Online Learning:

Anywhere, Anytime, Radically Altering Education for Engineers

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Your boss hands you an assignment. As you assess how to accomplish the task, you realize that there are facets you can't solve with your current skills. No problem. Pulling up an electronic agent, you fill in your needs, previous education, and experience.

After a series of questions and subsequent prompts, an e-coach directs you to an online course that will give you the specific knowledge for the assignment.

Is this reality or wishful thinking? “It’s not here yet,” says Andy DiPaolo, Ph. D., executive director at Stanford University’s Center for Professional Development and senior associate dean in the School of Engineering, “but on-demand customized learning soon will be.” It has to happen because people in the global economy no longer compete only on the level of low-scale jobs. Continuing education for engineers is imperative, but we need to assess how to juggle it with a full-time job, business travel, and family responsibilities.

The computer has become a door to highly engaged learning that invites teamwork and communication.
According to engineers and managers surveyed by Stanford University’s Center for Professional Development, continuing education should be much more accessible than it is now. The Center’s survey asked these professionals what they wanted from continuing education. Their “wish list” ranged from choosing exactly which parts of a course to take to previewing a class before enrolling. Due to online delivery, the format for pursuing graduate degrees, professional development, and certification has significantly changed in the last few years, with more progress to come.

They are increasingly accessible because consumers don’t want to be locked into a time and place for education. With the Internet and technology, they don’t have to. In 2004, about 2.3 million people registered for one or more online college courses. A year later the number jumped to 3.2 million, an increase of 40 percent, according to a report by the Sloan Consortium, an organization for colleges with online programs.

Eduventures, a research and consulting firm focusing on education, found that about 50 percent of people who want to enroll in post-secondary education prefer online delivery or a mix of online and on-campus.

Though undergraduates make up the bulk of online education, most engineering programs offer only graduate degrees. According to Lesley Greene, a research analyst at Eduventures, online engineering master’s degrees are still a “niche market.” Her research finds that many schools have between one and four engineering programs at the master’s level. Sloan Foundation’s catalog for online engineering programs lists three online bachelor’s programs and 40 master’s programs.

Frank Mayadas, Ph.D., program director of the Sloan Foundation, points out that the master’s takes only two years and usually doesn’t require much lab work, so that engineers prefer the online format after they start their careers. In addition, corporations that hire engineers and organizations such as the Institute of Electrical and Electronics Engineers, the American Society of Mechanical Engineers, and the American Society of Civil Engineers report a significant growth in online courses as they can cost-effectively train more people in a shorter period of time.

According to Bill Weipert, Ph.D., vice provost of distance learning and professional education at Georgia Tech, online education is market-driven, as companies respond to their customers and clients with specific technologies and tools. Online learning enables them to keep up. “What I see happening is that there will continue to be a need for additional training and education for engineers, but it will be done in a ‘distributed’ manner by both universities and companies, having customized online programs for just that company,” says Dr. Weipert.

Online learning is beginning to fundamentally change the way education is delivered.

“All of a sudden students have more power, as do employers,” observes Allison Rossett, Ed.D., professor of educational technology at San Diego State University. She recently completed the book Job Aids and

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How Do You Want Continuing Education to Look?

Stanford University’s Center for Professional Development asked engineers what they wanted from continuing education programs. Their responses point to the future of online education.

- **Access learning anytime, anywhere** – I am willing to assume responsibility to increase my market value.
- **Choosing how to learn** – Give me multiple avenues for learning.
- **Learning that uses ‘real’ problems** – I want courses that allow me to transfer learning to direct application.
- **Learning that is customized to my needs, based on an assessment of my knowledge gaps** – I want just-for-me focused learning.
- **A networked learning community** – I want to work with teams from all over the world.
- **Efficient administrative and technical services** – I want an easy registration process, homework returned on time and someone like a concierge to help address administrative problems.
- **A preview of courses before registering** – I want to look at student evaluations and the reviews of ‘experts’.
- **Choosing how much of a course to take** – Maybe I only need five hours of a 45-hour professional education class.
- **Advice from my university throughout my career** – I want my university to understand my learning needs and prompt me about new classes.
Performance Support: Moving from Knowledge in the Classroom to Knowledge Everywhere. Individuals who want to learn can go beyond the limitations of an institution. Professors, too, will have "louder voices and longer arms," she asserts, because online learning gives them greater potential for escaping 'geographical' boundaries and prescribed class times.

From the University of Wisconsin, Wayne Pferdeshirt, director of the Master of Engineering in Professional Practice, also notes a "groundswell of change in academia," not because of technology, which he says is interesting in its own right, but because of positive changes in interaction and collaboration facilitated by online learning. He mentions an on-campus course in computational science that was part of the usual series of lectures. With online delivery, the professor recorded his lectures so that students could access them before class. During class time, students were involved in interactive labs, team projects, and workshops, rather than only taking notes.

Pferdeshirt thinks the biggest challenges facing online learning are not technical but involve course design. "What I like about online learning is that it's turning education on its head and asking what type of learning is most effective for various types of students. In my case we are talking about experienced and mid-career people. The best way to educate them is not sitting in lectures designed for inexperienced 22-year-olds," he says. Online learning is about interaction — between students and instructors — and the abundance of material accessible through the Internet.

Online learning from a student's perspective

Leah Bober has worked with Harley-Davidson as a powertrain engineer in product development and manufacturing. In her current position for Rider's Edge, she does marketing and sales promotion for new motorcycle riders. Before beginning her online master's in engineering in engine systems at the University of Wisconsin-Madison, she assumed it would be a traditional correspondence course with little interaction between the professor and students. That assumption changed as she met other students online from different companies in different locations. A few weeks later, the cohort attended a mandatory five-day summer program at the Madison campus to become familiar with each other, the instructors, and the tools they would use for the course.

The week before each online class session, Bober receives a CD or PowerPoint presentation of the lecture to review and 'discuss' with other students. Weekly classes are comprised of a Web conference with the instructor and students sharing their perspectives. Teams of students present homework assignments and projects in an environment in which everyone can view the documents simultaneously.

Bober is particularly enthusiastic about the blend of academic and real-world learning. "Some lessons are theoretically based, and others have application for theory in industry. It is very attractive to have that bridge between the two and see the technical aspect molded into realistic applica-
Diploma Mills Are Online, Too

Online education can be expensive — as many fraudulent providers have noted. As the number of distance students increase, so have scammers. Prospective online students could stick to brand names, but they would forfeit possible alternatives that could better suit their needs. With so many choices, online learners must be well-informed about providers to get the best distance education.

To become knowledgeable about what is available, start with accreditation. If you are deciding between degree programs, recognition by an accepted accreditation board is essential. You should be aware of the difference between regional and national accrediting organizations and make sure that reputable agencies accept them. It is not uncommon for diploma mills to create their own accrediting agencies and proclaim that they are valid. There are several agencies and Web sites for getting this information, such as the Distance Education and Training Council (www.detc.org), the Federal Trade Commission Web site, “Avoid Fake-Degree Burns” at www.ftc.gov/bcp/online/pubs/buspubs/diplomamills.htm, and the Council for Higher Education Accreditation, which maintains a current listing of accredited institutions at http://chea.org/search/default.asp.

Thoroughly investigate the curricula and ask whether the details of the course fit what you need to further your career. Other ways to evaluate a program include rates of degree granting or certificate completion. Find out who will teach the course: is the individual a full professor or a graduate assistant? Has the teacher been published? What experience do they have teaching online? What do previous students say about the course? For professional development courses, look into the organization’s background and the credentials of the instructors.

Just-in-time knowledge

Looking at education from the aspect of designing courses, Dr. Rossett notes that many students and employers want knowledge available on a just-in-time basis, a habit created by Google. They are eager for “morsels of knowledge delivered at the moment of need.” She predicts that one model of adult education will be to sign up for a “subscription” to school, so they can reach for advice when they need the knowledge, which can be through online delivery or an e-coach. “Basically, no employer wants to hire an engineer to sit in class,” she says. “Knowledge is everywhere, not just in a classroom. How do we take the ‘smarts’ that are available in 30 seats Tuesdays and Thursdays from nine to ten a.m. and distribute them so that they are readily accessible?” She differentiates between knowledge, information, and support. Knowledge is committed to memory and can be instantly recalled. Information is accessed when a decision must be made and then utilized. Support is immediate help, and all three can be part of on-demand online learning.

The effect of technology on online learning

Standing in the university cafeteria, Robert Weiler, Ph.D., dean of engineering and computer technology at Capitol College, watched a student download data from a lab project to his cell phone and send it to a lab partner. He uses this as an example of how technology will shape online learning. “Where are technology and online

ed to their jobs, which could entail anything from systems analysis to new software. Pferdehirt uses engineering employers from all sectors to “seed the curriculum with ideas from outside,” as he describes it, though he differentiates this approach from developing specific internal programs for a particular employer. The University of Wisconsin Master of Engineering in Professional Practice Quality Engineering and Quality Management course is an example of action learning. Students select a project or process in their workplace and find an in-house team which includes supervisors, other engineers, and designers. Quality management tools taught in class are used in the problems. “By working together and applying the tools, students are learning, identifying problems and their root causes, and coming up with solutions. That class alone covers the cost of tuition paid by their employers, because they see results. Case studies are good, but if they are your own applications, so much better,” says Pferdehirt.
learning going?" he asks. "Stay tuned." Capitol College is actively exploring the technical challenges toward offering online courses. Currently, they have six master’s degrees in engineering and are going to offer the second half of their bachelor’s in engineering online. "We are trying to mimic face-to-face input with online and supplemental synchronous and asynchronous classes," says Ken Crockett, director of academic administration and support at Capitol College.

Also from Capitol College, Charles Conner, Ph.D., professor of electrical engineering, points out that 15 years ago, the latest technology for online delivery was the telephone. Looking ahead, he thinks that technology will ultimately replicate the classroom. Currently, he teaches a graduate electrical engineering class using PowerPoint, Open GL, a software to write applications, and MATLAB, a program that allows students to perform and share advanced analyses, visualize data, and develop algorithms. He and his students communicate via streaming audio, so that students hear his voice as he lectures. Students can click on an icon that indicates they want to ask a question, but he finds they prefer using the more efficient text chats.

Handling hands-on labs online

One of the challenges that online engineering program designers face is how to incorporate hands-on lab work, but Dr. Mayadas questions the whole concept of lab work by asking, "Why do we need labs? What are we trying to teach? This needs rethinking."

This challenge has been met with software that connects computers to actual lab equipment in another location. He speculates that more than half of lab work can be done online. For hands-on experiments that cannot be duplicated electronically, he suggests learning about lab instruments online and then going to a lab for only a short time.

Capitol College students work online and when necessary access local labs. They are currently testing equipment for their online students to buy and then interface with home computers to work with lab equipment plugged into a USB port, which in effect creates a workstation. Students can e-mail images of the workstation screen to an instructor. As simulation software becomes more powerful, the limitations of price and bandwidth will be overcome.

"Students tell us they would rather buy the equipment than travel 30 miles to our campus. With this equipment, we will be able to do 90 percent of lab exercises online," notes Dr. Weiler.

Technology won’t solve all the challenges involved with online learning, but for students like Bober who travels extensively in her job, she can continue learning online and get a master’s degree that she wouldn’t have had otherwise. As Dr. Weiler says, "Stay tuned."