AC 2009-1752: DEVELOPMENT OF A WEB-BASED COURSE IN MINER SAFETY TRAINING

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Development of a Web-Based Course in Miner Safety Training

Abstract

This paper highlights the work at a Center for Applied Research and Technology (CART) at a small college to develop a web-based miner safety course in our Mining Engineering Technology (MIET) program that continues to meet the quality standards in the industry. Capitalizing on the initial success of our web-delivered courses in the School of Engineering Technology and Computer Science (SET) delivered through the CART Course Management System (CMS), this work describes the research process used to measure our capability to provide an online version of this training. Mid-career professionals interested in completing certification requirements without having to attend on-campus classes represent a new program target. The program will continue to conform to our curriculum requirements ensuring the quality of any on-line MIET courses.

The paper will address the development of this new delivery method. The curriculum will be designed to operate in an interactive web-based environment for submission of coursework; concept diagrams, drawings, reports, and assorted forms. Class discussions, conferencing, forums and real-time project reviews will utilize current "chat-room" technology and newly emerging conference software applications. Testing opportunities will be devised through models similarly employed by our own CART CMS allowing online mine site vignettes and projects.

Finally, the research will analyze the hardware needs required by the institution for the delivery of the program and by students taking the individual courses. Cost analysis will include the cost of delivery of the program, individual courses, and impacts on faculty resources. Research will examine development of marketing strategies and propose market pricing for tuition and fees required by the program.

1. Introduction

The CART Course Management System (CMS) was developed by the Center for Applied Research & Technology, Inc. established on 28 July 1998 to enhance the competitive position of the college for applied research opportunities in the current environment for research and development; promote the general economic development of the region; expedite and simplify the acquisition and utilization of research contracts; improve technology transfer; and link applied scientific research and technological advancements to economic development of the State.

The Mining Engineering Technology (MIET) baccalaureate program has been a serving the mining industry profession at the college since 1972. A bachelor's degree in mining engineering technology will qualify the graduate for mining industry entry positions in production, construction, preparation, equipment sales, and environmental controls and in assisting mining engineers. After experience in industry, career paths are possible for positions as executives, managers and entrepreneurs.

The Mining Engineering Technology program publishes the following program educational objectives as broad statements describing expected accomplishments of its graduates during the first few years after graduation.

1. Graduates produce and utilize mining documents.
2. Graduates function effectively on teams and communicate effectively with speaking, unity, and graphical skills.
3. Graduates respect ethical and social issues as well as a commitment to quality.
4. Graduates manage mining activities in support of a mining plan.
5. Graduates apply ventilation technology, roof control technology, and electrical and mechanical systems for support of mining operation.
6. Graduates stay current professionally.

The program outcomes for the Mining Engineering Technology program are:

1. Students demonstrate an appropriate mastery of the knowledge, techniques, skills, and modern tools of mining engineering;
2. Students identify, analyze, and solve technical problems;
3. Students effectively communicate by written oral and graphical means;
4. Students function effectively independently, as well as on teams;
5. Students conduct standardized field testing in the mining environment and apply results.
6. Students clearly understand professional and ethical responsibilities.
7. Students understand diversity, societal, and global issues relating to solutions to problems in mining.
8. Students recognize the need for and the ability to engage in life-long learning.
9. Students perform analysis and design in the production of mining plans and operations.
10. Students apply basic technical concepts to the solution of mining problems involving ventilation, roof control, conveying systems, drainage systems, and mapping systems.
11. Students perform economic analyses and cost estimates related to operations and maintenance of a mining system.
12. Students use project management skills and people management skills to operate a mine efficiently.
13. Students comply with MSHA and state regulatory laws, rules, and regulations in operations.
14. Students maintain an understanding of labor-management relationships in a mining environment.

Since the inception of the mining program, we have been concerned with increasing our enrollment while retaining program quality. This led to the interest in developing web-based courses that could reach prospective students outside our traditional service area and address the increasing concerns for miner safety for the next generation of miners. We have had considerable success in delivering other SET courses via the CART CMS and wanted to explore the possibility of using it more extensively throughout the curriculum. This expansion of web-based delivery presents obvious and not so obvious challenges particular to the delivery of an MIET Online curriculum. We are in the process of critically analyzing the advantages and disadvantages of such program delivery.

2. MIET Online Admission Requirements

To enter our program a student must be 18 years of age and have completed a high school diploma or a GED equivalent from an accredited school. Students must be seeking employment in the mining industry or further education in an MIET career field position. As part of the admission requirements, credentials, transcripts and evidence of course work shall be submitted for review and a personal contact will be made to describe the evaluation process. There will be an application fee assessed each student to cover administrative costs.

3. Transfer Credits

Transfer of credits from other institutions will be reviewed on an individual student basis. The student will be assigned an online advisor and the adviser will evaluate courses for content and application to the program. A maximum of 72 semester hours of credit or 108 quarter hours may be transferred from junior or community colleges accredited by a regional accrediting association. Work transferred from non-profit institutions that are approved by a state and not accredited by a regional accrediting association maybe eight separate to meet specific degree requirements up to a maximum of 64 semester hours after earning at least twelve hours of the degree credit at the college with an institutional grade point average of at least 2.0. Students desiring transfer credits will submit catalog descriptions of course content as published in their respective college catalogs. Conditional information; course syllabi, assignments, projects and other evidence may be required if no description exists.

Over the past decade, the School of Engineering Technology and Computer Science (SET) has been working directly with a number of local and regional community and technical colleges to establish articulation agreements. These agreements specify how and institutions associate degree and courses transferred directly into the MIET Program. As our MIET Online program expands, the intention will be to continue to develop such agreements with institutions all over a national and international arena.

4. Mining Engineering Technology Curriculum

The following courses are required for the baccalaureate degree in the recommended sequence:

First Semester

ENGL 101	*Composition I*	*3*
MEET 111	Engineering Drafting	3
GNET 102	Tech Physics II	4
GNET 115	Technical Mathematics I	4
Core Skills	*Social Science*	*3*
		Total 17

Second Semester

ENGL 102	*Composition II*	*3*
GNET 101	Technical Physics I	4
GNET 116	Technical Mathematics II	4
ELET 110	Circuit Analysis	4
ELET 112	Electrical Measurements	1
		Total 16

Third Semester

ELET 205	AC/DC Machinery	4
MEET 214	Hydraulics & Fluid Power	3
COSC 201	*PC Software Applications*	*3*
MEET 112	Computer Aided Drafting	3
MIET 101	**New Miner Training**	***3***
		Total 18

Fourth Semester

CIET 110	Surveying & Mapping	4
MGMT 110	*Principles of Management*	*3*
ARET 313	*Applied Project Management*	*3*
	Technical Elective	*3*
ENGL 208	*Technical Communication*	*3*
		Total 16

Fifth Semester

MIET 300	*Intro to Mining Engineering Tech*	*3*
MIET 400	*Mine Safety and Law*	*3*
CHEM 101	*General Chemistry* **& Lab***	4
ACCT 102	*Principles of Accounting I*	*3*
COSC 210	*Visual BASIC*	*3*
		Total 16

Sixth Semester

MIET 404	Ground Control	3
MIET 406	Mine Ventilation	3
MGMT 230	*Organizational Behavior*	*3*
Core Skills	*Social Science*	*3*
Core Skills	*Literature*	*3*
Core Skills	*Social Science*	*3*
		Total 18

Seventh Semester

MIET 303	*Mine Plant Technology*	*3*
MIET 490	*Projects in Mining*	*3*
MGMT 482	*Collective Bargaining & Labor Relations*	*3*
ENGR 315	*Engineering Economics*	*3*
Core Skills	*Fine Arts/Humanities*	*3*

		Total 15

Eighth Semester

MIET 408	Coal Preparation	3
MIET 410	*Mine Production Technology*	*3*
MEET 410	*Industrial Operations*	*3*
GNET 499	*Engineering Technology Projects*	*3*
Core Skills	*Social Science*	*3*
		Total 15

Italicized courses are either already offered or in development. We will need to initially rely on the availability of some transfer coursework in the student's area, on campus residency, or other online courses to round out these requirements. Common market agreements and fee structures will need to be developed. A low residency program may develop to fill in some supervision intensive laboratories. Our industrial advisory board has also indicated general support, offered some laboratory solutions, and will be called upon to share their concerns throughout the development process.

5. MIET 101 – New Miner Training Course Units Overview

Unit 1: Line of Authority

This lesson is included in the New Miner Training program in the form of a worksheet to be completed by the competent person/instructor and reviewed by the new miner in order to become familiar with the specific line of authority at the mine site.

Unit 2: Introduction

This lesson is presented in the form of a checklist to be completed by the competent person/instructor while presenting the new miner with an introduction to the mine site, its layout and its hazards.

Unit 3: Emergency Procedures

Injuries, fire, and equipment damage are typical emergencies that may occur at a mine. Other emergencies might include earthquakes, tornadoes, explosions, bomb threats, hazardous spills, and acts of violence. Knowing the actions to take could be the difference between life and death. This lesson describes emergency procedures mines have in place for handling emergencies. Students will learn who to contact, how warning signals notify employees of emergencies, how to evacuate, and where to report.

Unit 4: Statutory Rights

When congress enacted the Federal Mine Safety and Health Act of 1977, certain statutory rights were given to miners and their representatives. This lesson provides an awareness of the rights that directly affect miners their representatives.

Unit 5: Hazard Recognition and Avoidance

Miners work in an environment where there are both mechanical and physical hazards such as mobile equipment, heavy machinery, electricity, unsafe ground conditions, loud noise, and heavy dust. To work safely at a mine site, miners must learn to recognize these hazards and take appropriate steps to avoid the risks.

Unit 6: Reporting Hazards

Miners work in an environment where there are many hazards such as mobile equipment, heavy machinery, electricity, unsafe ground conditions, loud noise, and heavy dust. To work safely at a mine site, miners must learn to recognize these hazards and take appropriate steps to avoid the risks and to promptly report hazards. In this lesson the student learns the importance of promptly reporting hazards.

Unit 7: Health and Safety Aspects of Assigned Tasks

The competent person/instructor uses this checklist as a guideline to ensure that the health and safety aspects of a new task are adequately addressed for the miner assigned to the task.

Unit 8: Respiratory Protection

The goal of this lesson is to discuss why a miner may need to wear a respirator, how to select the right respirator and how to wear it properly.

Unit 9: First Aid Methods

New miners will learn how to initially respond to an accident or injury situation, become aware of first aid guidelines and best practices.

6. Maintaining Quality

Pairing the lessons learned from past and current online delivery schemes with our overall experiences with the mining program, we want to address our own objective requirements without compromise, and enhance our delivery of the program without simply creating a web-based novelty. Therefore, the requirements for successful delivery of our program will remain consistent with the objectives and outcomes outlined above. Outcomes based assessment will be a continuous process based on student evaluations, industrial advisory board feedback, and instructor collaboration.

7. Delivery Systems

A wide variety of online programs are being offered across the nation. The courses being provided by these programs provide their students with many online features such as: registration, syllabi, course materials, schedules, class notes, online testing, document submissions, and chat rooms for discussions, FAQ pages, and grade recording. Our MIET

Online program requires an additional set of elements to be successfully implemented. The program will require a means of submitting additional materials in other formats including: drawings, presentations, group projects, and graphic examinations. Drawings will be submitted, marked up for modifications and corrections, and then posted for return. Presentations will be made to an online audience of faculty, guest reviewers, and the other students in the class. The program will also need the ability to organize students into workgroups that allow them to cooperate in projects as well as working independently of other groups. Graphic examinations need to be administered utilizing an online CAD format, requiring a rudimentary CAD skill level while allowing students to solve multifaceted mining engineering problems. These elements combined to create a unique set of requirements for the online program. These features have yet to be developed within the CART CMS suite. However, there are existing graphic testing and sketching and Tablet PC systems that hold promise for inclusion in our CART CMS capabilities.

Our CART CMS development was based on a Moodle-enabled platform such as gaining popularity around the world over other open source options. We have adopted this platform throughout the SET.

According to the Common Collaboration and Learning Environment Update (CCLE Update), "in November, 2006, the UCLA Faculty Committee on Educational Technology decided that UCLA should converge on Moodle as the single open source platform for its common collaboration and learning environment (CCLE). The decision includes a commitment to remain engaged with the higher education community as it builds solutions for interoperability and cross-system collaboration. UCLA intends to continue as a Sakai Foundation member and, as capacity is available, to work with others in the Sakai, Moodle, and IMS communities who are interested in working on data, tool, and language interoperability solutions.

The decision to converge on common solution is a response to faculty leadership in the articulation of a vision for improving the student learning and the faculty teaching and research collaboration experience. The selection process was accomplished through the significant effort of many staff and faculty who worked on the CCLE Technical and Functional Sponsor Groups and the CCLE Assessment Taskforce. This decision will now be carried through UCLA's IT governance process in order to build even broader campus consensus and to define a campus implementation strategy.

The decision to choose Moodle over Sakai as UCLA's convergence platform was based on many factors that, over time, led us to believe it to be a better match for UCLA's current needs. The decision to remain engaged with the Sakai community reflects our support for the Sakai vision and our desire to promote CMS interoperability solutions."

Graphic Material

Drawings and other graphic materials make up a major portion of the course content assigned in four of the six required MIET courses in the BS degree curriculum. Drawings will need to be created in specific formats using standard nomenclature; titles, scales, uniform sets of symbols, and text appearance criteria. As part of the requirements of these courses, drawings will be submitted for periodic reviews. Projects submitted for these scheduled reviews will be marked-up for modifications, deletions, and corrections utilizing current Tablet PC Windows features or

equivalent. Drawing files will be uploaded through the CART CMS as .DXF or .DWG format files. Drawings sets will be reviewed by the faculty member and posted on the CART CMS for return and feedback. Final drawings sets will be archived by the MIET Department and maintained as hard copy portfolio evidence on the CART CMS server.

Presentations

The MIET Online program will require students to compose presentations in the courses involving mining operations design and planning. Presentations will become the tool used to describe the background, intent and solutions to these problems. Presentations will be delivered to a variety of reviewers: faculty members, guests from the mining professions, and the other students in the course. The audience aspect provides some technological challenges. Presentations may be prepared using PowerPoint or other presentation software and presented in real time. Other formats, such as streaming video and web-cam broadcasts are possible; however the development and transmission software needs to be available to all students. We have experimented with Go To Meeting, Live-Scribe, and Team Speak during the fall semester and the paring of these tools appears to be one low cost solution and new technologies are continuing to emerge that provide better opportunities for completing this task.

Workgroups

Course work in the MIET Online program will involve projects assigned to student groups described above. Developing and maintaining teams in online format course will pose the most problematic set of challenges. Program courses will use existing CART CMS "chat rooms" and forum technology and newly emerging conferencing software to allow collaboration between group members. Software features will establish communications parameters between members of individual groups, while providing security via password from viewing by other nonmember students.

Online graphic testing

The MIET Online program poses a situation that will require an innovative solution to the online testing challenge. The design courses in the program will require a series of real-time graphic examinations to measure skills and knowledge of course materials. The graphic exams will use a vignette format, solving limited scope design problems in a set amount of time. The graphic exams will be posted on the CART CMS specific to MIET Online. Each student will generate a solution to the vignette utilizing an internal, limited scope CAD program. No additional software will be required. AutoDesk, Inc. and Educational Testing Services (ETS) have devised such a CAD system and the program is working on a licensed version for use within our CMS. The exam solutions will be stored on site for retrieval and grading by the instructor. Graded exam results are then posted for student review.

8. System Resource Requirements

Computer:

The computer should be a multimedia computer with a Windows Tablet PC XP or XP, Unix, or Macintosh operating system and the internet connection speed should be at least 56 kbs.

- Intel Centrino Core2 Duo or greater equivalent
- Windows (Tablet) XP
- Microsoft Office 2007®
- Microsoft Word®
- PowerPoint®
- Microsoft Excel® (for selected courses)
- Microsoft Access® (for selected courses)
- Microsoft Project 2007® (for selected courses)
- A current anti-virus application
- **DSL or cable modem**
- E-mail address
- Internet service provider (ISP) account
- Microsoft Internet Explorer latest version

9. Conclusion

We have learned through our experiences with other CMS's that controlling the organization of the site and updating the material without becoming programmers is the most important concept in creating a living and lasting online curriculum. Therefore, we needed to develop our own CMS through CART to take advantage of an open architecture Moodle®-based system that could be customized to perform consistent to our own requirements. The website at www.cartinc.com is continually evolving to respond to the increasing requirements as they arise. The basic philosophy is that no one can simply put an instructor's course on the web for them, then stand back and watch it perform. Conversely, instructors will be more than reluctant to use a CMS that requires that person to become a programmer. Therefore, CART CMS was designed to require a limited set of instructor proficiencies used in the current office setting.

For example, instructors upload course materials that were created in familiar software rather than learning in a one-time, single point-of-use environment that is, all too often, subsequently replaced by still another unique software. Working within the standard Office suites encourages faculty to continue developing course materials consistent with existing resources. If we are able to complete the development of a graphic testing module, and enhancements to our drawing file exchange, then we should be able to both maintain an acceptable comfort level, while creating the "red line" markup capabilities vital to graphic communication in any mining engineering technology program. Tablet PC operating systems provide a universal grading by markup capability without the need for additional software. The instructor markups the student posted assignment on screen, then repost for student review of grades. The graphic testing module will essentially operate as a simplified CAD template populated by symbols limited to the appropriate subject. In a general sense, recent results of student satisfaction surveys have highlighted both

the strengths and weaknesses of their online experiences. We will have to overcome several conditions in order to better provide an online curriculum.

- Students sometimes enroll in online courses as a "catch all" solution because of scheduling conflicts with other courses, work, etc. They may lack web experience, computer skills, or the even the self-motivation required for success. We do not want students to take these courses because nothing else would fit their schedules.

- The quality of previous online experiences may lead the student to believe the myth that these courses do not require as much of their time or lack rigor. We have developed a "Student Responsiveness Policy" to augment our "Attendance Policy" in response to this wide variance in quality of experience. We want both the expectations of the students and the faculty to match. Essentially, if the student fails to engage (log-in) the course for fourteen days, then the CMS requires readmission by permission of instructor.

- The development of a well-designed and tested web course orientation, mini-training program, and a *CART CMS 2.0 Student Guide* for first time online student could become a key factor in their success and satisfaction with the program.

- The web-based curriculum will eventually require a full-time web technician to provide trouble shooting assistance to the students, faculty, and the CART CMS web master, and requires release time to faculty members for design, development and testing. We want the program to continue running smoothly while experiencing growth and development.

- We envision our web-based program serving 50 MIET students within the near future. A targeted web-based marketing plan must be devised to attract the proper number of students with the proper background for success. We should partner with a variety of other institutions and organizations where common student serving interests exists.