Service Learning and Virtual Worlds

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Abstract - This project leverages virtual world environments to create spaces to support sustainable problem solving communities. These communities are seeking to address pressing social problems through the collaborative efforts of college students, high school students, volunteers, and staff members affiliated with the Gleaners Incorporated. Our approach is to have engineering students build a Second Life environment that provides a structure for collaborative problem solving activities. Second Life serves as a vehicle to build a stronger sense of community among food bank network members, to help conceptualize parameters of their problems, develop virtual solutions collaboratively, test these solutions, and implement these solutions in the real world. In order to involve high school age students, engineering students are using the Torque Game Engine to build virtual environments to support instructional activities focusing on nutrition and economical shopping. Initial student survey data indicates satisfaction with the service learning experience.

Index Terms - Virtual worlds, Service learning, Serious games, Capstone design.

BACKGROUND

The use of virtual environments is an attractive alternative to live meetings in the current financially strapped corporate environments. Geographically dispersed users can meet easily and economically in cyber space. Bessiere suggests that by the end of 2011, 80% of active internet users will be involved in some form of virtual environment and that corporate entities will find value in their use [1].

Predictions about the proliferation of virtual environments in the workplace seem to be coming true. Harry reports creating simulated “meeting spaces” in Second Life [2]. One motivation for this effort is to demonstrate the impact the aesthetics of any environment can have on team cohesion and collaboration. As part of this work, Harry developed an application that facilitates group meetings using both a virtual environment and a website. This is a good example of corporate meeting simulation that fosters collaborative efforts through immersion in a virtual environment. This work demonstrates the potential for immersion as a tool in a business environment. The virtual environments created by our students attempt to capitalize on this type of immersion as a means to engage the participants in realistic simulations. The hope is that their exposure to an immersive experience will entice them to real action in the community.

There are several applications of virtual environments in education. Virtual chemistry and biology laboratories are among some of the most impressive examples of the potential to use virtual worlds to deliver meaningful content in an educational setting [3]. Chivukula created a Java-based application to provide the students with a game-like structure for Internet experiments as well as providing access to chat and video resources [4].

Ritzema created a virtual environment using Second Life to support distance learning of computer science concepts. The results from this work suggest that virtual environments enhance both knowledge retention and foster interest in a given topic [5]. Other investigators have reported similar results [6] [7] [8].

Virtual environments allow for participants to be in widely scattered geographic locations instead of requiring them to be in one place at the same time. This allows for multiple participants to engage in training at various times. Virtual environments provide flexible and adaptable environments for presenting a multitude of scenarios within a problem domain. Finally, although only a simulation, participants are often quick to suspend disbelief and fully engage themselves as if each crisis were real and react accordingly. The results presented in this study also suggest that these simulations are comparable in their educational benefit to much more expensive, manikin-based instruction.

To become viable as educational delivery vehicles, virtual environments need to provide users with a sense of motivation. A successful educational experience in a virtual environment requires the delivery of coherent, goal-driven content that directs the user toward a purpose [1]. The environments created for our project make use of a set of goal-oriented games to educate participants about the problem of hunger in their community and the resources available to them.

We believe virtual environments that focus on hunger can function well in their ability to reach and engage a broad audience of people and that various problem domains have and can be adopted into a virtual world. We also believe students who develop these types of virtual world applications can benefit from this experience as well.

Engineers recognize the value of using virtual simulations of mechanical prototypes. They note that developing such a test model via conventional means requires a lot of effort in developing not only the prototype itself but also in developing the environment under which it will be tested in an effort to predict potential problems. This is necessary to provide a mechanism for introducing design changes. When building physical prototypes success may be
at risk due to the large resource issues required to perform rapid prototyping in short time periods [9].

These difficulties have forced engineers to seek alternatives such as implementing an automobile heads up display [10] and an eye-movement-based prototype [11]. These prototypes were implemented in virtual worlds. Although often cited as clumsy and initially difficult to learn, virtual environments can provide inexpensive, viable test beds for real-life applications [12]. While these types of engineering simulations are solving real world problems, it is doubtful their users receive a lasting sense of experience by being submerged in these environments.

Ellis developed a series of games in Second Life to foster team development. Ellis claims that people become cohesive teams when they associate their self-identity with the identity of the team. This research is relevant to our project in two major ways. First, game playing in virtual worlds may, in fact, build a strong social community. Second, it is possible to use virtual environments as a team-building exercise [13].

In other related work, Loui offered a course in which students were forced to play roles within the context of different technologically based ethical scenarios. The results showed that role-playing participation in a scenario eases the tension caused by unpredictability and helps people to better collaborate with each other [14].

Loui did not make use of virtual environments. This research suggests that game playing may provide a sense of team cohesion. This research does not examine whether these same principles can be used to build sustainable communities. Attributing a sense of social identity to a group via a virtual environment can be extended to mean not only team membership but also community membership.

In the virtual environments created for our project, participants are encouraged to understand and identify with the roles portrayed within the games. This should encourage outside involvement and personal identification in much the same way that the team building exercises might do.

Our virtual environments immerse users in the worlds and allow them to learn from their experiences and encourage community involvement. We believe it is important to foster a sense of community involvement among the computing students on our campus and provide them with a sense of purpose for their work.

An important goal with some educators is to foster a sense of professional activism within their students. While Decker claims that it remains unclear how this mentality can be reliably created, he does cite optimistic data that suggests that even during high school, students are predisposed to community service [15].

Martin reports a study in which students were forced to participate in what she referred to as social impact analysis, as one means creating an attitude of professional activism. By becoming intimately aware of the technology used in a real-life organization, both the client and the student were forced to consider the social and ethical components of the technology the client was using. This led the students to provide the client with ideas for alternatives or future upgrades to improve both productivity and social impact. This suggests that students can become much more interested in human aspects of the environment and much more in tune with social implications of the profession [16].

This immersion approach can be beneficial for instilling the social impact of one’s work and a desire for activism. Tsang notes that most capstone design courses do not allow for serious reflection upon one’s accomplishments in the context of community impact [17]. Tsang claims that if reflection were included, it would drive students to provide community service in the future. He does note also that service learning projects can be provided to community organizations with little or no cost to them with the risks being mitigated to, “Could this project be done by professionals?” and “What happens if the students don’t get it done?”

In our approach, our community partner makes no financial contribution and sacrifices only time to meet with the students. The students become very aware of the organization’s structure and its needs as a result. Their work products are provided to the client free of charge, with virtually no risks to the client.

Some advertisers feel that virtual environments are an ideal means to advertise products online [18]. Despite its allure, Barnes also notes that there currently aren’t any suitable metrics to measure the effectiveness and profitability of such advertising. It is hard to measure the direct impact of a project like ours. We believe that, in the context of community service organizations, the general public wants to help. However, these people may not know how to help or even if they are capable of helping.

Through our project, we can assist in educating the public about community needs and resources. In our project, the participants assume the roles of food bank volunteers and shoppers and this will not only provide them with a better understanding of the roles, but it will also ease the apprehension of getting involved with the community.

Project Overview

Students taking the CIS capstone design course on our campus provided the majority of the software engineering effort for this project. They were assisted by a paid staff consisting of a graduate CIS student, an undergraduate CIS student, and an undergraduate interior design student. The paid staff set up the Second Life island and provided supplementary software engineering support as needed.

We organize our software engineering capstone design experience as two, two credit-hour courses (CIS 4961 and CIS 4962) which students complete over two semesters. These courses are required of all software engineering majors. Most students taking these courses complete projects for off campus clients as part of their capstone design projects. The educational outcomes for the capstone design experience appear in Table 1.

Students enroll in CIS 4961 after they complete all required software engineering courses. The capstone projects
generally require about 500 hours of student effort to complete. The major activities in CIS 4961 are requirements gathering and project planning (including risk management and quality assurance efforts). The major activities in CIS 4962 are product design, implementation, and testing. Serious game projects usually make use of a rapid prototyping process, so a clear distinction between the analysis and design phases of a project may not exist.

Students work in three or four person teams. In exceptional cases and with proper justification, smaller or larger group sizes are permissible. Students select their own teammates and determine their own plan for rotating team leadership. We have observed that students tend to organize themselves so that one person is the hardware expert, one person is the software expert, and a third team member takes charge of documentation and coordination of activities. The asset creators similarly tend to specialize in the areas of 2D art creation, 3D animation, and audio design.

### TABLE I

<table>
<thead>
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<th>Educational Outcomes</th>
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<tr>
<td>1. The ability to lead a software development team in the successful completion of a software project for an external customer</td>
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<td>2. The ability to manage the successful completion of a software project for an external customer</td>
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<td>3. The ability to write a management plan for a software project that involves time and resource estimates, personnel scheduling detail, and its production costs</td>
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<td>4. The ability to create a risk monitoring, mitigation, and management plan for a real-world software development project</td>
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<td>5. The ability to create and execute a software quality assurance plan for a real-world software project</td>
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<td>6. The ability to conduct a project post-mortem to determine the effectiveness of a project plan</td>
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<td>7. The ability to write a complete analysis document and create an analysis model for a real-world software system</td>
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<td>8. The ability to write a complete design document for a real-world software system</td>
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<td>9. The ability to participate on a team to design and implement a software system to meet the needs of a real-world customer</td>
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<td>10. The ability to make use of appropriate software engineering tools in the development of a software product</td>
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<td>11. The ability to create and execute a test plan for a real-world software system, including test case creation based on the specified requirements</td>
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<td>12. The ability to conduct two thirty-minute seminar discussions on ethics or professional issues papers requiring independent library and/or Internet research</td>
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Classes meet for two hours each week for 56 semester contact hours over a period of 8 months. The ACM/IEEE Computing Curricula 2004 recommendations suggest that 11 lecture hours be devoted to social, ethical and professional issues. We include this material in our capstone design experience. The recommended topics associated with these knowledge units come from four broad groups of topics:

- **Historical and social context of computing** this includes: definition of computing subject matter, comparison with other disciplines and computing technology uses/limitations.
- Topics associated with responsibilities of the computing professional such as: professional societies, social responsibility, professional growth and ethical choices.
- Risks and liabilities focusing on: risk types, loss types and liability.
- Intellectual property including: definition of intellectual property, protection of intellectual property and infringement penalties.

During the first two weeks of CIS 4961, class time is devoted to course introduction and project organization issues. After project teams assemble, class meetings consist of seminar-type class discussions on professional issues or team presentations of significant project milestone artifacts. These presentations might consist of a brief progress report, a structured walk-through of a work product, or a product demonstration. Students select discussion papers from a textbook containing a collection of contemporary papers on computing ethics and professional issues.

In addition to the two hours of class-time each week, students put in an additional six hours per week out-of-class on their project. Six hours of out-of-class work is typical for a two-credit hour course. The out-of-class time in the capstone course consists of team interaction, project planning, software design, product implementation, presentation preparation, report writing, meeting with clients, and consultation with instructor. The six hours of outside work is very important as a means of fostering team development.

The role of the instructor in our course is that of a coach or mentor not a project manager. The students handle routine client contact. Project scheduling and progress tracking is also handled by the student teams. The instructor is available to help student teams resolve unusual problems with the project and the client. The instructor provides feedback on the milestone documents and presentations. Students revise their milestone documents based on the feedback from the instructor and their classmates following the presentation of their documents. The instructor participates in the paper discussions, but does not control their direction or content.

A final presentation is required of all teams at the end of the second semester and includes a product demonstration and report. The sections in this report appear in Table 2. Students leave copies of their final report with their client and the instructors. Copies of the final reports reside in the department library.

The final project presentation is very important as a vehicle for assessing oral communication skills. The project presentation requires the use of audiovisual support such as a computer projector and PowerPoint slides. Students are required to be professionally dressed for the presentation. The entire department and other interested individuals receive invitations to the final presentation.

Students must present a letter of acceptance from their client to the instructor in order to receive a grade for CIS 4962. The use of the client acceptance letter is a very
important element of our course to drive home to students the importance of satisfying their clients’ needs.

The instructor’s assessment of the student work products, tempered by input from the client acceptance letters, determines the student course grade in CIS 4962. The final presentation and report account for 40% of the student’s course grade. The student discussions on professional practice and ethics papers account for 20% of the course grade. The milestone documents and presentations account for the remaining 40% of the course grade.

Three projects were developed by student design teams for the collaborative problem solving island known as the Campus of Hope. The first project involved creating a software system to support meetings held simultaneously in real life and Second Life. Desktop video is streamed to the island to allow presenters to interact with geographically dispersed problem stakeholders.

A second project team created several interactive learning simulations (or mini-games) to educate users on how food is collected and flows through the food bank network to reach people in need. One game allows players to drive a truck among food pick up points using the shortest route possible. A second allows users to experience the canned good sorting process that follows food collection. This helps drive home a message regarding the effort required to process donations. The third game allows players to manage efficient food distribution among several regions so that no region runs out of food.

The paid student staff created several games to supplement those created by the senior design students. The bridge card shopping game lets players try to budget for one month using only items that can be purchased with state issued vouchers known as bridge cards. A virtual pac-man like game allows users to collect canned goods in a competitive fashion. A food fight game allows players to select quality food donation items by shooting at them. A food pinball game was created that lets users try to score by collecting food-related prize items.

The third team created 6 interactive exhibits highlighting local hunger problems and food banking best practices. One exhibit illustrates graphically the problems of waste encountered by food banks. A second exhibit helps the user visualize the impact of individual food donations on an entire city. A third exhibit challenges the user to create a complete meal from typical food bank items. The fourth exhibit allows users to listen to several people’s hunger stories. The fifth exhibit allows users to see which items can be purchased with state issued vouchers known as bridge cards. The sixth exhibit is an interactive state map that shows the network of food banks and their service areas.

The paid student staff created several additional exhibits for the Campus of Hope. A donations ride shows riders ten important food donation items. A food pyramid exhibit provides themed rooms showing the various food groups. A run for food game allows students to run on a treadmill while learning about hunger problems. A volunteer training center was created to allow users to experience various volunteer roles in a typical food pantry.

During the second semester of this project, we held a high school web site design competition. Seventeen two person teams were given the task of developing web sites that promote food banking best practices and hunger awareness.

After three hours of development, each team gave a short oral presentation on the nature of their design and their creative vision for their web site. The final web sites were evaluated by professional web developers. The judges assessed the web sites for their technical quality, usability, accessibility, and aesthetic appearance.

As part of the roll out of this project to the public, we hosted a one day conference on using virtual worlds to support the solution of real world problems. This conference was held simultaneously on our real life campus and on our Second Life Island. This conference made use of a live streaming media feed and allowed participants in real life to interact with participants and presenters in Second Life.

Second Life does not allow adults and teenagers to interact with one another in the same virtual environment. In an effort to better support the Gleaner’s educational program students developed a 3D game using the Torque game engine to provide players with a virtual shopping experience. The educational goal of this game is to provide practice in selecting economical and nutritious food while staying within a limited food budget.

**Evaluation**

The results of this project come from several sources: results from the service learning students, Second Life visitor surveys, and our real life contributions. We capitalize on a virtual environment’s capabilities to take advantage of the four components of advertising to maximize its exposure to a broad audience. Active immersion includes the development of the various hunger-themed games in Second Life and the Torque Game Engine by the students as well as the participant experience of these environments.

The course evaluation forms for CIS 4961(Fall 2008) and CIS 4962 (Winter 2009) indicate above average levels of satisfaction on the part of the students. Table II contains the average scores for the course evaluation items for the first two CIS 488 course offerings (4 = completely agree, 0 = completely disagree) and the overall course rating (4 = highest, 0 = lowest).

While student feedback from CIS 4961 and CIS 4962 was complementary, students made several suggestions for improving the course. Some students did have problems establishing a working relationship with a food bank client at the start of the project. Our initial community partner backed out at the last minute. This made some students wish there were other project options for the course this time around. The students felt they needed more experience with iterative software development processes. They did enjoy the ethics discussions and the real life project experiences associated with this course. The students felt that there was a lot of
work required for the credit hours awarded. Some students were disappointed that the implementation platform was Second Life. They were concerned that potential employers would not value their work in Second Life.

A short survey was completed by students from the Second Life project teams at the completion of the course. Table III shows the distribution of the responses from 8 complete Second Life student surveys. Students were encouraged to provide additional comments as well.

<table>
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<tr>
<th>Course fulfilled my needs</th>
<th>Fall 2008</th>
<th>Winter 2009</th>
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<tbody>
<tr>
<td>N=16</td>
<td>N=17</td>
<td></td>
</tr>
<tr>
<td>Course objectives were clear</td>
<td>3.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Course prerequisites are adequate</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Course was challenging and interesting</td>
<td>3.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Course material is up to date</td>
<td>3.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Course never repeats other course material</td>
<td>3.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Overall course rating</td>
<td>3.3</td>
<td>3.2</td>
</tr>
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</table>

Students felt they had become very comfortable with scripting and object manipulation in Second Life. They were divided on their beliefs that their knowledge of Second Life development will be useful to them after they graduate. In particular, they believed the concept of shouting and listening was a good illustration of event driven programming and that Second Life provided good practice for three-dimensional user interface design and game design principles. Some students felt that Second Life was not important to their career goals. Most students felt that their group communication skills improved as a result of participation in this project.

In aligning with the goal of fostering community involvement, students claimed they learned a great deal about their community partner, not only through the interpersonal interaction with their client and also through the task of creating a product to meet the needs of the community partner in a virtual environment. This seems to have fostered a greater understanding of general practices and protocols of food banks such as sorting, delivery, and distribution. Although none of them claimed to have any prior experience with community involvement, they suggested that they would be more willing to get involved in the near future as a result of this project.

At the time of this writing, the Interactive Shopping Experience has just been completed thus the end-of-project surveys have not been analyzed. However, current mid-project results are similar to the Second Life project in many ways. They have become comfortable with the Torque Game Engine and its capabilities but they did note that this is partially due it’s similarity to other development environments already taught to them during their undergraduate career thus it was inherently useful to them as computer scientists and engineers. They did also feel that their group communication skills had improved.

This group of students also learned a lot about the community partner’s Operation Frontline program and gained a better understanding of how to balance nutrition with a budget. Some of these students did have previous community involvement and, overall, they do feel more compelled to get involved in their community in the future.

The passive absorption and immersion experiences provided to project participants included the virtual hunger museum in Second Life and the joint, in-world, real-life conference held on June 3rd 2009.

The conference hosted approximately 30 real world participants and 32 Second Life participants. The conference itself was well received and Second Life survey responses were similar to student results with 1 contrast. Although conference attendees felt their knowledge of food pantries (their needs and processes) had increased, fewer of these people who weren’t previously involved in their community indicated they were willing to be involved in the future.

The active absorption experience provided to project participants included a web design competition in which 17, 2-person teams of high school students were given the task of developing websites which promoted food banking best practices & hunger awareness.

Most of the student teams were able to produce a working web site in the time allowed. The judges were impressed with resulting web pages. Several of the teams were successful in developing branding as a theme with the resulting web pages.

Lastly, we succeeded in making a genuine contribution to hunger issues in the metro-Detroit area through this project. In the Second Life Marketplace, approximately L$250 equals $1 USD. Gleaners Incorporated provides 3 meals for every $1 donated. Utilizing this principle, we have set up donation buckets on the island in Second Life for people to donate their Linden Dollars to a Gleaners-owned avatar that collects the donations. As of 5/24/10, this avatar

Session T2D
has accumulated L$16,165. This means that participants have provided 195 meals during the course of this project.

**FUTURE PLANS**

The Second Life projects were deployed for public access during summer 2009. The investigators are continuing to work with the community partner to develop metrics to quantify the impact of this project. The island in Second Life is funded for a 5 year time period. We plan to continue our student collaboration with Gleaners and hope to add more content to our island. We are also exploring the use of the Open Sim environment as a means of providing access to this content to high school aged users.

The virtual shopping experience is scheduled to be completed and deployed during summer 2010. This summer we plan to begin developing a series of mini games for the Gleaners. The purpose of these games is to provide younger children with information on healthy eating habits in an entertaining format.

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**REFERENCES**


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