplace), and usually exist in large packages of multiple scripts for users to use in conjunction with a HUD. Of course, there are not many users in the general population of *Second Life*® interested in creating animations or HUDs that met the needs of the students and staff in a standardized patient session. Animations such as slouching, walking with a limp, or rubbing a sore limb were determined to be animations vital for creating an authentic virtual standardized patient. These animations were also not found on XLStreet.com at the time, and still remain unavailable now, as they are not normally desired by the general *Second Life*® public. Therefore, the development team used a separate program tool called *Avimator* to create new animations, and rewrote the scripts in a HUD object to activate the new animations. This made animated gestures and facial expressions easy for the users to activate, as they were organized into an easy-to-decipher HUD that would sit on the user's screen with large pictograph buttons representing the desired gesture animation. They were also organized in such a way that posture changes and facial expressions could be toggled on and off, while other one-time animations such as rubbing an arm or yawning would be played once for each click of the button.

A separate, more complicated process was devised to allow multiple user gestures to be used as well. Most notably was the addition of a button to the gesture HUD that allowed users the ability to offer a handshake to another user. This script, when activated, would search the nearby vicinity of the user, and return a list of other users to which they could offer a handshake. They would then select another user from the list, and that user would receive a message asking if he or she would accept the handshake. If the handshake request sent by the first user was accepted by the second user, the two avatars would walk to one another and initiate the handshaking animation at the same time. As it turned out, this proved to be an effective method of non-verbal communication for the staff member playing the role of the standardized patient, as they were given an opportunity to *reject* the handshake of a student, conveying a message of disapproval or distrust, without speaking a word.

Figure 3. HUD

TUTORIAL AND SURVEY STATIONS
Requirements
Because it was extremely unlikely that students and staff were familiar with *Second Life®* prior to becoming members of this project, there needed to be an effective mechanism for delivering information about how to function in *Second Life®* and opportunities for practice. These tutorials would need to allow students the flexibility of accessing information and practicing information and practicing whenever convenient for them, rather than limiting them to a scheduled time. Additionally, to properly assess the usefulness of these tutorials, a short survey would need to be completed by the students and staff, preferably in the *Second Life®* environment. Moreover, it would be important to know if the students and staff actually completed the tutorials before attending the session. This was important to the development team, because it was feared that if a student expressed difficulty using *Second Life®*, it would be important to know if they had bothered to go through the tutorial videos or if they had decided to skip them and simply "wing" the session. This would obviously endanger the validity of the data collected, and could be remedied if the student's history viewing the tutorials could be matched to their survey data.

Solutions
Displaying the tutorial within *Second Life®* was relatively easy. Given the nature of the programming in *Second Life®* to download data on a per user basis, it also actually worked extremely well for producing asynchronously accessed videos. Video screens were set-up in five locations, following a few static screens that convey basic information on using *Second Life®* effectively and efficiently. Video tutorials for setting up voice communication, avatar appearance, and the aforementioned gesture HUD, were created by the development team using a third party program called *Camtasia* (see Figure 4). The videos were about 5 to 10-minutes in length and proved to be extremely effective for the students and staff who utilized them.

Figure 4. Tutorials
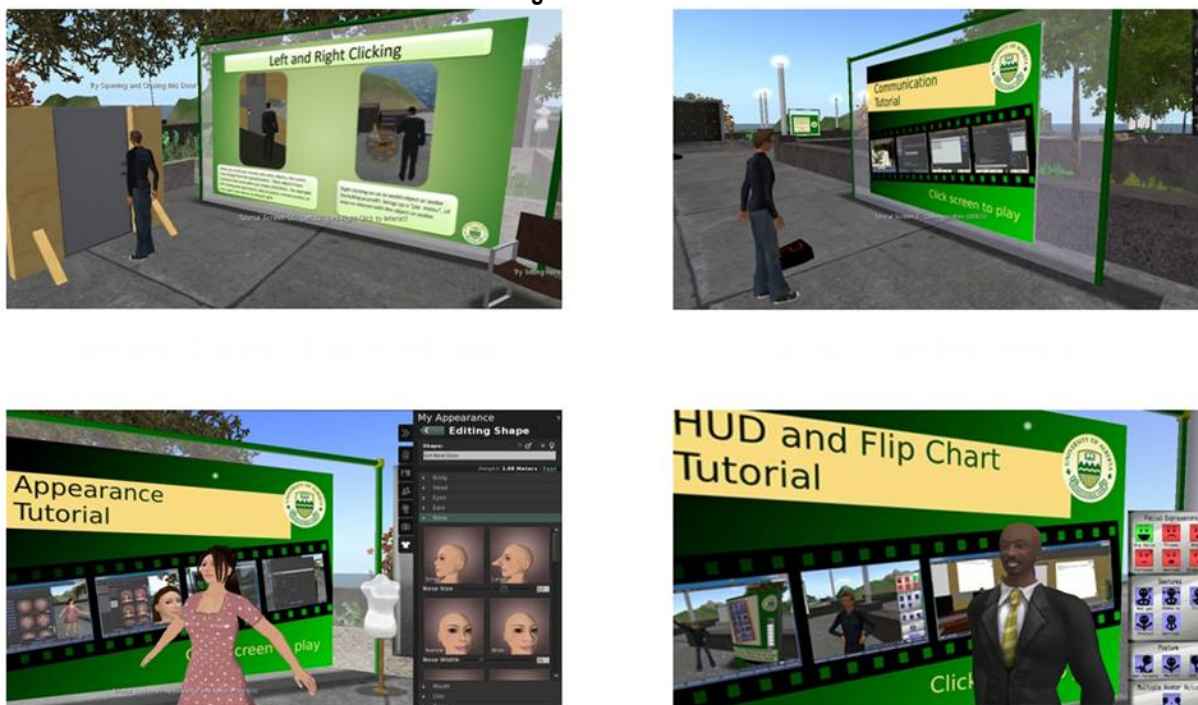
To track the use and efficacy of the tutorials, a series of objects were created to act as position sensors at each station. The position sensor worked by scanning the area immediately around it (a radius of four virtual meters, scanning every two seconds). For each detected user, the sensor picked up the user's ID and sent it to an online database, which logged the user ID, station number, and time that the station was visited. A visit history retrieved the set of locations visited by a particular user, and compared that against the full set of stations that can be visited. At the final station, students are then shown a screen with their

name and a series of check marks and X's below a number corresponding to the stations they just visited. Any "missed" stations (that is, locations not visited by the user, but in the full list of stations) are shown to the user with a red "X".

Finally, the student is presented with a media screen that asks them to go to the online survey directly from *Second Life®*. When the user clicks on the survey, the user ID was once again sent to the online database, this time with the message that the user needed to visit the survey from within *Second Life®*. Thus, when combined with the position sensors described previously, a "trail" is created in the database for each user, indicating which locations they have visited and whether or not they completed the survey from within *Second Life®*. Finally, the online survey itself was created using Survey Monkey, an online survey-creation system. Using this system, we were able to create a simple survey that the students could access from *Second Life®*, and that facilitators could view the results in an online interface or download the survey data into a spreadsheet program for further analysis.

IMPLEMENTATION OF THE CONFERENCE
At the outset of the actual *Second Life®* conference, each facilitator waited by their conference room to direct the students as they arrived. The facilitators were told that technical support would be available through the entire session and that all they had to do was ask for assistance.

The facilitators presented an outline of the sessions' activities so the students knew what to expect throughout the three-hour session.

6:00 – 6:10	Overview of Session
6:10 – 7:00	Students Plan admission conference
7:00 – 7:15	Enact Admission Conference with Standardized Patient
7:15 – 7:30	Feedback from observing group, facilitator and SP
7:15 – 7:30	Video (part 3)
7:40 – 8:00	Students Plan discharge conference
8:00 – 8:15	Enact Discharge Conference with Standardized Patient
8:15 – 8:30	Feedback from observing group, facilitator and SP
8:30 – 8:45	Scenario Reflection
8:45 – 9:00	Debrief

The facilitators guided the students through these activities and introduced the SPs at the appropriate times during the session.

RESULTS AND RECOMMENDATIONS
Pre-Conference Sessions and Training
The initial face-to-face training/orientation session served to introduce the *Second Life®* team to the students and allowed them to connect with classmates they already knew from other courses. This was a valuable meeting as the students' first exposure to the *Second Life®* environment was a guided tour which helped to avoid confusion about how the environment worked. The students seemed to really enjoy this session and proceeded through the activities enthusiastically.

For the students that completed the tutorials, the delivery and content worked out very well. In a survey administered to the students right after tutorials were completed, the majority were neutral or agreed a) that it was clear to them how to proceed through the tutorials, b) that they were more confident about functioning in *Second Life®* once they had done the tutorials, c) that they understood how to use the communication devices and how to adjust their avatar's appearance, and d) that they understood how to access and use the customized gesture menu (HUD). However, only eighteen students completed the tutorials, and the students that went into the conference session unprepared created considerable disruptions during the sessions. In future, we would include a participation grade that would act as an incentive for students to complete these activities prior to the conference session. Completion of these practice activities would also lessen the novelty of the *Second Life®* environment so students could concentrate on executing the expected activities in the conference session. Taking into account that *Second Life®* was not designed to include any form of classroom management mechanisms, we would also institute a set of behavior guidelines for students for professional practice making it clear that these are expected within the *Second Life®* environment.

Although the tutorials worked well for those students that accessed them, the training and practice sessions that occurred in *Second Life®* were limited as far as the numbers of avatars in-world at one time. Consequently, at the outset of the conference, one of the facilitators was overwhelmed by the numbers of avatars once all students were present within the *Second Life®* environment and had some difficulty identifying which avatar represented which student. This was mostly due to the fact that although the avatar names were visible above the avatars' heads, some students were not able to use their first names when

they created their accounts as that name had already been assigned to another *Second Life*® account. This issue has now been resolved with the new *Second Life*® viewer as the students are now able to display any name they choose while they are in-world so the facilitator and other students can readily identify each participant.

Our pre-session training for the facilitators did not include any direction in classroom management because both facilitators had executed face-to-face and Elluminate sessions for this course in the past. There were some unexpected student behaviors that suggested this would be required in subsequent training. First, students engaged in behaviors in one conference room that were not like a typical classroom environment (e.g., flying, standing on furniture, and using the gesture menu repeatedly). Second, because facilitators could not rely on non-verbal indicators such as pointing, they needed to include more verbal direction about where students should be within the environment. Third, because some students had not completed the tutorials or practiced using the communication devices, direction needed to be given by the facilitator as to how to use these functions as the class was running. One facilitator was able to make adjustments to these circumstances by organizing the students immediately as they entered the classroom, giving more verbal direction and asking for technical help as necessary. For this facilitator, the session ran well. Students took on the expected professional roles, executed each conference well, and asked appropriate questions of the SPs. The SPs, even though they had limited practice time, were able to execute their patient roles as per the pre-determined scenario.

In future, we would suggest including guidelines for classroom management in the facilitator tutorial sessions, including how to greet and organize the students as they arrive, how to set a professional tone in the classroom, and how to deal with disruptive behaviors. We would also stress the importance of choosing the right instructors as facilitators. They must be very comfortable and experienced with the material and activities they are delivering, be willing to practice in the virtual environment, and comfortable enough with technology that they will be able to collaboratively troubleshoot with the technical support staff.

Communications During the Session
The flipchart worked well in the sense that the students understood the process and could manipulate their input reasonably well. However, at the outset of the planning activity, the number of students attempting to write to the flipchart at one time caused a backlog of comments that overloaded the programming of the device, which led to the device no longer being able to administer or revoke writing privileges when they were requested. This was rectified, temporarily, by one the technical support staff resetting the device. Despite this, once the students were instructed to take turns posting, the flipchart was a valuable element as it allowed the facilitators to revisit the student plans and comments during the debriefing after the intake/discharge conference had been executed.

The procedures for students and facilitators using the voice chat to break into smaller groups during the conference were more difficult for students to execute than anticipated. When students were instructed to join separate conversations in different rooms, some were unable to connect to the voice chat for that room and were sent, by default, back into the local voice chat. Some were unable to reconnect and unable to listen to the conversation in progress. These issues were due to the limitations of the Second Life software in which case an adjustment in procedures is required to address this problem. Also, because the two conference rooms were side-by-side, the text chat postings appeared on screen from both rooms, which caused some confusion. To address this, we will not run future sessions simultaneously.

Regarding technical assistance, technical support personnel responded quickly to any technical support queries and resolved issues in a very timely manner. The sessions ran longer than the regular sessions as everyone adjusted to using the technology, but there were no technology problems that caused large delays in the session schedule. Although students were told they could access technical support at any time, we neglected to specify which communication device they should use to do so; hence, some students used the text chat and others used the voice chat. In retrospect, to streamline the flow of communication, we would instruct students to refrain from talking to each other via the text chat and use that function specifically to access the technical support staff. Using this approach, technology support queries would not intrude on the session activities.

CONCLUSION
Given our experiences in developing this virtual world in *Second Life*®, the technical solutions for achieving our goals and overcoming obstacles can be characterized according to three approaches: 1) using existing tools in *Second Life*® to create and manipulate objects, 2) searching out and merging existing software that was designed for specific purposes into the *Second Life*® environment, and 3) reworking script to modify mechanisms. We made use of all of these approaches, but for educators who are not programmers, the first and second approaches are potentially more easily executed and would be a good starting point for exploring the development of any given feature or function. We have found that although considerable time and effort went into the initial development phase, this was a well-laid foundation, as now that we have delivered sessions in our virtual world, the

desired revisions are planned in respect to the development techniques we have already learned and we expect they will be relatively straight forward.

In the implementation of our initial session, although some of the problems we encountered in the *Second Life®* environment were a combination of technical and procedural issues, frequently the solution lay in adjusting the procedures for using the technologies. Our experiences in delivering the course highlights the importance of setting and clearly articulating these procedures for each of the participants within the course, in this case, students, facilitators, standardized patients, and technical support staff. However, with appropriate facilitators and in-world procedures, we believe the technology shows much promise in the delivery of Standardized Patient learning opportunities for health science students.

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