AC 2009-1244: DESIGN CONSIDERATIONS FOR VIRTUAL-CLASSROOM AND LABORATORY ENVIRONMENTS

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Design Considerations for Virtual Classroom and Laboratory Environments

Abstract

With the ever-increasing demand for distance education one of the key challenges facing faculty is not only delivering effective instruction through both lecture-style and laboratory means, but also giving students an environment with a sense of presence. The key challenge here is to improve on the distance student's capabilities for interaction and collaboration thereby enhancing their ability to work in more group and team settings. In short, virtual environments present distance students with exciting new forums for meeting and sharing their thoughts and ideas in real-time.

Today's virtual environments like Second Life (SL) provide students with open-ended opportunities for exploration and invention. This has broad reaching implications for faculty, and allows for the delivery of course content in stimulating and highly engaging manners. However, before these virtual environments can be implemented as academic tools, virtual spaces in the form of classrooms and laboratories need to be designed and developed to facilitate student and faculty interaction.

This effort describes considerations made when designing some of the early virtual classroom and laboratory spaces developed within a newly established virtual campus. Once these spaces were built, class sessions were conducted and the students were surveyed in order to document their first impressions of the experience. Finally, the survey responses are analyzed and consideration is made for the establishment of design criteria for further virtual site development.

Introduction

The recent emergence and rapid growth of the numerous virtual online environments has energized several efforts within various educational institutions to evaluate SL's possible value within the academic process. One of the most successful of these is the phenomenon known as Second Life (SL). SL is a three-dimensional virtual world created by its participants (commonly referred to as residents) and since it's unveiling in 2003, scores of educators from over 130 colleges and universities have begun to evaluate SL as an educational platform. [1]

The growth of SL in the education arena has been wide-spread and global. However, before academia can evaluate this relatively new environment, virtual spaces need to be planned, designed and developed that allow for academic discussion and identification of new pedagogical uses for this communication media. As with any new delivery mechanism each must undergo a process of building, evaluation, and assessment with virtual environments being no exception.

Although the value of SL as an academic tool is still in its early stages of evaluation, many in academia have begun to experiment with its utility and are reporting some positive early results. Recently, academics using SL in various distance education classes have indicated that "communication among students actually gets livelier when they assume digital personae.

Anthropologists and sociologists see the virtual world as a laboratory for studying human behavior. University architects use it as a canvas on which to explore design. Business professors see it as a testing ground for budding entrepreneurs." [1]

Designing Virtual Classrooms and Laboratories

There is a fine line between similarity to the real world (RW) and to the development of a virtual world (VW). The idea that we in academia might utilize the capabilities of current virtual technologies to mimic or even supplant RW classroom and laboratory instructional settings is not a new one. Hiltz & Turoff noted early on that fundamental to maximizing the capabilities of computer mediated communication systems is "the ability to tailor human communication processes to the application and group undertaking its application". [2] With virtual environments, the focus upfront centers on the need to develop virtual classroom and meeting room environments that not only replace the actual RW academic experiences, but also maximizes the inherent functionalities that the new VW provides.

With respect to the availability of SL for use as a distance educational tool, creating an avatar and membership in SL is currently free; however, owning land in SL does incur a monthly charge. The price of owning land is currently based on the "size" of the land and is either purchased or leased. [6] For any academic institution looking to utilize SL or any other virtual technology, the next logical step after purchasing or leasing your land spaces is to design and build out the spaces to be used for academic instruction.

Classroom Design Fundamentals

The fundamental constructs of instructional design do not change with a delivery media such as virtual environments; however, changing the delivery media requires new academically-centered production processes and makes attainable some learning outcomes that were previously not considered possible. Kemp and Haycock note that in a web-based, online class, an instructional developer would decide on intended learning outcomes, create and upload documents, design enrichment activities and arrange a communal learning space. In the web-based environment, the media content is usually the equivalent of pieces of paper, flat and usually sequential, that limit potential learning outcomes. However, the production process in a virtual environment is quite different; unlike with web based developments, skilled virtual instructional developers focus on building structures, walkways, and interactive objects that allow for creative interaction between students and instructors. [3]

Participants in a virtual environment typically come together based on their interests in a specific subject. It is suggested therefore, that the development of virtual class environments be dedicated to specific disciplines verses general usage facilities. [5] This fits with Terashima's definition of virtual classroom environments as technical environments where coactions between reality and virtual reality are based on a shared domain of knowledge. [9] One caveat here involves student expectation; although more study is needed in the area, students new to virtual environments find a degree of comfort and ease of assimilation into their new virtual settings when the classrooms, laboratories and other supporting facilities have some semblance to the

Real Life (RL). Understanding each of these unique considerations, the first step to understanding how and what to build into virtual classroom and laboratory spaces.

Technology continues to redefine the environment in which we exist; Senge describes a learning organization as "a place where people are continually discovering how they create their reality and how they can change it." [8] When designing for the size and layout of virtual classrooms and laboratories the need for students to explore, create, build, and collect are considered and virtual classroom spaces openness and spaciousness are a must. Since avatars tend to need room to move, classroom spaces should be built to allow them to pan their camera perspectives around to get the most out of their virtual experience. Furthermore, a unique value-addition to using virtual environments is that they are very flexible and as such, should be considered dynamic in both design and content.

Virtual environments like SL have limitations on the number of objects or prims (primitives) that can be used. These prims are like virtual building blocks that are used to create everything that is built within the virtual environment. Understanding these limitations aided in design planning for placement of virtual objects and structures ensuring efficient use of each virtual space. Another limitation that is critical to classroom space design is the number of allowable avatars in one particular land area (referred to as a Sim). Currently in SL a Sim is limited to about thirty-five avatars at any one time.

In building classrooms or meeting areas, incorporating seating or standing stations are found to be quite essential to more lecture and discussion style spaces. Not only are seats or stations a familiar sight for new virtual students, but by considering enough simple seating arrangements for the anticipated number of avatars, helps to control avatar movement in the virtual class session.

Classroom Doors, Windows, Lighting, Walls and Ceilings

Since avatars can not only walk and run but also fly and teleport around the campus area, the concept of doors, windows and ceilings takes on a new significance when designing virtual classroom spaces. Generally, lecture-style class sessions tend to be more closed and therefore, having other wandering avatars flying into your room from overhead may prove to be a distraction to the session. On the other hand, more open class sessions may welcome roaming visitors to the class discussion. If the class sessions are focused strictly on a specific group of students then building spaces with limited accesses may be appropriate.

When laying out floor-to-ceiling windows we realize that they are great for light and viewing but also allows others to look into the classroom; this can be a significant distraction to your class if there's a lot of activity outside the classroom. An appropriate lighting design for classroom spaces is a must, as well. Although lighting typically can be controlled by each avatar, designers should ensure that enough ambient light is let in to illuminate the room. When considering classroom entry points, wider entry points are generally best; wide entry points allow for easier movement of groups of avatars in and out of a space. Finally, doors at entry points tend to be an annoyance unless there is enough activity outside to warrant having one to reduce the distraction.

Also, consider a roof or ceiling only if you want to limit access from flying avatars or want more control over lighting.

Classroom Content

The adaptability of any given virtual space should always be considered when placing content within class and meeting rooms; virtual spaces have the distinct advantage of adding or deleting content on the fly. If more presentation screens or browsers are needed they can easily be added. Unlike conventional RL academic spaces, virtual classroom and meeting spaces and their contents are considered dynamic to the needs of faculty and students. When designing virtual classroom layouts, these spaces should present enough of a visual that lends some degree of RL familiarity to maximize student expectation and comfort levels. Whiteboards, presentations, and audio-video clips are all familiar classroom tools that can easily be incorporated into virtual classroom and meeting room designs.

In a virtual environment, the relationships between knowledge and problem domains propose an important contrast to RL classroom processes. In a RL classroom the application of knowledge to problems are expressed symbolically through alphanumeric notation and two-dimensional still pictures. Regardless of whether it is in a RL classroom or a virtual classroom, a whiteboard which acts as a short term memory of an instructional event is one of the most basic and powerful instructional devices and should be available in a virtual environment. [5] Current whiteboard technologies allow for several modes including presentation of text chat activity, basic slide presentation, basic surveys and polling, and presentation of text from prepared note cards. Having multiple whiteboards within close proximity of other image screens can provide faculty and student presenters with multiple simultaneous visual media presentation.

Lectures for virtual courses are available in various video formats and as bandwidth to the home increases, videos will become more relevant in the virtual classroom and lab. In an effort to conserve the bandwidth however, many faculty design lectures as a combination of picture slides and audio files. Students are able to view the lecture slides ahead or in synch with the instruction allowing them to amend or append to these lecture notes when appropriate. [10] The value of presentations such as PowerPoint slides and instructor notes is to consolidate lecture information and reduce bandwidth demand.

Virtual world software or servers may limit the ability of land or Sim owners to store various audio and video media within the environment. However, if the video or audio files/feeds are available by Universal Resource Locator (URL) or hyperlink then a land owner can present them within their virtual class or meeting room. The examples that follow are taken from experience within Second Life and may not be representative of all virtual environments.

Incorporating Audio/Video and Polling Stations in Classrooms

Currently SL limits each parceled area, such as a classroom space, to one video, so to have multiple video options the class or meeting room must be broken into multiple parcels or classroom spaces. In the case of SL, the limit here is that a student's avatar is only able to see what video is streaming in the parcel that the avatar is actually located in. So simply dividing a

single class or meeting room into different parcels without providing some sort of visual barrier, wall, or partition can be confusing.

Incorporating audio feeds in a virtual class or meeting room can also be set by identifying an appropriate streaming audio URL. Keep in mind that the higher the bit-rate listed against it, the more bandwidth it will need. One final design note: a parcel in SL has no vertical limit so placing class or meeting rooms one on top of another currently can be problematic not only from an audio and video perspective, but also when utilizing voice chat. One way in SL to avoid this issue would be for each avatar to pre-set their audio distance (chat range) to a closer limit.

Finally, when considering simple question and answer sessions there are several approaches to incorporating consensus and polling activities in virtual spaces. One simple method involves laying out an area on the floor that labels sections for Yes, No and Maybe, where avatars can move and stand on one or the other; this can be a very effective teaming tool. There are also virtual whiteboards that incorporate this functionality.

Laboratory and Floating Spaces

As with classroom spaces, work and lab spaces should be considered dynamic as well. Although many elaborate lab schema's are being developed by educators in virtual worlds, the inherit nature of these environments lends itself to constant development and redevelopment over time. That said, providing creative work areas for both student individual and team development can add real value to the learning experience.

Similar to laying out virtual classrooms, virtual laboratories and work spaces require openness and lots of space to move, build and interact. A virtual laboratory has unlimited possibilities. Virtual laboratories and work spaces are areas where students are allowed to build and show off their own creations. These spaces can also be three-dimensional mock-ups of any imagined or RW situation or place that can be explored and experienced by students.

Considerations for virtual laboratory spaces include the size and area allotted for each working space. These spaces need to be large enough to accommodate the building and moving activities by multiple avatars at one time. Students in a virtual laboratory will be communicating via chat and voice as they build and explore. Since sound in virtual environments can travel as well, to avoid interference with other classes or groups in the virtual campus, placement of the lab space out of chat range of other labs or classrooms will limit crossover-chatter situations. Virtual spaces can be identified as large open areas of land, as a separate large building, or as areas on a floating platform. If privacy is a concern, installing a script to issue a message to visitors explaining a privacy policy may be considered; creating walls and ceilings all around that provide obvious visual barriers that require avatars to teleport into and out of a lab area is another option here.

Three-dimensional virtual environments can have gravitational forces that are controllable perimeters; both horizontal and vertical space is available for building. Temporary or permanent floating laboratory and work spaces can typically be built at any altitude giving students and faculty plenty of space to build and interact within a given area. To move students to and from

these spaces, teleport modules can be used at key locations on campus. SL currently supports Second Life Universal Resource Locators (SLURL) that enable teleporting directly to virtual laboratory locations making locating floating labs easier for students.

Finally, when choosing a floating platform to serve as a class laboratory space make sure the platform is large enough to accommodate the work or projects that the students will perform. Some type of railing or wall should be in place to prevent avatars from inadvertently walking or falling off the edge of the platform. Also, consider building virtual laboratory spaces at heights above current default, maximum flying heights; this allows for some degree of privacy and fewer trespassers.

Initial Class Meetings

Prior to conducting the first sessions with students, there are several considerations that must be taken into account. Class-size, avatar naming conventions, basic skills training, and general expectations in the form of either guidelines or formalized rules of engagement are all addressed up front. To conduct a productive and meaningful first meeting in the new virtual spaces students need to have a basic set of skills that enabled them to function effectively in the environment; this is akin to having basic computer and internet skills before taking online courses today. These basic skills can be learned by the student a week or two prior to the first virtual class meeting. The SL environment currently maintains a location where new users can learn the basics of getting around once they sign up as new members. The following outlines the first assignment given to each of the students.

<u>First Assignment using SL: Avatar Setup</u>

This is a student participation assignment. A week prior to the first virtual classroom session each student is required go into Secondlife.com, create an avatar and complete the basic learning tutorials provided by SL. The basic skill-sets that each student was expected to have a basic understanding of included:

- Basic avatar movements (walking, running, flying)
- Changing avatar appearance
- Communicating via text chat & audio
- Use of gestures
- How to make or track friends
- Managing camera views
- Basic use of the avatars inventory

Once the student complete their initial assignment the student then contacts (via email) the instructor with their avatar's name and indicated completion of the SL basic skills tutorials. Upon receipt of the student's avatar name, the student is offered a friendship by the Instructors avatar so that the student's avatar could be teleported directly to the virtual classroom site for the first session. The student is then given a [DATE] and [TIME] that the class demo session in SL is to be conducted.

As important as understanding how to function in the virtual world, students must also know and understand the "rules for engagement" for these virtual sessions. Since the virtual campus is an extension of the real campus, students should know that the same rules and codes apply. However, there are some additional considerations that are unique to the virtual campus.

- *Avatar Appearance* - To avoid distractions to other students, avatars are to be a humanoid and adhere to the same dress standards as the real campus. Students should not show up as an Animal, a Robot, or a Transformer; however, having a space on the virtual campus set aside for students to experiment with their creativity would be encouraged.
- *Communication, Sounds, and Gestures* - Just as in a real classroom, students should not disrupt the class. Since many gestures have sounds which can be distracting to others, students should avoid distracting gestures during meetings. The exception should be for basic head nods that indicate 'yes' or 'no' or hand gestures such as raising a hand or pointing when a student has a question or comment. These gestures can be very effective at minimizing chat and allowing the instructor to recognize students at the appropriate time. Finally, having text chats or sending Instant Message (I/M) sessions are to be used as a back up when voice chat is the primary means of communication. Engaging in multiple chat conversations other than the one meant for a particular group on hand, also referred to as chatting on the side, can be distracting by the typing sound and gestures that accompany texting activities and there is also the possibility of accidentally sending the I/M to the local chat instead of the private session.
- *Handling Griefers* - Although harassment is rare in the virtual campus areas that are devoted to academic pursuits, it can happen. When an avatar behaves in a harassing or threatening manner to others, he or she is referred to as a "griefer" and can have their avatar banned from the virtual campus or region. Unfortunately, there is nothing to prevent the real person from creating a new avatar and reentering with a new face and name, virtually reincarnated as it were. [4] Just as in RW situations, students are encouraged to notify faculty or technical staffs if this activity occurs.
- *Avatar Naming Convention* - Faculty should have a well defined naming convention for student avatars so the avatar can be quickly associated with the student it represents. For example, since SL uses only predefined last names, the avatar's first name is the only part of the name that students can use to identify themselves with. One suggested naming convention is 'Real First Name_Real Last Name' then the SL last name. Here is an example of what John Doe's would be: John_Doe Everhart with Everhart being the SL selected last name. Naming an avatar is not the same as an anonymous chat name. Also, students should avoid using their email prefix, as well and whatever the first name is, it should be pronounceable and not some cryptic like 'ABC0123' since it is difficult to converse using voice chat with an avatar that has a cryptic name like that. Finally, having a first name that is similar to the student's real name will also make early interactions more effective as classroom expectations are generally open and upfront and not anonymous endeavors.

<u>First Virtual Class Activities and Outcomes</u>

For the first virtual class session the students are brought to the virtual campus in small groups of ten to twelve. Students are teleported directly to the first classroom area on campus. This virtual

classroom is equipped with enough seating for each of the students and contains many of the typical contents found in a lecture-style discussion room including presentation screens, whiteboards, browser, and class notes at the main table where the students are seated. Once the students are all seated, a check of each student's voice, text chat, and gesture capabilities is made. Next, each of the presentation screens is demonstrated and the students are pointed to the session notes in front of each of them on the table. These activities give students the opportunity to set and adjust their camera views showing that viewing can be made from different angles within a virtual environment and unlike in RL the avatar can remain seated or standing in one spot and still see any object or area that is within the classroom.

Following a short video, the next activity was to test the students flying and navigational skills. Students as a group are taken to other virtual office spaces, classrooms, laboratories and floating labs across the virtual campus. Each of these spaces have specific educational goals in mind supporting classes in technology, medical services, library science, the arts, and many other early virtual course implementation on campus.

I. Initial Student Survey Results

Following these first demonstrations of the various virtual classroom and laboratory spaces, a student course survey was conducted with four concepts being canvassed. Although the surveys primary intent was to illicit feedback from the new virtual students on their first experiences rather than evaluation of virtual space designs, the results did shed some light on the potential of these virtual environments for further study. The first concept surveyed focused on gaining a foundational understanding of the surveyed population's background with respect to this type of communication media. The second was to assess the initial learning curve experienced by each student and the third concept focused on the early avatar interactions and the mechanics associated with the utilization of the avatar as a personal proxy in a real world communication forum. The final concept was to glean feedback from the students on their experiences with the Second Life virtual environment that was presented to them.

Following initial development of the virtual and classroom spaces within Second Life in the fall of 2008, a short series of course assignments were developed to present and demonstrate the new virtual spaces to a sampling of students. Two courses, one a Technology Management graduate-level course and the second a Network Technologies undergraduate course were presented with the assignments and then surveyed. There were a total of twenty-nine graduate and twenty-one undergraduate students that were surveyed for this initial effort (see Table 1). The survey results and analysis presented here will focus on the collective responses of the total population surveyed. Although there were some noted differences between the two populations, it was not the goal of this exercise to evaluate those differences. The data is presented however, and further study may warrant another round of study in this area.

SURVEY GROUP RESPONSES		
Classification	Responses	
	Number	Percentage
Undergraduate	21	42.0%
Graduate	29	58.0%
Total	**50**	

Table 1: Survey Results: Population Background

First Survey Concept: Population Background

The first group of statements presented in the survey focused on gaining a better understanding of the surveyed population. Results of the first four statements (see Table 2) indicate that over half (56%) of the students were new to the distance education experience. Most of the students (90%) had utilized online collaborative tools; this was anticipated since the surveyed population came from technology related course programs. For the vast majority of the students (70%), the SL environment was a new experience for them with less than (5%) of the students indicating previous regular use of SL or other similar virtual environment. Finally, hardware and software compatibility, availability and connectivity are all significant concerns when evaluating the usefulness of a new communication media within academia.

A small percentage of the students (12%) experienced some sort of hardware or software compatibility issue with SL demonstration, yet all students were able to eventually resolve their connectivity issues and were able to complete the demonstration.

Statement	Concept Being Canvassed	Responses	Total Population		Undergraduates		Graduates	
			No.	Percent.	No.	Percent.	No.	Percent.
1. Prior to taking this course, had you ever taken an online distance education course for academic credit?	Population Background	1. YES	22	44.0%	8	38.1%	14	48.3%
		2. NO	28	56.0%	13	61.9%	15	51.7%
2. Prior to taking this course, had you ever utilized online collaboration tools such as or similar to: Instant Messaging (IM), Chat, or Blackboard.	Population Background	1. YES	45	90.0%	20	95.2%	25	86.2%
		2. NO	5	10.0%	1	4.8%	4	13.8%
3. Prior to taking this course, rate your frequency of use with Second Life or other similar virtual worlds.	Population Background	1. Never	35	70.0%	14	66.7%	21	72.4%
		2. Seldom	11	22.0%	4	19.0%	7	24.1%
		3. Sometimes	2	4.0%	2	9.5%	0	0.0%
		4. Often	2	4.0%	1	4.8%	1	3.4%
4. Did your computer have any hardware or software compatibility issues with Sescond Life that you were unable to resolve?	Population Background	1. YES	6	12.0%	2	9.5%	4	13.8%
		2. NO	44	88.0%	19	90.5%	25	86.2%

Table 2: Survey Results: Population Background

Second Survey Concept: Initial Learning Curve

The second group of four statements in the survey focused on the need for students to develop new interactive skills in order to interact in the new virtual environment. All students were required to create, manage, communicate and move about the environment using their own avatars. Results indicate that prior to the class demonstration, most of the students (92%) spent 2 hours or less setting up their avatars and practicing all of the basic interactive skills outlined in the pre-demonstration assignment. The vast majority of the students (76%) did not find the local

text and voice chat skills difficult to master. Similarly, the majority of the students (74%) felt that moving their avatar around within the virtual spaces was not a difficult skill to develop as well. Finally, although avatar appearance changes are not necessarily required to function within the environment, nearly half of the students (48%) found it challenging to manage the appearance of their respective avatars.

Statement	Concept Being Canvassed	Responses	Total Population		Undergraduates		Graduates	
			No.	Percent.	No.	Percent.	No.	Percent.
5. Changing your avatars appearance was difficult to accomplish?	Initial Learning Curve	1. Strongly Agree	8	16.0%	5	23.8%	3	10.3%
		2. Agree	16	32.0%	6	28.6%	10	34.5%
		3. Undecided	9	18.0%	4	19.0%	5	17.2%
		4. Disagree	16	32.0%	5	23.8%	11	37.9%
		5. Strongly Disagree	1	2.0%	1	4.8%	0	0.0%
6. Moving your avatar (to include walking, flying, and sitting) was a difficult skill to learn?	Initial Learning Curve	1. Strongly Agree	0	0.0%	0	0.0%	0	0.0%
		2. Agree	11	22.0%	5	23.8%	6	20.7%
		3. Undecided	2	4.0%	1	4.8%	1	3.4%
		4. Disagree	31	62.0%	12	57.1%	19	65.5%
		5. Strongly Disagree	6	12.0%	3	14.3%	3	10.3%
7. Communicating in Second Life (to include Local Text Chat and Voice Chat) was a difficult skill to learn?	Initial Learning Curve	1. Strongly Agree	0	0.0%	0	0.0%	0	0.0%
		2. Agree	9	18.0%	3	14.3%	6	20.7%
		3. Undecided	3	6.0%	1	4.8%	2	6.9%
		4. Disagree	30	60.0%	12	57.1%	18	62.1%
		5. Strongly Disagree	8	16.0%	5	23.8%	3	10.3%
8. How much time did you take to practice in Second Life prior to your first class session?	Initial Learning Curve	1. Less than 10 minutes	7	14.0%	3	14.3%	4	13.8%
		2. 10 to 29 minutes	8	16.0%	5	23.8%	3	10.3%
		3. 30 to 59 minutes	17	34.0%	9	42.9%	8	27.6%
		4. 1 to 2 hours	14	28.0%	3	14.3%	11	37.9%
		5. More than 2 hours	4	8.0%	1	4.8%	3	10.3%

Table 3: Survey Results: Initial Learning Curve

Third Survey Concept: Avatar Interaction

The third group of four statements in the survey focused on the avatar interactions and the mechanics associated with the utilization of the avatar as a personal proxy in a virtual environment affecting real world communications. Although avatar appearance changes are not necessarily required to function within the environment, the students were queried as whether they felt they were distracted by the appearance of the various avatars. Only a select few students (12%) indicated that the general appearance of most of the avatars was distracting. Furthermore, only (18%) of the students felt that avatar appearances needed to closely resemble those of their owner.

The majority of the students (68%) indicated that the presence of avatars enhanced the group's communication and interaction. Finally, nearly all of the students (94%) express the need for maintaining a code of conduct within the virtual spaces if academic sessions were to be conducted using this environment.

Statement	Concept Being Canvassed	Responses	Total Population		Undergraduates		Graduates	
			No.	Percent.	No.	Percent.	No.	Percent.
9. How would you rate the importance of maintaining a Code of Conduct for holding academic sessions in Second Life environments?	Avatar Interaction	1. Unimportant	0	0.0%	0	0.0%	0	0.0%
		2. Of Little Importance	3	6.0%	2	9.5%	1	3.4%
		3. Moderately Important	11	22.0%	7	33.3%	4	13.8%
		4. Important	14	28.0%	5	23.8%	9	31.0%
		5. Very Important	22	44.0%	7	33.3%	15	51.7%
10. The general appearance of most avatars was distracting?	Avatar Interaction	1. Strongly Agree	2	4.0%	1	4.8%	1	3.4%
		2. Agree	4	8.0%	0	0.0%	4	13.8%
		3. Undecided	6	12.0%	3	14.3%	3	10.3%
		4. Disagree	32	64.0%	15	71.4%	17	58.6%
		5. Strongly Disagree	6	12.0%	2	9.5%	4	13.8%
11. It is important for avatars to closely resemble the human they represent?	Avatar Interaction	1. Strongly Agree	1	2.0%	1	4.8%	0	0.0%
		2. Agree	8	16.0%	3	14.3%	5	17.2%
		3. Undecided	11	22.0%	5	23.8%	6	20.7%
		4. Disagree	23	46.0%	8	38.1%	15	51.7%
		5. Strongly Disagree	7	14.0%	4	19.0%	3	10.3%
12. The presence of avatars enhanced group communication and interaction?	Avatar Interaction	1. Strongly Agree	6	12.0%	4	19.0%	2	6.9%
		2. Agree	23	46.0%	11	52.4%	12	41.4%
		3. Undecided	10	20.0%	5	23.8%	5	17.2%
		4. Disagree	8	16.0%	0	0.0%	8	27.6%
		5. Strongly Disagree	3	6.0%	1	4.8%	2	6.9%

Table 4: Survey Results: Avatar Interaction

Fourth Survey Concept: Perceived Effectiveness

Finally, the fourth group consisted of three statements in the survey that focused on the students' perceived effectiveness of SL as an academic tool. Although the majority of the students (79.4%) felt that a virtual environment such as SL made them more motivated to conduct online collaboration, half of the students indicated that they were only somewhat likely to use SL again. Finally, about a third of the students (34%) felt that SL was an effective platform for conducting academic meetings.

Statement	Concept Being Canvassed	Responses	Total Population		Undergraduates		Graduates	
			No.	Percent.	No.	Percent.	No.	Percent.
13. Second Life is an effective platform for conducting academic meetings?	Perceived Effectiveness	1. Strongly Agree	4	8.0%	4	19.0%	0	0.0%
		2. Agree	13	26.0%	7	33.3%	6	20.7%
		3. Undecided	24	48.0%	8	38.1%	16	55.2%
		4. Disagree	6	12.0%	2	9.5%	4	13.8%
		5. Strongly Disagree	3	6.0%	0	0.0%	3	10.3%
14. Does a virtual environment such as Second Life make you more or less motivated to conduct online collaboration?	Perceived Effectiveness	1. More Motivated	27	79.4%	13	61.9%	14	48.3%
		2. No Difference	15	44.1%	6	28.6%	9	31.0%
		3. Less Motivated	8	23.5%	2	9.5%	6	20.7%
15. How likely are you to use Second Life again?	Perceived Effectiveness	1. Not at All	12	24.0%	3	14.3%	9	31.0%
		2. Very Little	10	20.0%	6	28.6%	4	13.8%
		3. Somewhat	25	50.0%	10	47.6%	15	51.7%
		4. To a Great Extent	3	6.0%	2	9.5%	1	3.4%

Table 5: Survey Results: Perceived Effectiveness

Overview of the Survey Results

Although these early survey efforts focused heavily on the new virtual student rather than virtual space designs, the results do shed some light on early effectiveness of the media and the potential of the virtual media for further study and use by academics. The results from the first group of statements presented in the survey were promising from a further study and use perspective. Even though a large percentage of the students were new to the online experience few had any significant hardware or software compatibility issues. Since the SL environment was at no cost to the students, this can be a big advantage to educators looking for viable open channels for communicating with their students.

Although most of the students had no familiarity with the SL environment, the vast majority of them had to invest less than two hours of time to set up their avatars and gain the basic skills needed to interact within the virtual environment.

The results from the third section of the survey focusing on the avatar interactions again proved positive. Not only was the general appearance of the most of the avatars not found to be distracting, but the majority of the students but also most of the students felt that the presence of avatars enhanced the group's communication and interaction. The fact that nearly all of the students expressed the need for maintaining a code of conduct within the virtual spaces demonstrates the need for some level of expectancy and decorum within the environment, especially within the context of the mediums use as an academic delivery tool.

It appears from that last set of survey statements that the jury is still out with respect to the effectiveness of the media as an academic tool. As this survey was limited to students with only a single demonstration session to pull from, obvious further study and analysis following more extensive academic sessions should glean more definable results to evaluate from.

Lessons From Those First Virtual Class Demonstrations

Some careful consideration and advanced planning should be made in designing classrooms and lab areas for students to meet, collaborate, and build within. The same effective layouts used in the RW appear to work well within the VW. This may be attributed to the physiological effect of a familiar appearance. Important factors to consider when designing these virtual spaces are: the number of student avatars that will be present, the type of media to be displayed, and the activity that will take place in the space. Keep in mind when designing the space that avatars are not as dexterous as humans and need more space to move around.

If the intended purpose of the meeting space is to present a lecture to a sizable group of avatars, then a traditional looking lecture hall with a stage area and rows of seating works well. The humans behind the avatars in the audience will get the physiological feel of being in an auditorium and are focused on what is in front of them, the speaker. The speaker then has a field of view which allows them to see all the avatars in the audience. Just like in the RW, this makes it easy to see raised hands. There are some small modifications that must be made to accommodate avatars though. Avatars do not squeeze between seats and laps like humans – they climb over them which is distracting. Also, in SL, avatar names hover above their head and need to be readable to the speaker. To accommodate these unique avatar characteristics, do not pack seating together, as would be done in a real auditorium, leave an empty isle between each seat or make the walkway between rows extra wide so avatars can easily move to a seat. This also makes it easier for the speaker to pass out notes or other inventory items to audience participants.

For small group meetings, a simple round table works well. The advantage of a round table is that the camera view can be moved to look down directly at the table which makes it easy to see all participants and their names.

No matter the size of the group that is meeting in the virtual space keep in mind that you want avatars to be able to move around as freely and easily as possible. Enclosed spaces can create problems. Consider an open air type of design. Not having walls or even ceilings on classrooms and laboratories will make entering and leaving the area easier and faster for avatars but also opens the class to outside distractions. Since flying is the most common mode of transportation in SL besides teleporting, not having a ceiling can be an advantage. Since exit doors can become bottle necks for avatars have slightly opaque walls that can be walked through or no walls at all. Another consideration is where to have the avatars teleport to and from a virtual classroom or lab; have a defined area free of obstacles for incoming teleports.

With open areas (or free spaces) many will use virtual areas to build or to practice building. These areas should be quite large with no vertical or horizontal constraints like walls or ceilings. Often referred to as sandboxes, these areas are best located out in the open and they can even be designed to look just like a sandbox. These sandboxes can be on the ground level or floating in the sky. The size of the sand box will depend on just how many avatars and subsequently what their building activities will be. Less space is needed to build a picture frame or bookcase than to build a house. As you can see, the sandbox needs to be quite large.

Virtual classrooms and labs don't have to look like the bland antiseptic spaces we use now in RL. A designer's imagination can run wild here. If teaching a history class – the classroom could change every meeting to be in a setting that represents the period being discusses. A classroom could be a field of green grass with rocks or oversized mushrooms as chairs. One of the benefits of a virtual world is that there are few limitations on your imagination when designing virtual meeting spaces.

Consider using low prim furniture and other objects. The number of prims in an area can have an impact on the performance of the environments rendering on the student's PC. The more complex the objects the harder the video card must work to "draw" them on the screen. The value of building in virtual spaces is that unlike the RW, making changes to your virtual classrooms and laboratory spaces does not require hiring movers, contractors, or performing heavy lifting; these efforts are just a few mouse clicks away usually. Once a classroom or laboratory design is found to be functionally effective, the layout and contents can be saved to be used at any time. Consider having several different sizes and designs of labs and classrooms that can be opened up (or rezzed) when needed.

Follow-on Virtual Design Studies

Based on these early virtual classroom and laboratory developments the next step in evaluating these efforts should bode the question: how can virtual classroom and laboratory spaces be designed and built to maximize the virtual classroom and laboratory as an effective tool for academic delivery? Furthermore, the virtual environment functionalities and limitations notwithstanding, in the end, the moving forward question has to be: do these virtual classroom and lab developments amplify the capabilities of the environment as a viable pedagogical tool or not?

The SL environment provides academia with a communication and collaborative tool as well as a creative tool that provides the added value as an outreach tool for remote, distance education students. From both the communication and collaborative perspectives these early student interactions can glean many new insights into other areas where virtual classrooms and laboratories can provide improved options over other current online tools. And from a creative perspective, understanding the initial student reactions to the ease of building and creating within a virtual environment will be of potential value.

The ability to collect objects and case studies as virtual realities from multiple perspectives suggests a new methodology for research. Building environments that provide for these collections should prove beneficial to furthering the educational process and maximizing the virtual environmental spaces academic utility.

Students can work either individually, in pairs or in teams to design and build objects that will enhance the virtual labs. Items built will have learning and educational value for other students. Students can spend time at the beginning of the semester becoming familiar with the virtual environment and lab spaces. They can meet in-world to brainstorm ideas on what they would like to contribute to the lab and then coordinate the building activities amongst themselves.

Once their idea is approved, students can spend the remaining part of the course actually building and testing their creations. As an end of project presentation, they could hold a demonstration in SL with each team of students evaluating the creations of the other teams. This provides the students with a living project of sorts. Students can further make their contributions to the lab and have an opportunity to improve and expand on the creations of previous students.

Virtual environments provide students with tools having endless possibilities. Virtual classroom and laboratory workspaces should consider the aspects of teaming and interaction as a fundamental opportunity when building new areas for course activities. Some early virtual lab and work space uses have included: learning a new language with the help of other students who are versed in the new language, designing a new line of clothing and modeling them for their classmates comments, developing the concepts for a new virtual business in a business course, or building sample billboards for a marketing class. [7]

Although academics are there to provide the framework for meeting each educational goal, each student has their own unique settings for maximizing their learning process. Virtual environments give us the tools now for not just instructors, but also students to build their own learning environments. Creating classrooms, meeting spaces and laboratories that give students the freedom to explore and build their own learning environments is truly leading us into new uncharted territories.

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