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The Use of Second Life ® to Teach Physical Security Across Different Teaching Modes

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Abstract. Teaching physical security can be difficult since classes generally do not have access to physical structures to assess. The purpose of this study was to investigate a new way of teaching physical security using Second Life® and to see if there is a difference in performance related to mode of instruction. The research question sought to determine whether there was a significant difference in student performance based on differences in modes of instruction for students evaluating physical security in virtual world environments. Three groups of participants situated in three geographic locations in the United States and belonging to three different modes of instruction – traditional, online, and hybrid were taught using Second Life®. The results were inconclusive in determining the best mode of instruction. However, the research suggested that Second Life® can be used as a teaching platform to teach physical security.

Keywords: Second Life®, Virtual Reality, Simulation, Physical Security, Avatar, Virtual Learning.

1 Introduction

Simulation is a situation where physical models, computer programs, or a combination of both offers the opportunity to gain experience and assess skills through repeated practice within a safe environment [1]. This study tested the potential for using virtual world technologies for teaching physical security in a variety of learning contexts: online, classroom, and hybrid. Students use avatars and role-play as physical security auditors in a datacenter that is rife with problems and

then after a debriefing session, proceed to a second datacenter empowered with more information. The study focuses on comparing student responses to the first and second scenario to determine if this learning method can create significant improvement in response. This study was not able to reach any additional meaningful determination of which contextual mode of instruction better supported simulation-based learning.

2 The Use of Simulation in Teaching and Learning

Teaching and learning through the use of simulation can be especially effective in high risk areas like aviation and medical or surgical training. An important challenge for surgical training lies in providing conditions for effective learning without endangering the patient's life [1]. There are several advantages to using simulation in a field like surgical training. The training program can be determined based on the needs of the learner rather than the patient where learners can focus on complete procedures or particular parts depending on their needs. They can practice as often as required to meet their educational objective because a simulation environment when compared to a real life situation is a safe environment. Simulators provide excellent opportunities for formative and summative evaluation of learning through their built-in tracking and usage recording devices. Moreover, the ability of most simulators of providing immediate feedback has the potential to facilitate individual and collaborative learning.

Educational simulations share key characteristics with games including the common use of a virtual environment and the focus on a particular goal [2]. However, simulations additionally include strategies to guide participants to develop particular behaviors and competencies which may be highly desirable in the intended professional activities. In this research, the use of virtual world technology to teach physical security builds on both of these elements.

A virtual world of teaching-learning appears to be the ideal bridge between the innate interactivity afforded by online courses and the intense absorption offered by immersive role-playing video games [3]. Virtual worlds can act as digital learning objects and can provide an arena for constructivist learning. It can facilitate more student engagement than is possible through simple discussion boards in most online courses. The primary difference between games and the Second Life® Grid used in this study is that the latter is just the platform for creating objects in a space; the educator needs to develop the scenario, plot, motivations, and interactions that engage students with game-like narrative, context, and content characteristics.

A 2009 case study report published on the Linden Lab website mentions how the Customs and Immigration students at Loyalist College used Second Life® to experience the daily routine of their future job [4]. Worldwide terrorism related security issues have made it difficult for the students to get access to sensitive real life locations. The virtual border crossing simulation facility in this project replaced real life geographic border crossing experiences for the students. There was a significant improvement in grades on the students' critical skills test, raising the scores from a 56% success rate in 2007 to a 95 % success rate in 2008 after the simulation program was used.

A central issue of concern amongst those who use simulators for professional training is whether the skills learnt in an artificial environment can be translated into real life situations [1]. A study conducted to demonstrate the effectiveness of virtual reality training in the transference of technical skills to the operating room environment demonstrated that while there was no difference in the baseline assessment scores between the control and the experimental groups, the latter group which had received Virtual Reality based training as a component of their preparation, were able to perform a gall bladder dissection 29% faster than those who did not receive training. Those who did not receive training were found to be 9 times more likely to make less progress and five times more likely to injure the gall bladder. Hence, it was seen that Virtual Reality surgical simulation training significantly improved the performance of the operation room performance of surgical residents.

Dental education has been using simulation since the 1990's for training and development of psychomotor skills [5]. Activities within Second Life® can provide a way to combine new simulation technologies with role-plays which can be used to enhance instruction in diagnosis and treatment planning. Case-studies and role plays have been used as effective evaluation mechanisms to foster decision making and to learn problem-solving strategies. Synchronous distance communication made possible through Second Life® can result in resource sharing and collaboration, thus promoting the globalization of dental education .

3 Purpose and Research Design

The purpose of this study was to investigate the effectiveness of teaching physical security using virtual world scenarios. Particularly, the study objective was to determine any difference in learning performance in relation to accompanying modes of instruction.

The following research question was the focus of this project: Is there a significant difference in student performance based on differences in accompanying modes of instruction for students evaluating physical security in a virtual world?

A quasi-experimental research design was used for this study because the research participants were not randomly assigned to the experimental groups [6]. It was not a true experiment because the researchers did not have complete control over all experimental conditions. The three group pretest-posttest design used in this study can be graphically represented as follows:

Group(s)	***Pretest***	***Treatment***	***Posttest***
A	O_1	X	O_2
B	O_3	X	O_4
C	O_5	X	O_6

Figure 1: The Three Group Pretest-Posttest Design

The experimental group (A, B & C) participants were asked to visit the Second Life® website and to download the program. They created an avatar and spent an hour in the Help Island going through the tutorial. In class, they were given a scenario and a building to evaluate for physical security issues. The objective of this physical security evaluation exercise was to find the maximum number of security flaws within the environment. They had to complete the task within one hour. The scores in this session were treated as the pretest scores for this study. After this the students participated in an hour long debrief session where they shared their experiences. The objective of this debriefing session was to share their individual findings as well as to learn from each other's findings. In the next session, the students were assigned a different building with similar physical security challenges but in a different layout. The objective of this exercise was for the students to find as many security flaws as possible within the virtual buildings. They completed this assignment as an asynchronous homework assignment, limited to one hour again, to be completed within the next one to two weeks. This homework assignment was treated as the posttest for this study.

5 Assumptions, Limitations, and Delimitations

It was assumed that the participants in this study already have basic computer skills. These skills should include activities like accessing the internet, as well as knowledge of how to download and access Second Life®. It was assumed that the participants will answer the pre and post test questions honestly and to the best of their ability. It was also assumed that the participants will be interested to participate and complete the project.

The researchers had to work with intact classes in order to comply with research site requirements. Hence, it was not possible to randomly assign the participants into the experimental groups. Also, instructional differences may have occurred as a result of difference in the quality and content of the debriefing sessions at the three different sites.

The study sample consisted of three groups of students participating in three different mediums of instruction - traditional face-to-face, completely online, and hybrid (with face-to-face as well as online course components). The researchers had no control over the prior knowledge, skill, and backgrounds of the students in the experimental groups. Depending on individual circumstances, some participants may have had more or less background knowledge and skills.

This study being quasi-experimental, its participants were not randomly selected. Hence, its findings may not be generalizable to all students. The pre and post tests were developed by the researchers and may not be reliable and valid.

7 Significance of Study

Physical security auditing takes a special kind of perspective. The physical security auditor tries to find and correct the risks and flaws of an organization's physical facility, before any untoward event happens. To do this work effectively, auditors must develop the skill of walking through a place and seeing what is dangerous, what is misplaced, and what things are missing. Some auditors get this by experience working with others, but these are rare opportunities. Picking it up from books is hard because it is hard to get a sense for "casing a scene."

Teaching physical security in any setting can be a tricky thing to do, especially if one wishes to allow the students to have a meaningful "hands-on" experience. Physical security is one of the most important aspects of the overall security posture of an organization. A well configured firewall and locked down workstations are insufficient protectors when someone can easily access the network from the inside and simply pull cables or attach key loggers. While there are many concepts that can be discussed in a course on physical security, developing a spatial appreciation for physical security in a three dimensional space should be enhanced by actually inspecting a structure.

Finding a "classic case" is not an easy thing to do in the real world. First, it may not be possible to find a single building that contains all the attributes and feature one would like ot discuss. This is especially true if what one would like the student to see is a building constructed with serious security flaws. Even if one did find a building with all the teaching points, and even if the building owner/manager didn't mind exposing vulnerabilities through an educational audit of the space, (semester after semester), it may be an impractical idea to accommodate the entire class physically into the premises under consideration. Or the weaknesses might be remediated.

The researchers developed a scene with virtual buildings on which students can perform physical security audits. Students were given a scenario that required them to identify the features of the building that presented security issues. This included items such as, blind spots in surveillance camera coverage, poor lighting, inappropriate fire suppression equipment, and poor access controls.

The project is in the Second Life® Grid, so that it is both accessible to the students remotely on their schedule and also has the power to host large events "in-world". If people would like to see the facility they can download the Second Life® browser. Initially the facility was on Science Island III, just north of the National Public Radio Science Friday radio show set in Second Life®. Currently it is hosted on 3D Learning Island by the MASIE Center. Please contact the researchers to obtain appropriate permissions to enter the space.

8 Participants and Procedures

The total number of participants in this study was 43 (N= 43). The participating groups were located in three geographically disparate parts of the United States – Idaho (Idaho State University), Maryland (Capitol College), and Colorado (Regis University). The hybrid classroom group at Idaho had 17 students, the completely

online group at Maryland had 19 students, and the traditional group at Colorado had 7 students. Ten participants from the Maryland group did not submit their posttests.

Pretest and posttest data were collected from each group. The results were subjected to a descriptive procedure which is used to depict the commonly-used statistics that summarize key properties of distributions of quantitative variables [6]. Due to the huge difference among the number of students in the three groups, a one-way ANOVA was not used in this case. Here the "score difference" refers to the score differences between the pretest scores and the posttest scores. The dependent variable is defined as the posttest score minus the pretest score.

10 Instrument Development, Reliability, and Treatment

In order to answer the research question for this study, the researchers constructed two scenarios for use during the pre and posttest situations. They further made a list of security issues in a template format using Microsoft Word. They derived the security issues from security examinations and government documents. The document template contained 30 items. The items were not weighted according to their difficulty index. The students were required to identify the physical security issues they observed in the areas they visited within Second Life® and fill in the template based on their observation.

One of the researchers developed pre and post tests based on each of the scenarios. However, the testing instrument was not formally analyzed to determine reliability.

The treatment was a period of instructional debriefing and discussion of the students' findings on the pretest and was administered prior to the posttest.

11 Results

The sample sizes were unequal. Group 1 (a hybrid classroom of 17 students), group 2 (a traditional classroom of 7 students), and group 3 (an online classroom of 9 students). The posttest score data was collected after the treatment/instructional debriefing session.

Minimum, maximum, means, and standard deviations of the dependent variable, the differences between the pretest scores and the posttest scores, are shown in Table 1. Of the 33 samples collected, the total score difference (n = 33) averaged to be 13.82 (*SD* = 16.46), the mean of score difference in the posttest (*M* = 49.70) is higher than the mean of score difference in the pretest (*M* = 35.88).

Table 1. Descriptive Statistics of the security flaw numbers for all samples

Item	*N*	*Minimum*	*Maximum*	*Mean*	*Standard Deviation*
Pretest	33	8.00	77.00	35.88	15.84
Posttest	33	14.00	98.00	49.70	18.52

Difference	33	-19.00	50.00	13.82	16.46

Comparing Table 2 to Table 1, it was found that the mean score difference of the hybrid group (M = 21.00) is higher than the total mean score difference (M = 13.82). In contrast to the hybrid group, the mean score differences of the other two groups, the traditional group (M = 9.43) and the online group (M = 3.67) were lower than the total mean score difference.

Table 2. Descriptive statistics of the security flaw number differences for the three groups

Classroom Conditions	N	Minimum	Maximum	Median	Mean	Standard Deviation
Hybrid	17	-4	50	15.00	21.00	17.91
Traditional	7	-7	24	13.00	9.43	11.27
Online	9	-19	17	6.00	3.67	10.21

Table 3 shows the percentage of students in each classroom condition that made progress after the treatment/instruction. There were 94.12% students in the hybrid group, 85.71% in the traditional group, and 77.78% in the online group who made progress.

Table 3. The student performance improvement rate for the three groups

Classroom Condition	***N***	***Positive Difference Number***	***Percentage***	***Negative Difference Number***	***Percentage***
Hybrid	17	16	94.12%	1	5.88%
Traditional	7	6	85.71%	1	14.29%
Online	9	7	77.78%	2	22.22%

12 Discussion

The original intent of the researchers was to identify whether there was an improvement in student performance based on the related instructional mode. However, the results of this study were inconclusive in determining any difference between the modes of instruction. This research might have yielded more representative results with better control measures on the online group and if there was a larger sample in the traditional group.

The data from the research also revealed that the participants were able to identify more physical security flaws within the Second Life® environment than were consciously built in by the creators of the environment. Some of these were related to

artifacts of the modeling process. Never the less, this encourages the researchers' belief that a 3-D interactive environment has the potential to provide a learning environment that allows the opportunity for students to make a comprehensive and open-ended evaluation of scenarios. The Second Life® environment allows for a greater amount of learning to take place than what was represented in the intended text-based outcomes. The performance of most students improved irrespective of the mode of instruction used. The data showed that 87.88 % of the students improved in their posttest performance.

13 Conclusions and Suggested Further Research

This study suggests that it is difficult to isolate the many factors related to the larger learning context that determined student achievement related to virtual world scenario learning. Therefore, better onsite control measures as well as larger and equal sample sizes are required for more conclusive results. Also, the participants in this research study were graduate students. Further research with undergraduate as well as high school students may be helpful to establish the generalizability of the findings across a broader range of ages and backgrounds.

An interesting area of further research may be in comparing the number of items found in a virtual building with those found in a similar actual physical building. The purpose would be to discover meaningful differentials between spatial analysis in virtual and real world experiences. This would help clarify the validity of virtual world training in preparation for real world security. If so, this platform might demonstrate value as an additional feature in information assurance competitions like the National Collegiate Cyber Defense Competitions (NCCDC).

Second Life® has the potential to support the information assurance curriculum. While the results of this study were inconclusive in determining a difference in performance attributable to modes of instruction, the students' posttest results show a general improvement in performance across all three instructional modes.

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