Towards a mobile learning pedagogy in radiation protection

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Abstract
This paper describes advances aimed at teaching radiation protection in a mobile learning environment at Canada's newest university, the University of Ontario Institute of Technology (UOIT). Specifically, this paper will describe the use of various tools and techniques utilized to enhance teaching of students who require radiation protection knowledge, and students who desire to become radiation protection and health physics professionals.

Some topics to be included in this paper are use of course management tools (WebCT™), synchronous and asynchronous course presentation software (Silicon Chalk™), electronic preparation and administration of tests, quizzes and surveys (Respondus™), and other interactive tools such as discussion boards, on-line submission of assignments and laboratory reports, and distance interaction of professor with students (Argentina-Canada). In addition, laboratory delivery enhancements via the mobile platform will be discussed. Examples and demonstrations relevant to radiation protection will be included.

1. Introduction

Canada's newest University, the University of Ontario Institute of Technology [1], opened it's doors in September 2003 to approximately 1000 students. Over 10% of the first year enrollment was in nuclear engineering and radiation science programs. The current enrollment stands at approximately 300 students.

The four year honours Bachelor of Science degree program in Radiation Science curriculum includes medical, industrial, agricultural and material science applications, and emphasizes a strong mathematics and science foundation to the discipline. All students in the program generally take the same courses in the first and second year, but have opportunities in the third and forth year to specialize in selected aspects of Radiation Science, such as Health Physics and Management. The program map for the health physics option is presented in Table 1. The four year honours Bachelor of Engineering in Nuclear Engineering curriculum includes training in radiation protection and nuclear reactor operations. One of the primary goals of both programs is to train a new generation of radiation-knowledgeable professionals to contribute both to the existing Canadian and Worldwide nuclear infrastructure, and to research, development and deployment of new radiation-based technologies and required nuclear energy.

One key aspect to the pedagogy at UOIT is web-centric learning, where each student has a similarly equipped laptop, and is encouraged to bring it to class, tutorials and laboratories. The professors have a mandate to use technology to assist the student learning process. On-line testing and coursework submission is being utilized. Course materials are provided on-line, and use of computational and simulation tools in real-time are developing.

A key mandate of the new university is to be "market oriented"; so many of the future program offerings will depend on the needs of the industries using radiation techniques and the interest of potential students. The University is located in close proximity to both the Pickering and Darlington Nuclear Power Plants, and to a number of regional health centres, so the initial focus of the programs is to serve the needs of the power utility and the health sectors.

This paper will explore the early success obtained in teaching radiation protection in a mobile learning environment.

Year - Term	Subject	Subject	Subject	Subject	Subject	Subject
1 - 1	Calculus I	Linear Algebra for Engineers	Physics I	Chemistry I	History of Science and Technology	Technical Communications
1 - 2	Calculus II	Biology for Engineers	Physics II	Chemistry II	Introduction to Programming	Impact of Science and Technology
2 - 1	Differential Equations	Cell and Molecular Biology	Problem Solving, Modelling and Simulation	Introduction to Organic Chemistry	Introduction to Nuclear Physics	
2 - 2	Numerical Methods	Statistics and Probability	Environmental Science	Radiological and Health Physics	Health Physics Laboratory	Collaborative Leadership
3 - 1	Radiation Detection and Measurement	Anatomy & Physiology	Intro. to Nuclear Reactor Technology	Scientific Instrumentation	Introduction to Imaging	
3 - 2	Radiation Biophysics and Dosimetry	Radioisotopes and Radiation Machines	Senior Science **OR** Engineering Elective	Economics for Professionals	Liberal Studies Elective	
4 - 1	Risk Analysis Methods	Industrial Applications of Radiation Tech.	Environmental Effects of Radiation	Thesis Project I	Safety and Quality Management	
4 - 2	Material Analysis Using Nuclear Techniques	Medical Applications of Radiation Tech.	Senior Science **OR** Engineering Elective	Thesis Project II	Liberal Studies Elective	

Table 1 - Radiation Science and Health Physics honours program at UOIT

2. What is a Mobile Learning Environment?

A mobile learning environment is one in which both the students and professors make use of mobile computing technology (primarily laptop or tablet computers) to enhance the learning process. As part of the fees to attend UOIT, the student pays a lease fee for a pre-configured laptop. Currently, students are using IBM R51 wireless-equipped laptops. All software is imaged according to the student's program of study and the software requirements dictated by the professors. Every 2 years the student gets the latest model version laptop, and at the end of their degree, they have the option of purchasing the equipment.

Professors are issued tablet computers, with the current model being the Toshiba M200 Protégé. The tablet computer adds the flexibility of allowing professors to emulate the "good old days of chalk" by facilitating writing directly on the tablet screen, and projecting it to the students. It further makes it readily possible to mark assignments, quizzes and laboratory reports directly on the screen. This eliminates the need for paper submissions, and makes it very simple to archive work for program accreditation or in case of a challenge.

The entire campus is serviced by wireless internet, and all classrooms have LAN seat drops and electrical outlets to plug chargers. Students typically "plug in" to the wired network when in class, since the throughput is an order of magnitude greater than wireless. Minimum teaching equipment in classrooms consists of a multimedia projector, sound system, DVD/VCR, laptop docking stations, white board and even chalk board. Larger classrooms and teaching theatres are also equipped with dual projectors and document cameras.

In the mobile learning environment, the students are encouraged to use their laptops in class. One of the criteria for hiring professors is also that they support the use of mobile learning. In addition to utilizing mobile technology for classroom teaching, it is also utilized in laboratories for data acquisition and analysis. The following sections will discuss interactivity with students in a mobile learning environment.

3. Interacting with students in the classroom

There are a number of ways to interact with students in the classroom. The primary mode of lesson delivery that is most common is face-to-face interaction. To provide more efficient use of time in a highly demanding radiation protection program, face-to-face interaction may be supplemented with on-line resources. One tool being used at UOIT is a product entitled WebCT [2].

One of the missions of the University is to provide all course materials electronically. WebCT is a course management tool which has an interface similar to a standard web page. However, all of its

functionality is geared towards course material delivery. For its most simplistic use, it can be a repository for course notes and assignments. More advanced features of the tool allows the instructor to administer quizzes, to open discussion boards and chats, and to allow on-line submission of assignments and laboratory reports. It may be used in a synchronous fashion, although it is more oriented to asynchronous use. All courses at UOIT are assigned WebCT space, and students are informed how to access their instructors WebCT at orientation.

For synchronous interactions with the students, UOIT uses a tool called Silicon Chalk [3]. Silicon Chalk is designed to allow the instructor to broadcast his or her presentation materials, live audio and perform other functions such as administer polls and small quizzes. The tool, upon start, sits in the background of the operating system (Windows) and records and transmits everything the instructor has on the screen, including presentation slides, web-sites, videos, simulations and whatever the instructor is writing on the tablet. It allows advanced features in multi-cast mode for instant student feedback. For example, the instructor can poll the students to determine if the lecture pace is adequate, or send a small test question and immediately see the results to assess if students are understanding the course material. In synchronous mode, the student may open a notepad within Silicon Chalk, and take notes. The importance of this is that the notes are inserted in the time line with the slide transitions and the audio track, making their value much greater. In addition, Silicon Chalk allows the instructor to observe all running processes on all student computers, and select which processes are allowed versus which should be denied. This allows the instructor to ensure that the student, if taking an on-line test, is not running an application that is disallowed (such as e-mail or a messenger service). It is worthy to note that Silicon Chalk may also be used in an asynchronous fashion, whereby the instructor posts recordings of his or her class on WebCT. The importance of the recording can not be underemphasized, as it has been shown [4] that students who review course material with an audio component have much greater retention of material as compared to students who study conventionally.

Along with the course management and interactivity tools, another important use of the mobile learning environment in radiation protection is the use of interactive simulations. For example, concepts such as energy loss through Compton scattering and Klein-Nishina scattering probabilities can be easily explored using a graphically based modeling tool, such as MATLAB [5]. Even more advanced codes for atmospheric modeling or Monte Carlo simulation can be demonstrated and interactively practiced, since the students can simultaneously run the code while the demonstration is being conducted. This allows for accelerated functional use of the analysis tools, and more time to be spent on WHY the tools work, rather than HOW they work. The advantage is that the students will have a greater understanding of the physics models, as opposed to using them in a “black box” fashion, which is all too common.

4. Interacting with students in the laboratory

The use of the laptop at UOIT does not end in the classroom. Students use laptops to interface with various instruments used for training applied radiation protection and health physics concepts. For teaching students about simple Geiger-Mueller tube operation, a Spectrum Techniques ST360 Radiation Counter system is used [6]. Students load the control software on their laptops, and can plug in directly to the experiments using a USB interface. Similarly, for investigating scintillation gamma spectroscopy, a Spectrum Techniques UCS20 Spectroscopy system is used [6]. Other laboratories, using gamma survey meters, contamination meters, TLD readers and high purity germanium detectors all have USB (or serial) interfaces. Students can load up the appropriate software prior to the laboratory exercise and directly interface with the equipment.

Analysis of data in the laboratory is also encouraged using common software tools such as Microsoft Excel™ or MATLAB™. The advantage of performing real time data analysis is that students can repeat experiments that have poor data quality, or seek the advice of the instructor prior to leaving the laboratory.

A unique tool that has been developed at UOIT for enhancing the student’s laboratory experience when not in the laboratory is the Virtual Interactive Radiation Graphic Laboratory (VIRGiL™) software. This application, which is currently in beta test version, emulates the functionality of both the GM tube and a NaI scintillation spectroscopy system used by the students. The software allows students to replicate experiments conducted in the laboratory, and in some cases expand beyond what can be

done in the laboratory. For example, in software, students may drive the GM tube to voltages that cause continuous breakdown, which is prohibited in the laboratory.

5. Assessing students

Assessment of student performance within a mobile learning environment can be performed to varying degrees in an electronic format. One of the advantages to students being equipped with identical laptops is that the instructor has flexibility to assess student performance on common platforms. Students have installed all of the requisite software that the instructor can use for testing. Quizzes and surveys can be conducted on WebCT using files prepared with the Respondus™ tool [7]. Respondus is used for creating and managing exams that can be printed to paper or published directly to WebCT and other eLearning systems. Various forms of quizzes can be created. For example, multiple choice, true/false, paragraph, matching answer, short answer, multiple response or computational questions can all be created. Besides being able to assess students electronically, which allows for rapid turn-around time, a side benefit of this form of testing is that it emulates certification-type exams; for example the Certified Health Physicist exam administered by the American Board of Health Physics [8].

In addition to quizzing students, the mobile learning environment also facilitates submission of assignments, research papers and laboratories on-line. Specifically, WebCT has the functionality to allow students to upload their submissions and allow the instructor to return the submissions electronically. WebCT has functions that allow opening and closing electronic drop-boxes, allows for the tracking of submission times and tracking student grades. A side benefit of this type of submission is that the instructor can archive a copy of each submission. Marking submissions is relatively simple when using a tablet PC, since you can write directly onto the submission, whether in Microsoft Word™ of Adobe PDF™ format. Electronic submission of laboratories also makes it possible for students to submit their worksheets or code files, to allow the instructor to verify the calculations.

6. The future of the Mobile Learning Environment in radiation protection

Mobile learning can be a wonderful enhancement to traditional learning pedagogies. Mobile learning cannot, however, replace traditional teaching, especially as pertaining to hands-on experience. A degree of care must therefore be taken when teaching within the mobile environment. When using on-line resources, it is often possible to create “information overload” for the students, whereby more information than can be absorbed is made available. This can lead to confusion and/or meandering about the course material. In addition, it is possible that the instructor and/or student colleagues become “too accessible”, thereby reducing the amount of time the students struggle on certain problems. This can lead to a false sense of comprehension of concepts. Mobile learning is therefore a balance between instructor desire to teach with the technology, student’s ability to effectively utilize the technology, and the learning rubrics which must be met. The challenges presented by incorporating teaching via the mobile learning platform are far outweighed by the ability to teach more complex concepts early in students’ training, and to provide more industry oriented topics.

It is difficult to assess, after two years, the success of the mobile learning environment confounded with UOIT being a new University and offering primarily market driven courses. If enrolment is any indication, UOIT is the only Ontario university to experience an increase in enrolment (~ 20% over other Ontario universities for the past 2 years), which is likely due in part to the mobile learning approach adopted. In the future, the mobile learning environment will expand in radiation protection and other nuclear options at UOIT to include more distance learning possibilities and more training and certifications for industry personnel.

References

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