Ensuring Quality Articulation for Enhancement of Construction Workforce Education

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Abstract

It is common knowledge that the construction industry is experiencing a serious workforce shortage at all levels of the workforce that will only get worse in the future unless something is done about it and done soon.[1,2]

The issue is receiving broad discussion at diverse levels and different solutions are being suggested. In most cases, however, the measures being foreseen to overcome the workforce shortage concentrate on the shortage of the "trades" in construction industry rather than the total workforce. This is to be expected considering the specific mission of the construction labor force organizations deeply involved in the issue of workforce shortage.[3]

The authors believe that the issue should be looked at all levels of the workforce and this paper, in particular, will deal with the issue of training of the construction workforce for technical and managerial positions. One of the promising approaches under implementation is that of articulations between the academic institutions and the vocational institution so that qualified students from the vocational programs can continue their education in academic institutions for filling technical and management positions in the construction industry. One problem with these articulation arrangements has been that of ensuring relevant laboratory knowledge on the part of the vocational education students in certain specific areas. Even though vocational programs are inherently hands-on, the labs in such institutions have limited capabilities in terms of soils testing, materials testing, asphalt testing, to name a few areas.

This paper focuses on an approach for addressing this shortcoming of vocational education students not having access to some of the labs that academic institutions do by means of employing a construction lab-cam and broadcasting a lab session in asynchronous or synchronous modes to other institutions so that they have live or delayed access to relevant lab sessions. As a result students coming to academic institutions to further their knowledge will have the adequate background in lab work that relates to their fields.

The paper elaborates on the technology employed in this undertaking and what are the advantages and the possible extensions of use of this technology and what this means for ensuring a high quality workforce in construction and related industries. This approach brings a solution to the lack of appropriate labs in some good vocational programs of possible articulation quality.

Problem statement

As a university department we have access to the technology, training facilities and the construction experienced faculty to share our knowledge and testing labs with the Vocational Community, (be it K-12 or 2 year Technical Colleges.) Faculty at vocational institutions do not have the funding for the well equipped testing labs as we do, and are thus at the disadvantage of teaching only the lecture aspects of certain kinds of classes without the benefit of the experiments to reinforce the technical concepts. This project is intended to address this shortcoming.

This is especially important in teaching Civil Engineering Technology because so many of the structural properties and concepts these students must learn are best understood through experiments and because these kinds of testing machines will be used in many of the jobs these students will eventually be doing.

Current Articulation Situation

Our degree program in Civil Engineering Technology and Construction Technology at IUPUI require four lab-based classes for a total of 12 credit hours (CET 104- Fundamentals of Surveying; CET 231-Soils Testing; CET 267-Materials Testing and CET 312-Construction Surveying). In the present current articulation agreements with Vincennes University and Ivy Tech State College, it is not possible to articulate some courses due to this lacking lab component even though there are courses whose text/lecture part is similar to what we have.

Both Vincennes and Ivy Tech State College could offer similar classes to ours if supplemented and coordinated with our labs through live-interactive use of a Lab Cam and lab technicians. These courses could then be upgraded to match the learning objectives of our classes and thus would be directly transferable toward our degrees, instead of the current situation where additional lab classes they must be taken to meet our 4 year requirements.

Sharing our lab resources would enlarge the pool of highly trained educated people in the Construction industry and increase the number of 4-year degree holders, by shortening the time between the 2 year and 4 year degrees since more courses in the 2-year program could replace more of those in the 4-year program. Also more of the workforce that is geographically remote from IUPUI will have exposure to our 4-year school that would increase the likelihood of them continuing their education here.

Solution

This Project, which we call CNT (Construction Technology) LabCam, will develop and make available the resources that we think gives the non-IUPUI student the advantages of “being there” without the complications of actually coming to our lab facilities. This will be done by using live video feeds from our testing labs viewed in a remote classroom via the Internet, and discussed in conjunction with their traditional lecture based classes at their vocational institution. Instructional materials could be generated by the Labcam to record sample labs as performed by the faculty and the lab tech or the lectures themselves. Room SL221 is currently set up for remote access to live lectures (and the same set-up can easily be replicated in our Lab Rooms). These images could be converted to slide shows, which can be used in research papers or as video clips in presentations. Sophisticated applications could even notify remotely located teachers when specified testing are being run so they can “tune in” for live viewing in the classroom, or for saving to discuss later.

IUPUI's CyberLab has developed controlling software that allows the viewer to control the directional view of the camera so that the viewer determines where to look as if viewing the test in person. This control of the camera involves the student viewer in the experiment and doesn't" give away the answers" by moving to show the correct dial of the measuring device. The remotely located student would have to insure that he watches for the needed information just like a student on site would. It also involves the students in their learning and provides them access to lab testing that cannot be learned from textbooks, lectures or standardized videos.

There are two ways to go about involving the remote students, depending on the level of interactivity between the remote and on site courses. With little live interaction, the remote class could send in their test requirements (a concrete recipe for instance) and the lab tech would be their on-site hands…designing and mixing the batch, setting up the machines and rung the test according to standard procedures. Remote site students would watch it live and send in questions, revisions etc through a live chat session going during the experiment. A more interactive version would be to compose teams of both remote and on-site students communicating using the Internet (specifically using the chat rooms of Oncourse our University wide Course management software) to plan, carry out and generate a lab report on the test as performed by students on site.

Teachers would use the controlling function to explain the process in their own way providing meaningful flexibility compared to a canned video. With the advancements in video/digital imaging, Internet technology and the special software developed by the IUPUI CyberLab, properly trained teachers can create unique teaching materials from this capability to access real time information. This ability to manipulate the input and output to create teaching resources specific to the individual instructors teaching methodology is a giant leap towards true innovation in teaching. Today, students of all ages are computer literate and they are inherently and naturally comfortable manipulating images from the Internet. Many of our students regularly log in and check their favorite real-time sites for game scores or news updates before starting their assignments. They are engaged by the "live" aspects of the Internet and wouldn't even realize they have taken control of their learning as they manipulate input and output of visual data from this real-time source.

CNT LabCam – Methodology

Purdue School of Engineering and Technology at IUPUI and the Department of Construction Technology are uniquely qualified for this endeavor to produce computer/internet- enhanced teaching materials, and encourage its use by instructors in vocational institutions through articulation agreements. IUPUI's CyberLab, under the direction of Dir. Ali Jafari, has already developed the software that allows the manipulation of both views and output from the video source. They have had their IUPUI Campus Cam up and running for several years and have recently expanded to ClassCam video streaming from lecture rooms. Visit class Cam at the web site http://cyberlab.iupui.edu/Projects/classcast.htm. Additionally you can visit the web site http://134.68.80.36/jafaricam / to try out the controlled web cam.

Universities are uniquely suited for this advanced delivery of instructional material because of the technical resources and the availability of faculty and lab technicans already trained on the testing equipment. Most of our testing equipment is within two rooms that we are in the process of

outfitting with the video equipment and desktop computers to control and link the live video shared captured by the cameras to the Internet. This is where it will be stored and/or sent out live through our departmental web site. We also have extensive testing laboratories with almost $500,000 of testing machinery that can be used to test samples sent in from these distant classrooms with the results shared through live video over the Internet.

The Implementation Process

Online course management is already in place for all of our courses through the "Oncourse"system. Faculty are able to post syllabi, obtain class lists and communicate with their students through e-mail, chat rooms and bulletin boards using this internet based system. Lab assignments and study guides and links to internet resources are posted for easy access by students and lab reports can be turned in electronically to the professor. Digital photos of the equipment and materials used in the lab are easily distributed to the students. See power point presentations or video demonstration clips for CET 231 Soils Testing at (www.iupui.edu/~cet231/details/week5detais.htm) and digital photos of measuring devices for CET 267 Materials Testing at week one details (www.iupui.edu/~cet267/schedule.htm)

Setting up the Lab Rooms for Distance Learning involves using technology to turn a lab into a broadcast situation (with a video camera, rotating mounting bracket and controlling computer). The hardware is readily available, even for sophisticated educational set-ups; mostly as off-the-shelf products and the costs are getting lower. But what is uniquely available to IUPUI is the camera controlling software resources of the CyberLab and Oncourse the University's web based course management software and framework (http://www.oncourse.iupui.edu). Each course would have its own link on its own Oncourse page to the specific camera in the lab room of that class. Communication between students and faculty is easily achieved through the chat room, email and discussion group features of Oncourse. A LabCam button on the IUPUI and School of Engineering Web sites would make it easily available to visitors at the vocational Institutions that we would be outreaching to. Some of typical costs related to implementation are given below:

Hardware: two video camera, controlling computer, & installation……..…$4,000
Software Modifications to Campus Cam by the IUPUI CyberLab……..…$5,000

Curriculum Modifications each IUPUI class……$5000
Coordination stipend for nonIUPUI faculty……..…$1000

As added bonus of this technology, it is possible to generate "home grown" instructional videos by taking and saving digital images from video cameras set up to record instructional lectures and example tests on the actual test machines. Due to the maneuverability of this software, which enables the user to set up the software to take pictures at any set of coordinates (controlling the view and zoom) at any set time period (slow motion), one is able to utilize the recorded views as an effective asynchronous instruction tool. Demonstrations using these stored views are posted on the course web site as a study tool to better prepare the students for the lab, prior to the lab. See week 13 of CET 231at http://www.iupui.edu/~cet267 this capability enables the teacher to make "search, find and explain" assignments that will truly engage the students in their lab experience. These captured videos help students answer more open-ended questions by repeated viewing from different angles, as warranted, so that they get to choose where to get their information as in a real world situation.

Creating learner-driven ("live/ synchronous mode") educational opportunities is the true advantage of this undertaking and its ultimate goal of this project. This is facilitated by the uniqueness of the Cyberlab's software that incorporates the capability for remote users to control the view of live images and speed of captured images. The interactivity of live viewing and live communication to manipulate the controls, materials and actions of the lab tech make the remote lab experience very close to being the same as for the onsite students. Remote users get to participate along with the onsite class in a "what if" mode that would bring them closer to the open ended problem solving situations common to real life jobs.

Future impact -Plans for Exposure and Dissemination

It is intended that the benefits of the undertaking first be made more widespread in the Department itself in terms of wider use and then conveyed to other departments in the School that have lab course and testing facilities, and perhaps to other schools within our university as part of the Oncourse Platform Faculty at the forefront of web and Labcam usage would mentor to other faculty, and showcase their interactive web sites. Since some IUPUI lecture classes are taught in classrooms other than the downtown campus, initially a few more lab classes could also be off-site and eventually lab tests could be all remotely undertaken

The real benefits to the construction Industry and its need for an educated workforce will be in terms of an increase in numbers of students in vocational institutions continuing their educations in a four year program through incorporation of the described undertaking in articulation agreement frameworks.

Work in progress intends for our departmental web site to have a LabCam button so visitors can see archived lab tests as an indication of the potential benefits of collaboration and articulation agreements. We will have a "contact us" button on the web site and a sign up button for visitors to register so we can establish contact of those who visit our site in order to develop a mailing list. This endeavor will also be disseminated through publishing and presentations within the university through the Center for Teaching and Learning, at Education related conferences such as the Frontiers in Education (ASEE/ISEE) and related Engineering Periodicals such as "The Journal-Technological Horizons in Education", and "ASEE- Prism".

Conclusion

It is intended that the CNTLabCam will become the entry point to the on-line world of construction education, and our connection to the teachers and students of vocational institutions, and eventually to the remote continuing education of the construction workforce. Once the web site becomes accessible to the public, the exposure is considerable (to both what we can teach and how we teach it) for the Department, as well as, for the School of Engineering and Technology and the University as a whole.

If you consider the number of Vocational and K-12 Institutions in our metropolitan area, that will benefit from this CNTLabCam technology and the sharing of our resources, the impact will be very significant for the construction educational community and our constituency, in terms of prospective employers and students alike. If you consider all the other uses of live video feeds as a way of accessing testing labs or resources that can't be brought to the classroom, then the

impact is even greater.

Live viewing on the Internet to generate or even supplement instructional materials is not widespread because the software to manipulate and retrieve the information is not commonly available. Although there is much use of the Internet and World Wide Web for teaching simulations and modeling, it is underutilized as a Live-on-line Resource. We think that once the capability of using of live data is understood and utilized through the kinds of technology as elaborated above, further uses will only be limited by the creativity of the students and faculty.

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