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Integration of Virtual Environment, Web 2.0, and Cloud Computing Technologies for Immersive Learning Tours

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Abstract: Virtual environment, Web 2.0, and cloud computing technologies offer significant benefits to educators towards enhancing face-to-face and online courses. Their utility was demonstrated via immersive learning tours conducted for information technology graduate students at the University of Maryland University College. Virtual environments are illustrated through Second Life, Web 2.0 via Twitter and Twibes, and cloud computing through Google Docs. As avatars, students visit educational sites in Second Life experience virtual demonstrations, presentations, and simulations. Twitter and Twibes are used as platforms to capture students' experiences in real time. Google Docs is utilized to compile students' reflections within a collaborative online environment. The technologies provide a new, rich, and effective educational platform that supports the pedagogical objectives of being engaging, interactive, and reflective. In this paper, the procedures for integrating virtual environments, Web 2.0, and cloud computing technologies are described; target outcomes from the immersive learning tours are identified; students' reactions to the technologies, based on a comprehensive survey, are presented; recommended teaching strategies, for educators who intend to conduct their own educational tours, are listed; and future plans on using cutting edge technologies for teaching and learning are revealed.

Keywords: Virtual Environments, Web 2.0, Cloud Computing, Innovative Teaching.

1. Introduction

Virtual environments, Web 2.0 technologies, and cloud computing represent the underlying foundations for the next generation Internet. It is important for educational institutions to explore these technologies and understand how to leverage them towards meeting their objectives. Among the objectives of the University of Maryland University College (UMUC) and its Information Technology Systems (ITS) graduate program is to raise the level of students' engagement, satisfaction, and learning through creative application of cutting edge technologies.

A novel approach that addresses the objectives of UMUC and ITS, as well as supports the learning objectives of core ITS courses, involves conducting immersive tours of virtual educational sites. The approach has been developed by the authors and applied to two core graduate ITS courses, ITEC 610 and ITEC 620, which combined have approximately 900 students enrolled in multiple sections each semester. The tours began in Fall 2009 and, because of their success, have continued for each subsequent semester.

The tours integrate immersive virtual environment, Web 2.0, and cloud computing technologies through

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utilization of Second Life, Twitter and Twibes, and Google Docs, respectively. Second Life is used to identify and conduct immersive educational tours at sites with demonstrations, presentations, and simulations relevant to course objectives. Twitter and Twibes are applied to capture students' experiences in real time. Google Docs is used to synthesize students' reflections and to produce a collaborative presentation.

The unique integration of virtual environment, Web 2.0, and cloud computing technologies resulted in the creation of a new rich, engaging, and interactive educational platform supporting student learning and reflections. The students "learn by doing," experiencing firsthand the cutting edge technologies that represent the next generation Internet, and participating in dynamic demonstrations and simulations. Faculty members also gain from the experience by being exposed to new technologies they can utilize in other courses and programs. Both students and faculty benefit from the rich classroom discussions that precede and follow tour sessions.

This paper is organized in the following manner. First, the pedagogical goals of the virtual tours are discussed. Next, the utilized technologies and applications are defined, and the tours conducted in Fall 2009 and Spring 2010 are described. Further, recommended teaching strategies, based on lessons learned from the tours, are presented; highlights of student survey results are revealed; and future plans on using emerging technologies in teaching and learning are shared. Finally, conclusions which summarize the outcomes of this innovative approach are presented.

2. Pedagogical Goals

The following pedagogical goals were established for the presented technologies integration approach.

- Introduce students to the emerging technologies that will lead to the Next Generation Internet: virtual environments, Web 2.0, and cloud computing.
- Identify the optimal technologies, tools, and teaching strategies for establishing an effective learning platform that both engages students and supports their ongoing reflections.
- Enhance the course learning objectives and the teaching of emerging IT topics for two core courses of the ITS graduate program: ITEC 610 (Information Technology Infrastructure) and ITEC 620 (Information Technology Foundations).

The ITEC 610 course objectives, relevant to the virtual tours and listed below, were attained by introducing a novel perspective on how data and information can be delivered, demonstrating how emerging technologies can support learning, and having students discover a new social-economic order for study and discussion. The technologies also reflected recent developments in the IT field.

- Analyze the underlying nature of data and information such as its digital measure, characteristics, formats, and processing.
- Demonstrate how the components of IT fit together to form useful systems that are responsive to organizational needs.
- Assess the utility of IT in the operations, decision making, and investment of organizations.
- Identify and appraise the principal economic, social, and cultural issues raised by the applications of IT.

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- Show currency with events and developments in the IT field.
- Assess the relevance of current events and developments in the IT field to management practices and significance to social change.

The ITEC 620 course objectives, relevant to the tour and listed below, were attained through interactive virtual demonstrations, presentations, and simulations on distributed data processing, and computer hardware and architectures. Students could relate the online experience to business applications as well as trends in information technology.

- Describe fundamental functions, architectures and applications of distributed data processing.
- Define, evaluate, and compare major IT components: computer hardware, operating systems, and communication networks.
- Identify and delineate modern computer architectures and the concepts involved in designing input/output devices and memory systems.
- Apply concepts and techniques to business applications.
- Evaluate trends in IT and their impact on the future developments.

3. Technologies and Applications

3.1. Virtual Environments

Virtual environments provide a venue for supporting social networking, entertainment, collaboration, and even business opportunities. Although a virtual environment appears to be like a video game, there could be real-world consequences to the activities undertaken in this world, such as generating income; therefore, these environments go beyond games. Virtual environments allow its members to build their own worlds, create social relationships, and participate in a virtual economy using simulated currency. The economic and social activities in these worlds create unique opportunities for users to pursue economic, social, fantasy, and real activities, such as learning (Mennecke, 2008). Virtual environments offer a new dimension in learning. The students can develop their own persona in the form of avatars, experience new modes of movement, such as flying, and discover new worlds of wonder.

The Second Life virtual environment was selected as the learning platform for the virtual tour. It is a popular web-based world, created by Linden Lab, that provides for virtual business, education, and entertainment opportunities. Many businesses and universities have established a virtual presence in Second Life. It is also the most promising virtual platform for supporting collaborative online learning (Tsiatsos, Konstantinidis, Ioannidis & Tseloudi, 2009). Going on guided tours in Second Life, students can explore new educational sites, interact and communicate with other users' avatars, participate in interactive demonstrations and simulations, and attend informative virtual meetings and conferences. There is no fee to obtain an account in Second Life or to visit the virtual worlds but there is a charge for a higher level of technical support, for virtual goods and for acquiring an island for building purposes.

3.2. Web 2.0

"Web 2.0," a term coined by Tim O`Reilly in 2004, refers to the second generation of web technologies

that is characterized by user communities and a wide range of services, including social networks, blogs, wikis and folksonomies, all encouraging collaboration and efficient exchange of information among users (Master Base, 2010).

One of the two Web 2.0 applications selected for the virtual tour is Twitter, a social media service for transmitting and receiving short messages, called tweets. The tweets are displayed sequentially on the Twitter page, as well as on pages of subscribers who "follow" the author. The maximum length of each post is 140 characters, which is why the use of Twitter is often called microblogging. The other selected Web 2.0 application is Twibes. A twibe consists of a group of Twitter users with common interest or purpose. By joining a twibe, users are able to post tweets in one thread with the rest of the twibe members. The Web 2.0 applications for the virtual tour were chosen because Twitter is the market leader in its particular niche and available at no cost via the Internet.

3.3. Cloud Computing

Cloud computing is defined by the National Institute of Standards and Technology as a "model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2009). Among its capabilities, cloud computing involves transferring part or the entire technical infrastructure (such as resources, software, and information) to the "cloud" or the Internet. For example, instead of housing applications and data on the client computer, they are stored on a third party server. The platform selected for the presented approach is an example of the software as a service (SaaS) cloud delivery architecture model (Cloud Security Alliance, 2009).

The cloud application used in the presented approach is Google Docs, selected because of its collaborative functionality. It is an online cloud-based office suite similar to Microsoft Office that includes a word processor, a spreadsheet, and a presentation application. Unlike the traditional Microsoft Office, it enables users to create, edit, and store documents completely online. All Google Docs tools have collaboration capabilities that allow multiple users to share, review and edit the same online document.

4. Virtual Tours

4.1. Background

The virtual tours are journeys of shared learning experiences using the virtual environment Second Life, the Web 2.0 tools Twitter and Twibes, and the cloud application Google Docs. This integration of technologies and applications are the first of their kind for the UMUC Graduate School and were utilized in classes initially in Fall 2009.

Three to four days before the tour, students were requested to complete a list of preparation activities. They had to review user tutorials tailored for ITEC students (Bojanova & Pang, 2009-2010) and complete a readiness checklist. They were required to review and comply with the UMUC Code of

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Student Conduct (UMUC Code of Student Conduct, 2010) and the Second Life security guidelines (Second Life Online Safety, 2010). They had to create accounts on Second Life, Twitter, and Twibes and complete the beginners' tutorials that Second Life requires.

At the beginning of the tour, the students logged into Second Life, teleported to the UMUC Second Life Island, and watched a short introductory briefing (Figure 1). The island serves as a "launching pad" for tours and its virtual campus provides a site for real-time presentations and lectures (UMUC Second Life Island, 2010). The presentation covered the following topics:

- Objectives of the tour
- Utilized technologies and applications
- Virtual educational sites to be visited
- Lessons learned from past tours
- Activities schedule
- Questions and answers

Figure 1: Tour introductory briefing at the UMUC's Island.

During the actual tour sessions, two faculty members were assigned as "tour guides" to direct students within each location, monitor their actions, and assist them on technical issues. One of the tour guides welcomed the students and guided them to the educational sites. The other guide monitored for late arriving students, students with technical issues, and responded to questions. During the course of a tour, the students teleported to appropriate Second Life locations through SLURLs (Second Life URLs) that are precisely defined by Second Life three-dimensional coordinates.

At each educational site, one of the guides provided background information about the site, explained the key activities at the site such as demonstrations, presentations, and simulations, and responded to student questions. Typically, the guide proceeded through the site and performed the activities as an example to the students. Students were reminded to tweet to Twitter and post to Twibes their immediate reflections and to report any technical or navigational issues that they may have encountered. They were also requested to take pictures of their collective experiences using the Second Life snapshot capability. At the end of each scheduled visit, the guide informed the students that it was time to

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teleport to the next location and provided its SLURL in the chat area and on the ITEC twibe.

After all sessions were completed, the tour guides requested students to log into Google Docs and post their reflections and pictures in a shared presentation file. This collaborative effort enabled students to see and exchange what everyone experienced. Students were also requested to complete a comprehensive survey to measure their reactions to the use of the technologies and the value of their educational experiences.

Links to overviews of each tour, tutorials, Twibes accounts, Google Docs presentations, and recordings of conducted virtual tours are provided in Bojanova & Pang (2010).

4.2. Fall 2009 Tour

The Fall 2009 virtual tour encompassed the following four locations:

- IBM Systems Technology Island
- Cisco Live Conference
- National Oceanic and Atmospheric Administration (NOAA) Island
- Siemens Innovation Center

The tour began at the fountain plaza of the IBM Systems Technology Island. Students were directed to the IBM Server Tower where they were able to individually watch educational sessions about the System Z10 mainframe, the Power 595 processor, and the blade server center. The interactive environment allowed each student to open the mainframe computer doors and explore its parts (Figure 2). After the educational experience, the tour group had complimentary espressos and lattes, and sat on comfortable chairs and sofas to relax.

Figure 2: Virtual demonstration of a mainframe computer.

The next tour location was the Cisco Live Conference, an education and training event for IT, networking, and communications professionals, which in summer 2009 was held both in real life in San Francisco and virtually in Second Life. During the visit, students watched the conference keynotes and highlights, panel discussions on education in virtual environments and on sensor networks, and experts'

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technical chats on wide area network services, products for the remote workforce, and secure unified communications. The students were amused while visiting the gift center, where they picked up wizard hats and boxed gifts. Because of this visit, students gained knowledge about emerging telecommunications trends and concepts by attending the virtual asynchronous conferences. Despite their physical location, students were able to listen to world renowned experts and stimulating discussions on emerging technologies and issues.

Subsequently, the students teleported to "NOAA Island" which features dynamic simulations and activities related to the National Oceanic and Atmospheric Administration (NOAA). The students experienced flying above a real-time weather map, hanging precariously from an ascending weather balloon, observing the life cycle of a glacier in a time-lapse simulation, and experiencing being in the middle of a tsunami. Through this experience, students learned about and experienced simulations made possible by the immersive Second Life technology. These simulations provided an engaging approach to toward understanding NOAA's roles and responsibilities.

At the close of the tour was a visit to the Siemens Innovation Center. Siemens is Europe's largest engineering conglomerate, focusing on manufacturing, energy, and healthcare, and their Second Life center features innovations in each of these areas. The students experienced designing and creating rocket-propelled scooters (Figure 3) that their avatars were able to ride in the sky. As a result of this visit, students were exposed to cutting edge engineering techniques and technologies developed by Siemens and experienced first-hand the engineering design process from conception to implementation.

Figure 3: Virtual simulation on creating a rocket-propelled scooter.

4.3. Spring 2010 Tour

During the tour from Spring 2010, students visited the following four sites:

- Sun Microsystems Public Sim
- IBM Systems Technology Island
- US Military Veterans Center
- Genome Island

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After the introductory briefing at the UMUC Second Life Island, the students visited the Sun Microsystems Public Sim Island where they were introduced to the Evolving Data Center. The exhibit illustrates the challenges in migrating from a legacy to a futuristic data center showing dynamically the various scenarios by which such an evolution can be achieved (Figure 4). Through this visit, students learned about the data center – most of whom have never visited such a facility. They gained an understanding of the structure and issues associated with its current architecture and discovered the recent breakthroughs in data center design.

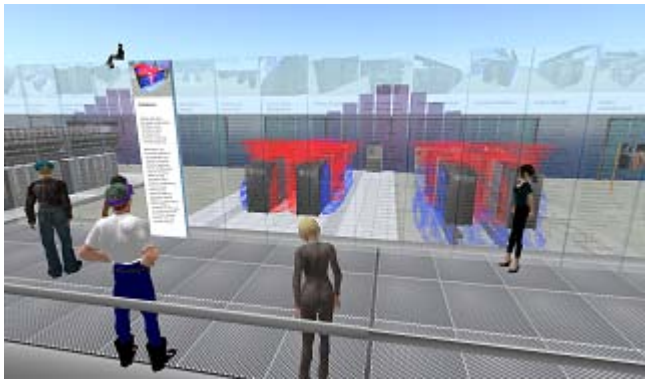

Figure 4: Virtual demonstration of an evolving data center.

Next, the students teleported to the IBM Systems EduCenter and its BladeCenter Serviceability Pavilion. Through virtual simulations, they were able to learn how to add a blade to an IBM BladeCenter and how to replace a faulty dual in-line memory module in an IBM BladeCenter S Chassis Server. Because of this visit, students appreciated the simplicity of the modern designs of server architecture by actually experiencing the technical procedure needed to maintain them. Such kind of virtual experience is difficult to replicate in real life.

Figure 5: Virtual simulation on replacing faulty memory.

The US Military Veterans Center was the next destination of the tour. It is a virtual center supporting the needs of American veterans, their families, and supporters by providing links to veterans' information and benefits. At this site, the students had a stimulating skydiving experience. Thus,

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students gained an appreciation of the needs and requirements of military veterans and the fact that, despite some veterans may be physically disabled, they are able to readily access veterans' information and benefits at this virtual site.

Finally, the tour group went on a scavenger hunt on Genome Island, built by the Texas Wesleyan University. Although designed to support genetics classes for undergraduate biology students, Genome Island is open for anyone to experience. Among the places visited was the Gene Tower, which includes in its multistory structure information and activities on genes, chromosomes, and DNA strands. The island included activities involving exploring the inherited traits that can occur from generation to generation. Therefore, students gained valuable learning experiences in the world of genetics through exploration and self-discovery and, in particular, conduct virtual genetic experimentation that in the real world takes years to accomplish.

4.4. Student Deliverables

In addition to Second Life (which represents virtual environments) the students utilized Tweeter and Twibes as representative tools of Web 2.0 technologies. The twibes created for the tours are named ITEC and ITEC-Spring2010 (Figure 6). Before starting the tour, the "tourists" were instructed to create Tweeter accounts and to join an ITEC twibe. The ITEC twibe was utilized by students during and after the tour to share their immediate impressions. They tweeted about which destinations they liked the most, which activities were the most useful and exciting, and what they discovered outside of the tour rout. The students stated that they learned a lot, had fun, and would like to do similar tours again. The ITEC twibes served also as a place from where lost in Second Life students we directed to the current group location.

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Figure 6: Excerpts from ITEC Twibes.

Finally, in addition to Second Life, Tweeter, and Twibes, the students utilized Google Docs which reflects the cloud computing technology. The PowerPoint like presentation document created for each tour in Google Docs was named "The ITEC Virtual Learning Tour" (Figure 7). After each tour, the "tourists" were asked to collaborate by populating the presentation with content. Each student was able to place snapshots taken from Second Life, as well as notes and conclusions and insert them among the items already placed by other students.

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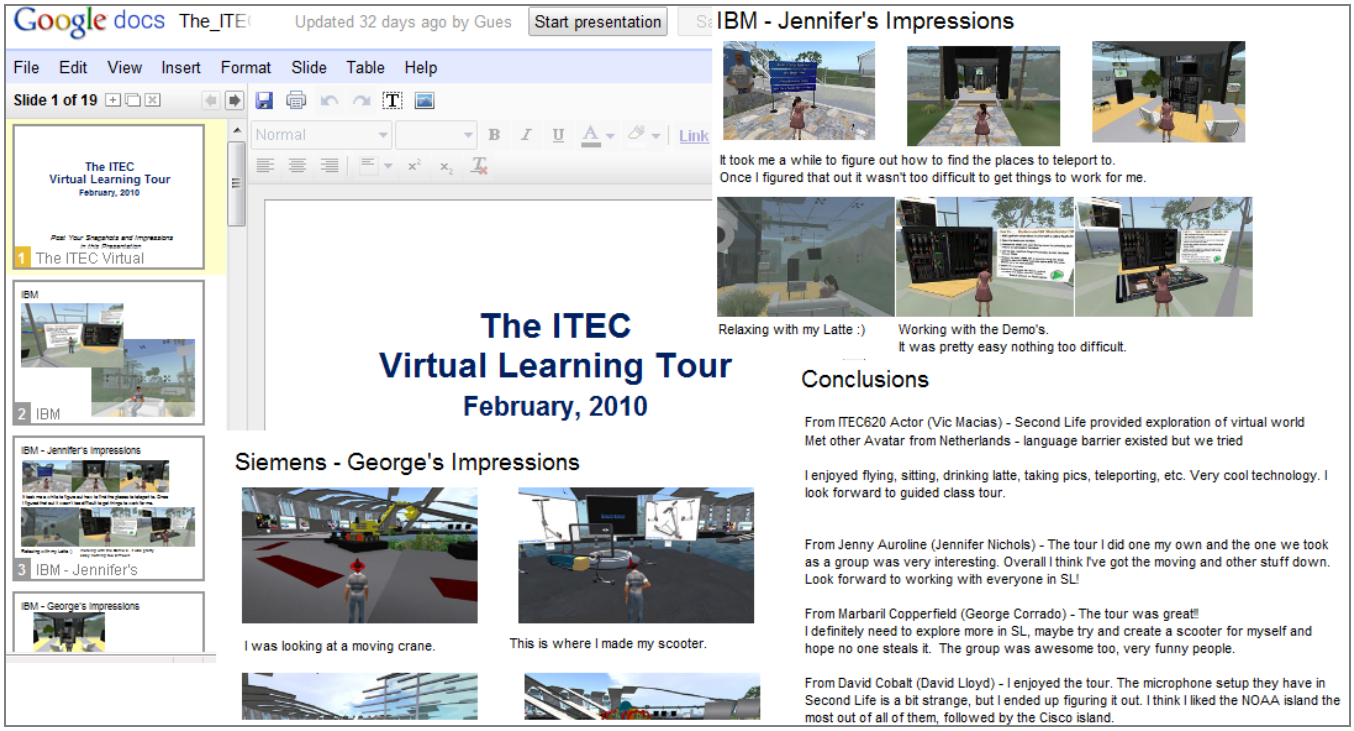

Figure 7: Excerpts from Google Docs Presentations.

5. Recommended Teaching Strategies

Valuable lessons learned have been gained from managing the virtual tours. They translate directly to recommended teaching strategies for future virtual activities. The following are the strategies, organized by the three phases of the tours: preparation, activity, and post-activity.

5.1. Preparation

- Select Second Life sites based on educational value, interactive activities and global reach: The locations have to be directly relevant to the course material and yet be interactive and engaging. These are key pedagogical goals. During a virtual tour, students can interact with avatars from other countries and visit sites owned by foreign entities. These experiences provide broad exposure to foreign concepts and ideas and establish international collaborative opportunities. Therefore, site selection should include those which provide a global perspective.
- Prepare clearly written activity tutorials: Students lost in Second Life might delay the tours while tour facilitators search for them. A navigation guide helps students explore sites that often do not have clear maps or guideposts.
- Check hardware requirements: Second Life requires use of a recently manufactured computer with a relatively powerful graphics card (Second Life System Requirements, 2010). Students with older computers will experience accessibility issues. Before joining an activity, the students have to check their system audio and video readiness. A high bandwidth connection is also

recommended. If students have computers which fail to meet minimum hardware requirements, provide them with access to those that do meet the requirements or provide an alternate assignment for them such as a research paper on virtual environments.

- Ensure students are prepared for the activity: The start of an actual virtual tour is not the time for students to do account setups or avatar design, nor to check audio and video functionality, or provide registration information. The preparations have to be made before the actual activity if the focus during the tour is to be on the learning experiences.
- Use the activity to expose students to emerging technologies: Second Life itself is an example application of the next generation of the Internet. Second Life is a new social and cultural community that has its own citizens, economy, and social norms. Twitter represents a social networking phenomenon that has captured the attention of prominent newsmakers, well-known politicians, and celebrity performers. Google Docs and other cloud applications represent an emerging architecture for computing and managing data and information.
- Provide a provisioning process that will ensure that only authorized students attend the tour: During one of the sessions, a student not part of the touring class joined in without prior authorization. Although the student in question did not create any problems, it is important to validate the students who attend these tours to ensure security during the course of the tour.

5.2. Activity

- Assign multiple activity facilitators: Some students can be laggards, others aggressive explorers; some experience technical issues, still others engage in unacceptable behavior. So the activity facilitators, who typically are faculty members, must closely monitor the students. As a rule of thumb, each activity requires a minimum of two primary facilitators. In addition, for virtual tours, at least one active "avatar herder" is required for every 12 students.
- Use proper tools for communication: Avatars can communicate in Second Life through text-based chat or voice. For the virtual environments, voice communication was found to be much more efficient. However, if many participants have their voice devices on, unwanted sound effects may occur. So it is recommended that only activity facilitators use voice at all times, while the tourists communicate mainly through text-based chat.
- Creatively utilize the integrated technologies: For example, use the ITEC Twibe to direct students lost in Second Life to the current group location through direct teleport SLURLs.
- Monitor tour duration: Virtual tours are scheduled to last one hour. However, they often end up lasting up to two hours. Students become easily engrossed in the virtual environment and the fascinating tour sites. So, facilitators have to know when and how to put an end to the group activity.

5.3. Post-Activity

- Provide reflective assignments: It is important, after the virtual activity, to reinforce the connection between the learning experience and the course content. One way to achieve this is through reflective assignments, which document highlights of the activities and measure the level of learning gained by the students.
- Integrate the experience with the rest of the course activities**:** Encourage faculty to reference the

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activity during subsequent lessons, conduct follow up class discussion sessions, and include questions about the activity in quizzes and examinations.

- Student assessments are needed to achieve the learning objectives of the assignment: It was observed that the quality of the student deliverables improved if these deliverables are graded.

6. Student Survey Results

At end of the tour activities, the students were asked to fill out a comprehensive survey. The sample size is 25 students. The demographics of the sample are as follows: 78% male; 73% with average technical skills, 87% employed full time; 13% in the 16-26 age range, 30% in each of the 26-35 and 36-45 age range, and 26 in the 46-55 age range.

Most students found the tour tutorials and instructions useful (88%). Many indicated that the preparation effort for the tour was not an issue (76%) and that the preparation time was reasonable (92%): averaging between half an hour and five hours. Students spent time at the tour sites on average two hours. Table 1 shows an overview of the survey results from the ITEC virtual educational tours.

Table 1 – Overview of virtual tours survey results.

	Definitely Not	No	Maybe	Yes	Definitely Yes
Engaging and interactive	0.0%	4.0%	8.0%	**60.0%**	28.0%
Supports collaboration	0.0%	8.0%	8.0%	**48.0%**	36.0%
Provokes curiosity and sense of discovery	0.0%	4.0%	4.0%	**56.0%**	36.0%
Provokes critical thinking and problem solving	0.0%	4.0%	16.0%	**64.0%**	16.0%
Academically challenging	0.0%	12.0%	24.0%	**40.0%**	24.0%
Fun experience	0.0%	12.0%	12.0%	32.0%	**44.0%**
Want similar activities in other classes	0.0%	20.0%	20.0%	28.0%	**32.0%**

The survey clearly indicates that the students had a positive and rich experience during the virtual tours. A clear majority of them felt that the tours were engaging, interactive, collaborative (students commented "helped me meet some of the class," "it was nice learning with other people"), academically challenging, instilled a sense of curiosity and discovery, and provoked critical thinking. Moreover, their strongest reactions were that the experience was fun and that they wanted similar activities in other classes (one of the additional comments included "I hope we can implement this in ITEC 630 and 640" which are the other core ITS courses). These indicators show that the virtual tours have achieved key pedagogical goals as well as being fun and entertaining to the student. This is a difficult combination to achieve in any classroom activity.

The integrated technologies helped most students learn about Web 3.0 (virtual environments) (75%), cloud computing (67%), and Web 2.0 (58%). They liked the most using Google Docs (70%), Second Life (63%), and the least Tweeter and Twibes (25%). More details on the three technologies survey results are shown in Tables 2, 3, and 4.

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Table 2 – Overview of Second Life (Virtual Environments) survey results.

	Definitely Not	No	Somewhat	Yes	Definitely Yes
Liked using Second Life	8.3%	16.7%	12.5%	**37.5%**	25.0%
Helped learn about Web 3.0	0.0%	8.3%	16.7%	**45.8%**	29.2%
Second Life enhanced WebTycho classroom	4.2%	4.2%	16.7%	33.3%	**41.7%**
Teleporting was easy	0.0%	4.2%	**33.3%**	**33.3%**	29.2%
Simulations (like server blade replacement) enhanced ITEC course objectives	0.0%	12.5%	16.7%	**45.8%**	16.7%

Seventy-five percent of the students found that Second Life enhanced the standard online classroom. They enjoyed teleporting (a comment was "cloud teleport - real cool") and found that the virtual simulations enhance the course objectives (63%).

Table 3 – Overview of Twitter/ITEC Twibe (Web 2.0) survey results.

	Definitely Not	No	Somewhat	Yes	Definitely Yes
Liked using Tweeter/Twibes	8.3%	29.2%	**37.5%**	8.3%	16.7%
Helped learn about Web 2.0	0.0%	8.3%	33.3%	**45.8%**	12.5%
Enhanced communication during tour	0.0%	20.8%	**33.3%**	**33.3%**	12.5%
Liked integration of SL and Twibe	8.3%	20.8%	**29.2%**	20.8%	20.8%

The integration of Tweeter and Twibe with Second Life was appreciated by less than 50%. However, it should be kept in mind that most students used Twibes for help requests.

Table 4 – Overview of Google Docs (Cloud Computing) survey results.

	Definitely Not	No	Somewhat	Yes	Definitely Yes
Liked using Google Docs	0.0%	4.2%	25.0%	29.2%	**41.7%**
Helped learn about Cloud Computing	0.0%	8.3%	25.0%	**33.3%**	**33.3%**
Enhanced collaboration after tour	0.0%	8.3%	20.8%	**33.3%**	**33.3%**
Liked integration of SL and Google Docs	0.0%	8.3%	20.8%	**41.7%**	25.0%

Most students appreciated the integration of Second Life and Google Docs (67%) and the collaboration after the tours. A significant majority of them (83%) stated they will use Google Docs again.

In addition, the students listed as the most valuable aspects of the tours the exposure to new technologies ("experience… I would not have otherwise attempted,") the online collaboration and communication, cloud computing and Google Docs, Second Life ("heard about it but never looked into using it before.") Although most of the students stated they could not think of any non-valuable aspects, some did not find Tweeter and Twibes useful, while others would prefer that this time-consuming activity be for credit. One of the comments at the end of the survey is as follows: "This technology has a tremendous upside for educational purposes. The biggest problem will be the high hardware requirements to run the applications. However, as the technology come together at the desktop level it could easily be integrated into almost any class as an additional tool for teaching, content delivery, study groups, and online collaboration." Other students' comments include the following:

- "It is a fun way of learning."
- "It was great. It gave me the desire to come back to SL, which I did to continue to explore. I

would call that successful."
- "Would like to continue to meet others in SL."
- "Gained a lot of insight on the advent of things to come."
- "Really interesting, Twibes and all."
- "Good to see new forms of communication."
- "The Cisco tunnel has a bunch of useful information."
- "Great, I was able to explore various islands both as part of the tour and on my own, seeing an "Island I would never have found on my own."
- "SL, Tweeter/Twibes, and Google Docs work very well together to use in a group project."
- "I think Google Docs is a great tool and has the position of working with lots of groups from non-profits to small businesses."
- "Want to participate more actively."

7. Future Plans

The success resulting from the presented approach motivated the authors to develop the following plans.

- Establish rubrics for assessing student performance.
- Provide concepts and direction on how faculty members can learn about the underlying technologies and better manage virtual tours.
- Identify new exciting virtual sites, which are relevant to course objectives and reflect current trends.
- Investigate the use of mobile devices, such as iPad and iPhone, for tweeting to the ITEC Twibe in parallel to using a computer to navigate in Second Life.
- Address technical challenges such as the need for powerful graphics cards. For example, identify ways for virtualized access to Second Life to facilitate students who lack appropriate hardware.
- Explore solutions to tour management issues such as addressing students' curiosity which often leads them away from the tour.
- Locate efficient tools for recording virtual tours to be shared with other students and faculty.
- Further develop the demonstrated ideas on combining virtual environments, Web 2.0, and cloud computing technologies for enhancing teaching and learning.
- Search for promising new tools and technologies which support virtual tours.

8. Conclusions

The presented novel approach reflects the fact that UMUC is at the forefront of educational technologies. The virtual tours, aimed at enhancing course objectives, have proven to provide a new, rich, and effective improvement to the current educational platform. They support the pedagogical objectives of being engaging, interactive, and supportive of student experiences reflection. They are academically challenging and stimulate students' curiosity, sense of discovery, critical thinking, and problem solving. According to the survey results, the students find the approach of integrating virtual environments, Web 2.0, and cloud computing technologies highly valuable and support further use. By maximizing the students' learning experience via cutting edge technologies, it can be expected that

student satisfaction and retention will rise.

One key challenge in implementing the approach is that teaching professionals will need to become familiar and comfortable with utilized technologies and learn how to implement them at strategic points in their courses. To address this challenge, educators have to understand the benefits from utilizing emerging technologies. As supported by the tours' survey results, students truly enjoy their experiences in the presented novel environment and want to return and learn more new concepts and ideas. This innovative and engaging approach is conducive to a higher order of learning and is clearly warranted for the future. The challenge can be overcome also through displayed acceptance and commitment by upper level institutional managers and their providing moral and resources support towards the utilization of these technologies. The expected reward from such a commitment is a clear return on investment such as raised pedagogical standards, increased student satisfaction and retention rates, and enhanced institutional reputation in terms of innovation.

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