11 DISTANCE LEARNING IN ENGINEERING AND CONSTRUCTION EDUCATION: PROS AND CONS

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Abstract:

Distance education has rapidly emerged as a new avenue for teaching and learning in the engineering and construction disciplines. Much has been written about the benefit and the downside of distance education. Many stakeholders in the construction and engineering fields remain skeptical about the validity of distance education. In spite of this skepticism the American Council of Education estimated that 85 percent of traditional colleges and universities offered, or soon would offer distance accessible classes. China alone produces more than 100,000 graduates, with more than half of China's 92,000 engineering and technology graduates having attained their degrees through distance education. A universal model for distance education in engineering and construction would include answers to questions about the reliability and validity of the distance curriculum. The virtual engineering and construction classroom will become much more student centered. The traditional classroom will likely be replaced with a more intimate virtual environment. The student centered distance learning archetype will include dynamic demonstrations of theoretical engineering and construction models allowing students to manipulate, experiment, and translate theories into real-world applications. The distance education curriculum in engineering and construction will likely include the creative use of virtual technologies, theoretical adaptation, and the incorporation of comprehensive evaluation of student performance. Distance education in engineering and construction in the future must provide an element of comprehensive student evaluation to be universally valued and accepted.

Keywords: *Universal model for distance education, comprehensive student evaluation, engineering and construction, distance learning archetype*

INTRODUCTION

Distance education is a rapidly emerging global avenue for teaching and learning. A universal model for distance education has not been developed and adapted by the engineering and construction disciplines. Many stakeholders in these two fields remain skeptical about the validity of distance education. In spite of this skepticism, distance education is becoming very popular. "Approximately one-third of higher education institutions in the United States offered courses via distance education in 1995. By 1998, the American Council on Education estimated that 85 percent of "traditional" colleges and universities either offered, or would soon offer, distance-accessible courses" (Kirk & Bartlestein, 1999).

With the advent of the Internet many traditional classroom functions are conducted electronically. The new technology has transformed the way universities conduct day-to-day operations. "Distance education is not a new concept. In 1836, the University of London had a distance education program; in 1874, Illinois Wesleyan University offered graduate and undergraduate degree programs via correspondence courses" (Fender, 1999). The academic community is very experienced in evaluating conventional programs, but has little experience with distance programs. Currently, the accreditation community is not sure what standards should be used to accredit distance education programs of all types-and having separate criteria for conventional and distance programs is not desirable (Fender, 1999).

Stakeholders in higher education can expect the technology to drive the future of the global higher education system "To some degree, all education is distance education. In traditional courses, students spend an average of only three hours per week attending class but are nevertheless required or expected to spend several additional hours on their own time reading, researching, preparing assignments, and perhaps conferring with other students. And in recent years, even campus-based students have come to rely on asynchronous e-mail conversations with faculty and other students rather than office appointments and meetings" (Worley, 2000).

The popularity of distance education stems from the demand side of the economic equation rather that from the supply side. That is to say the market appears to be driven from by the education consumer rather than by those providing the distance education product line. Therefore we can assume that consumers want educational opportunities. The opportunity to become educated is increased with the creative and fundamental use of virtual technology.

Distance education is being utilized for an expanding range of purposes and in multiple settings. Universities are using it to increase the number of students who have access to the higher education system. Corporations keep abreast of technological advances and update worker's skills using distance education. Government entities use distance education for training teachers and other professionals in remote or rural areas where traditional classroom settings do not exist. "Malaysian students pioneer on-line education a university in Malaysia is taking virtual education to the outer fringes of the information age. While many colleges around the world use the latest multimedia innovations to deliver some of their course or use the Internet to announce assignments, University Tun Abdul Razak-or Unitar-was set up with the sole aim of offering education through cyberspace" (Hiebert, 1999).

Even though distance education is becoming more popular many questions remain about its validity and reliability. Many academicians condemn the utilization of this medium of education because it lacks the interaction between student and instructor that the traditional classroom offers. Isolationism does appear to be a problem associated with this education medium, but dynamic virtual technologies, student-centered instruction, and a clearly defined distance learning archetype could improve this condition.

DISTANCE LEARNING ARCHETYPE

The distance learning archetype is differentiated from the traditional learning model by role the instructor plays in each model and by the level of autonomy the learner must have in order to participate in distance education. Although the classroom environment in Engineering and Construction Science is highly structured by the instructor, teaching students to be critical thinkers is essential in the virtual classroom of the future. The workplace is not systematic and concise, but rather it is filled with ambiguous situations. The teacher-centered classroom denies the student the opportunity to more self-directed, autonomous, and creative. The distance learning archetype can be best described as a dynamic creative autonomous learning environment. Often a virtual educational delivery system is used to facilitate distance learning rather than the age-old method of correspondence course curriculum. These virtual delivery systems (Hiebert, 1999; Long et al. 2000; Murphee, 1999; Phillips, 1998) have similarities around the globe. These virtual delivery systems hold student autonomy and creativity as essential attributes.

The archetypal distance learner can be defined as being primarily an autonomous adult learner. A level of autonomy is expected from the distance learner that may not be found in the learner in the traditional classroom. This type of autonomous adult learning does differ from how children learn, and a theory of adult learning was identified and labeled as "andragogy" by Malcolm Knowles (Knowles, 1978). He brought forth the word andragogy to describe the learning process for adults and believed that adults are self-directed learners. Adults accumulate a unique set of life experiences, that adults should be responsible for their own learning, and that adults want immediate application of what they learn (Knowles, 1978).

PROS AND CONS

Distance learning allows education to take place where traditional institutions do not currently exist or in areas that have few educational opportunities. Engineering and construction science graduate shortages currently exist in the United States and in other parts of the world. These shortages can be eliminated through using the distance education model. China alone produces more than 100,000 graduates a year through distance education, with more than half of China's 92,000 engineering and technology graduates having attained their degrees through distance education (Potashnik and Capper 1998). If the people of world are to become more educated distance learning is likely to play a positive role.

There are many barriers that educators must overcome before distance education will be fully accepted. Distance education is not the same as traditional education this fact must be recognized. Recognition of the differences between traditional and distance learning is essential in order to develop and facilitate successful teaching and learning experiences. "Distance education is different from traditional classroom learning in that it must be more learner-centered. A classroom instructor may lecture for two or three hours at a time, but the Internet creates a forum that allows students to take a more active approach to focusing on their own education. Instructors frequently present theoretical concepts and models for online discussion. The students then work independently or in groups to translate theories into real-world applications"(Murphree, 1999). This active autonomous approach supports the definition of the distance learning archetype.

FUTURE CHALLENGES

It is problematic for some in teacher-centered disciplines such as engineering and construction science to practice from a student-centered teaching model. Most traditional forms of instruction in these disciplines depend on the teacher-centered teaching model. The distance model also depends on utilization of autonomous hands-on activities that learners can experiment with and experience. The experiential aspect of distance learning should incorporate dynamic model that duplicate or simulate a real world application of engineering or construction theory. One such model (Haque, et al. 2000) is presented below:

Java Simulation based Soil Mechanics Laboratory Course Studio (Haque, et al. 2000): The principal objective of the Java Simulation based Lab Test Module was to provide students with the opportunity to carry out soil test on-screen using an interactive virtual instrument set-ups, and step-by-step test procedures. Figure 1 shows two screens layout of the Java-based virtual soil sieve analysis test. This test involves determining the relative amounts of particles within given size ranges in a soil mass. It uses a set of calibrated sieves, stacked in descending opening size, through which the soil is passed. The stack of sieves is mechanically vibrated for a fixed period of time. The weight of soil retained on each sieve is measured and converted into a percentage of the total soil sample. The amount of different particle sizes in a soil is then represented by a grain size distribution curve in a semi-logarithmic plot with the ordinates being the percentage by weight of particles smaller than the size given by the abscissa. From the shape of this curve, the soil can be classified as well-graded, gap-graded, and uniformly graded. The test is one of the most important soil tests for coarse-grained soil classification and for determining their influence in soil density, permeability, shear strength and liquefaction potential. The main screen of the simulation model depicts a schematic series of known mesh sizes, mechanical vibrating shake table, a weighing scale, and a sample heap of soil. In this model, the user will work interactively with all the objects, such as sieves, pan, vibrating shake table, and balance scale, etc., all of which are developed from actual digital photographs. During the interactive test procedure stage, the user is instructed to (1) weigh all the sieves, pan and soil sample, and (2) setup the sieves in stacks on the vibrating shake table by clicking and/or dragging operation. After placing the stack of sieves on the shake table, shaking is simulated using a timer. The weight of the soil sediment retained on each sieve is measured and entered into the table by user participation. Both graphical and tabulated methods of data presentations are developed for the interpretation of simulated data. The conceptual principle adopted here is to reinforce students understanding and strictly following the test procedure. To run this model on a PC, it needs Java plug-ins, which are freely available in many web sites. In this module, to deliver the interactive content on the web, Java programming language was used because of its platform and operating system independence. Java applications were developed using WebGAIN's Visual Cafe 4.0, and embedded in HTML documents as applets, which can be run over the web. Visual Cafe is a visual Rapid Application

Development (RAD) tool designed exclusively for Java programming language. It is a complete form-based development environment that provides a rich set of What-You-See-Is-What-You-Get (WYSIWYG) tools and components that enable the program developer to develop, debug, and deploy high-performance Web applets and stand-alone Java applications.

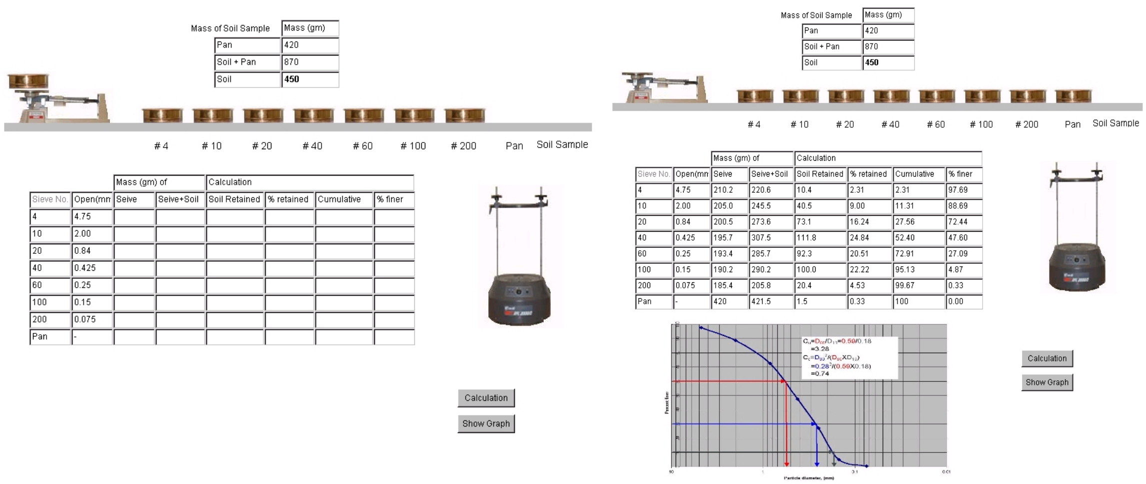

FIGURE. 1 JAVA BASED VIRTUAL SOIL SIEVE ANALYSIS

The development of the World Wide Web (WWW) has led us to an unprecedented growth for the last ten years in access to information over the Internet. The current information technology allows us to develop student-centered virtual design studio that can be reached to a large student population via the web. The important advantages of the virtual reality environment over other computer-based design tools are that it enables the user to interact with the simulation to conceptualize relations that are not apparent from a less dynamic representation, and to visualize models that are difficult to understand in other ways. The interactive nature of virtual environments made it a natural extension to the 3-D graphics that enable students to visualize real life structures before actually building them. According to Menn's (Mann 1993) evaluation of the impact of different instructional media on student retention of subject matter, it was found 90% of students remember, if they do the experiments themselves even if only as a simulation. In other words, guided tutoring and computer simulations through studios/labs that are properly designed and implemented could revolutionize technological education. The computer-based simulation software enables students to experiment interactively with the fundamental theories and apply them using electronic devices. It provides instant and reliable feedback. According to Gokhale (Gokhale 1996), in situations where the objective of instruction is to learn the facts without application or transfer, method of instruction is not a significant factor. However, if the educational goal is for students to transfer and apply the knowledge to real-world problems, then simulation integration into the class structure is an effective learning strategy.

Distance education can lack interaction between the instructor and the learner. If a universal distance learning archetype is to be accepted by teaching professionals, pedagogical experts, and by the students participating in distance education it is likely to be very user friendly, student-centered, and must contain an element of comprehensive student evaluation. These attributes would satisfy most stakeholders. In addition the virtual classroom would have to be intimate, allow for autonomous learning, and still have an instructional presence. In any discipline the outcomes assessment process contains an evaluation of the student, the course materials, and of the instruction. In a traditional engineering or construction course rigorous testing is an essential component to validate these outcomes. Testing of the distance student must be provided for. Therefore in order to gain the creditability that the traditional model has earned it is essential for distance education to adapt a model with comprehensive student evaluation. "Because the benefits and outcomes we can expect from designs and delivery technologies vary, programs and instructors must decide in their early planning of distance courses which pedagogical goals (or literacies) they most value" (Cook, 2000). These pedagogical goals become the basis for what and how we teach. The end product of this teaching and learning exchange can be measured by evaluating what the learner learned.

CONCLUSIONS

The eventual engineering and construction learning distance archetype will address the needs of the learner, the limitations of the distance medium, and define the parameters for student-centered instruction. The demand for distance education courses is likely to continue to increase (Kirk, 1999). The increased demand for distance education does not guarantee that distance education degrees from universities will have creditability in the engineering and construction science disciplines. In fact unless effort is made to insure that rigorous and comprehensive student evaluation occurs these degrees will become worthless or nearly so. One only needs to look at the MBA and other distance programs under scrutiny because they lack academic rigor.

As more and more distance education programs are created throughout the world, certification and accreditation become issues for all stakeholders. "While accreditation has typically been controlled by individual countries, the globalization of distance education has created a whole new challenge in accreditation and certification of learning. For example, the Global Alliance for Transnational Education (GATE) has been formed to carry out the formidable task of creating a global certification and review process for education delivered across borders" (Potashni and Capper, 1998). These degree programs may not be universally accepted by all countries, companies, or for that matter other universities particularly the traditional brick and mortar institutions.

The real winners in global distance education in construction and engineering may be the students in the traditional classrooms. These students benefit in two ways. One, their degrees currently seem to be more valuable than those degrees gained from today's distance programs. The other real gain for traditional students is the improvements that are part of the distance education archetype. The student-centered approach that works well in distance education works even better in the traditional classroom.

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