

Educational Pathways

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Timely, Relevant and Accurate Information About Distance Learning and Teaching in Higher Education

"Let's ride the online knowledge wave, stay balanced, learn how to avoid nasty undertows, know where we are at all times and reach the shoreline safely so we can hop on the next wave." - George Lorenzo, "SurfingThroughNoise"

Carnegie Mellon University Open Learning Initiative Advances Scientifically Informed Web-Based Instruction

In the spirit of a true "open source" and "community-based" educational research and development activity, the Carnegie Mellon University Open Learning Initiative (OLI) has created 11 introductory online courses that any individual can use for free by going to www.cmu.edu/oli/index.html. OLI also offers instructor accounts where instructors can select and sequence course material to fit their teaching needs. In this scenario, OLI tracks students' learning of key concepts and provides reports to support instruction.

Under a William and Flora Hewlett Foundation grant, totaling more than \$5.4 million since the fall of 2002, the folks at OLI have created some very sophisticated "scientifically informed" online teaching and learning environments. Currently the most active courses being used at institutions across the country, as well as internationally (to a smaller but growing degree), are Statistics,

Economics, Causal Reasoning, Chemistry, and Logic & Proofs. Portions of the other courses – Biology, Calculus, Empirical Research Methods, French, Physics and Mechanical Engineering (Statics) – are also getting utilized by a wide variety of educators but are in an earlier stage of "iterative" development.

Evaluation and Improvement Process

According to OLI's Director Candace Thille, OLI's online course development work is really never completed because these courses are built under a continuously refined evaluation and improvement process driven by both its creators and its budding community of users.

At the recent EDUCAUSE Learning Initiative (ELI) Annual Meeting held last month in Atlanta, Joel Smith, Carnegie Mellon's vice provost and CIO, explained that every OLI course is theory-based, designed using a variety of current learning theories, including some very effective cognitive online tutor-

ing methods. Plus, each course module is put through a meticulous evaluation process driven by each course development team, as well as by the actual faculty and learners who are using the course materials, who provide valuable feedback in order to determine levels of quality and effectiveness (more on this later).

Fully Online, Supplemental or Blended

Thille says that most of the courses – while designed for a fully online self-paced modality that an individual can move through without an instructor – are currently being used primarily as course add-ons. Instructors in face-to-face classes, for instance, are using the OLI course materials for online homework assignments and for supplemental instruction purposes. There's also a number of institutions that have been using the OLI courses in a fully online, credit-bearing, instructor-led modality. At other institu-

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tions, faculty have created blended learning courses in which the OLI environment replaces seat time. In addition, a virtual high school is using the OLI Statistics course as an Advanced Placement offering, and students who have taken the course have consistently scored fours or fives on their Advanced Placement exams. Plus, the OLI Physics course materials are being utilized at the U.S. Naval Academy.

How OLI Courses are Built

All OLI courses, which typically take about two years to fully develop, are created by collaborative teams of faculty content experts, learning scientists, software engineers, human computer interaction experts, evaluation/assessment specialists and student learners.

The faculty team developing the OLI Chemistry course, for instance, was comprised of a full professor of theoretical chemistry, a post doctorate in chemistry and a high school chemistry teacher. A learning scientist was also assigned to the team, as well as members of the OLI staff of professionals and graduate students who work up the instructional design and information technology elements of the course. Additionally, an undergraduate and graduate student enrolled in a Carnegie Mellon chemistry program were included in the development team.

Learning Outcomes Oriented

One of the first orders of business when developing an OLI course is to identify high-

and low-level learning outcomes within course modules. For example, a learning outcome could be to determine whether or not a student can effectively perform a specific scientific procedure or exercise, or what Thille refers to as reaching “procedural fluency.” Getting learning outcomes under control, she adds, “takes a fair amount of time, especially when trying to get faculty to agree on how they might measure a learning outcome.”

Literature Search & Review

Some of the OLI courses include a literature search and review process. Thille points to physics and calculus education, for instance, where there is a body of literature created by educational researchers who have already studied the challenges of teaching in their domain. The OLI development team may also conduct a survey of online courses within the discipline to determine the strengths and weaknesses of existing online teaching and learning approaches.

Delivery Environment

The software engineers are responsible for the underlying development and delivery environment and the course interface, Thille says. These courses are designed to be self-paced without an instructor, and:

Course designers must compensate for the lack of immediate intervention and tailored feedback. OLI’s toolkit for providing this kind of feedback to learners includes sophisticated tutoring systems

and virtual laboratories, as well as short Flash animations with spoken narration (based on the cognitive principles that students learn best if given mutually reinforcing information over both auditory and visual channels)¹

Computer-Based Tutors and Virtual Labs

One of the centerpieces of OLI’s “sophisticated tutoring systems” is called a “cognitive tutor,” which is defined as:

A computerized learning environment whose design is based on cognitive principles and whose interactions with students is based on that of a (human) tutor - i.e, making comments when the student errs, answering questions about what to do next, and maintaining a low profile when the student is performing well.²

A good example of a cognitive tutor can be found in the OLI Statistics course, where a “StatTutor” supports students as they solve data analysis problems. The StatTutor provides scaffolding exercises for choosing the appropriate analysis. It incorporates procedural steps that can be faded to gradually remove the scaffolding as the students demonstrate understanding of a procedure. The final problems are presented without any scaffolding. Overall, students develop a critical approach to study designs, data and results, which gives them a keener understanding of statistics, in general.

Virtual laboratories, which may also have tutoring environ-

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ments supporting them, are basically interactive simulation-based learning activities. The labs support students to explore multiple solutions to problems, including aspects that would not be visible in the physical lab environment. In the OLI Chemistry course, for instance, students are taught the rudiments of Stoichiometry (the branch of chemistry that quantifies the substances in a chemical reaction) by solving a real-world problem in a virtual environment. The first task students are given is to determine the level of arsenic contamination in a sample of well water in Bangladesh. In this scenario, the learner is put in the role of chemist and asked to analyze the sample in the virtual lab. Then they must conduct a dimensional analysis to determine if the arsenic level is toxic according to World Health Organization guidelines. If they are unable to successfully complete the analysis, they are directed to an online instruction that includes an explanation and demonstration, worked examples and tutored practice.

“One of the things that all of our courses attempt to do is promote coherence within the domain. As students learn discrete skills, they understand how they fit into the big picture,” says Thille.

HCI

The human computer interaction expert is responsible for conducting some of the evaluation studies, which includes observing students in OLI’s computer labs move through an OLI course module. The goal is to discover where they may or

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– Candace Thille, director, Online Learning Initiative

may not be struggling with the interface or course design. “We usually do this near the beginning of a course, especially if it is a new approach to a course, like in a mechanical engineering module where there are a lot of sophisticated simulations that are intended to teach things that are usually taught by manipulating 3-D objects in the classroom,” Thille explains. In short, these evaluation studies are geared toward ensuring that students engage in a transparent process for moving through all the elements of the OLI courses.

Assessment Specialists

In addition to creating assessments inside courses, OLI’s assessment specialists conduct “real, live studies,” Thille says. A current question under investigation relates to whether or not students can do more and learn faster in an OLI course as compared to traditional face-to-face instruction. Thille explains that over the next two years OLI evaluators will be conducting several “accelerated learning” studies using different OLI courses. This semester, OLI evaluators are comparing students enrolled in an eight-week instructor-led OLI Statistics course with a 15-week traditional face-to-face Statistics course. The assessment specialists are using a nationally

created pre- and post-test and other instruments created for the study. Ultimately they will write a technical report of their findings.

Feedback Loops and Evaluations

Providing a variety of what Smith refers to as “feedback loops” is another important OLI course development process. Feedback loops come in the form of student performance indicators, course design effectiveness strategies and science of learning theories. Feedback loops, which are supported by evaluation processes that collect student learning data, always wind up impacting learning outcomes. “We have been very serious about constructing evaluations throughout this project, and we have many more planned,” Smith says.

Results

Many of the evaluations have revealed some surprising results in terms of learning outcomes. In a Carnegie Mellon Statistics course comparison, for example, 20 students in a fully online OLI section, that included a voluntary option where they could meet with their instructor once per week, averaged 88.75 on their midterms compared to an average of 90.17 for 201 students in traditional face-to-face

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courses. Plus, in a final comprehensive exam, students in the OLI version averaged 84.79 compared to an average final exam score of 83.54 for students from the traditional class. Another study compared scores from a national statistics test given to 24 Carnegie Mellon students in an OLI Statistics course with 488 students in traditional Statistics courses from other institutions in the US, both before and after the students completed their coursework. The OLI students had an 11.7% increase in correct answers from pre-test to post-test results compared to a 7.9% increase for the students in the traditional courses.

Smith notes that during the development and evaluation phases of the OLI Statistics course, the faculty and staff from Carnegie Mellon's Department of Statistics felt that the OLI course would more than likely be used for exportation to other institutions and organizations. However, "as we worked on it, the department became more and more fascinated and grew more enthusiastic."

Student Satisfaction

In addition, Smith says that obtaining positive student satisfaction results have been "consistent across all of the evaluations we have done." For example, an end-of-course survey revealed that 100 percent of the students in an OLI Statistics section would recommend that their peers take the same course. All students also reported an increase in their interest in Statistics. Anecdotal evidence from student comments also supports this point of view.

“Not only will this produce more information about adaptive instruction, but also, if you demonstrate to your class that you are really listening to them, that increases the volume between the faculty member and the student. That is why we are working at instrumenting this entire environment.”

– Joel Smith, Carnegie Mellon's vice provost and CIO

One student said that he/she found the OLI course "to be one of the fastest, most efficient ways to learn new text." Another enjoyed the learning-at-your-own-pace modality; and another said, "this is so much better than reading a textbook or listening to a lecture. My mind didn't wander, and I was not bored while doing the lessons. I actually learned something."

Taking Evaluations to the Next Level

Smith explains that OLI is currently concentrating on a new form of feedback that is related to blended teaching and learning environments whereby OLI will analyze how faculty who chose to use a, so to speak, "new generation textbook," through the utilization of OLI course materials, can add value to their courses.

In addition, new forms of analytics are also under development. As more students work in, and rely on, digital environments for their learning and research, "we can gather more and more data about student activities in order to analyze what is working and what is not working," Smith says. This vision includes "a different form of analytics that really focuses on trying to identify the units of learning or the chunks of knowl-

edge and evaluate whether students are really getting those chunks of knowledge." Smith also admits that "this is not an easy thing to do." The ideal, however, is to build a system that automatically analyzes and organizes data in a way that will ultimately show an instructor, on a consistent basis and through an electronic dashboard interface, what levels of learning and understanding his or her students are achieving. The instructor can then adapt teaching strategies accordingly. "Not only will this produce more information about adaptive instruction, but also, if you demonstrate to your class that you are really listening to them, that increases the volume between the faculty member and the student," Smith says. "That is why we are working at instrumenting this entire environment."

Workshop Program

If all the aforementioned isn't enough for the folks at OLI, another major facet of the entire initiative is all about extending itself beyond the scholarly community of Pittsburgh. While faculty around the globe have been utilizing OLI course materials, the actual collaborations on course development and evaluation have been mostly

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confined to faculty and staff from Carnegie Mellon and the University of Pittsburgh, with some additional collaborations occurring recently with the Miami University (Ohio), Universidad de los Andes (Colombia), Qatar University (Qatar) and Santa Ana Community College (California). So, in order to engage with peers in diverse disciplines and diverse areas of expertise, OLI created a free workshop program that launched in the summer of 2004.

“We invite faculty from all over the world to participate with other faculty in looking through the materials and thinking about how they might adapt this to support their instruction,” Thille says. There are two workshop tracks held during the summer. Track one, which is two days, is on faculty course use and customization. Track two, which is five days and launched last year, is on developing effective online courses using the OLI tools and processes.

Interested educators must go through an application and approval process to participate in these workshops. “We ask people to apply because we are trying to keep the workshops relatively small (about 30 people), and we want to make sure that they are truly serious about using OLI materials or about developing effective open educational resources.” Track one workshop participants thus far have come from Penn State, Kansas State University, Rocky Mountain College, the University of Texas, Georgetown University, University of Wyoming, Duke University, and many more institutions in the US and

internationally from institutions in Chile, Colombia, India, Mexico, Qatar and Taiwan.

OLI Appliance

Last summer the National Chiao Tung University in Taiwan participated in the developers workshop, which is helping them to develop mathematics and science courses in Chinese. This led to OLI staff actually going to Taiwan to install OLI’s first instance of what’s referred to as the “OLI appliance.” The OLI appliance is a server fully configured with all of the OLI course materials, development and delivery environments. It is installed on the local area network and maintained and updated remotely.

The OLI appliance was developed “to address the needs of places that don’t have great Internet access,” Thille says, adding that the OLI system eats up a good chunk of bandwidth due to it being totally web-based.

Future Directions

“There is a lot of desire, we are finding, from people who have expertise in other areas, to want to create these kinds of effective environments,” Thille explains. So, the future challenge for OLI revolves around scale - “to move this from a small scale, community-based research activity to a large scale, international activity.”

Thille claims that one of the major challenges in meeting that objective revolves around getting different learning theorists together to collaborate effectively. So, to help develop some progress in this area of concern, OLI will be hosting a

series of meetings that will culminate in a 2008 conference that will “bring together learning theorists from a variety of backgrounds, disciplines and beliefs to really focus on how we can create effective web-based learning environments.”

Another challenge, according to Thille, is keeping the feedback loops on all levels operating efficiently. “Constructing those feedback loops within the appropriate contexts, as we get more contexts and more domains, will be increasingly challenging. We have the technology, but we found that just putting those tools in the right hands does not always do it alone.”

Finally, to put all of OLI into a relatively simple perspective, both Thille and Smith offered the following quote from the late Herb A. Simon, CMU professor and winner of the 1978 Nobel Prize in Economics: “Improvement in post-secondary education will require converting teaching from a ‘solo sport’ to a community-based research activity.”

End Notes:

1. EDUCAUSE Learning Initiative, Innovations & Implementations: Exemplary Practices in Teaching and Learning, “Open Learning Initiative: Carnegie Mellon University, Pittsburgh, PA,” 2006, www.educause.edu/ir/library/pdf/ELI5013.pdf.
2. Joel Smith and Candace Thille, “Scientifically Informed Web-Based Instruction,” presented at the EDUCAUSE Learning Initiative Annual Meeting, January 2007, Atlanta, GA., www.educause.edu/LibraryDetailPage/666?ID=ELI07104.

Blackboard Report Identifies Challenges, Solutions and Variables of an Emerging Vision in Higher Ed

Blackboard has published a free report, titled “A View From The Top: Building the 21st Century Campus, A Leadership Survey on the Challenges Facing North American Higher Education.” The report is based on interviews conducted by the company’s president of U.S. higher education and its vice president of education strategy. The interviews were conducted during Spring 2006 with more than 50 “higher education leaders.” Interviewees were “a combination of chancellors, presidents, vice presidents, provosts and CIOs in the U.S. and Canada.”

The report identifies four major challenges that emerged from the interviews, as well as from additional perspectives garnered from a variety of other reports about the state of higher education. Methods and solutions for meeting the four challenges are also provided, as well as an “emerging vision.”

The four challenges – Student Engagement, Institutional Accountability, Revenue Generation and Globalization – are briefly analyzed, and the four variables – Institutional Flexibility, Student Mobility, Pervasive Technology and Return on Investment – round out the emerging vision.

The Student Engagement section takes a look at academic achievement and student services. The Institutional Accountability section is about effectively gathering a variety of evidence and data to share with “trustees, state funding entities,

“A successful 21st century university is a student centered institution, unconstrained by time and place, that operates simultaneously in a local and global context, constantly measuring and communicating its progress, and continually renewing its commitment to students, community and the economic competitiveness of the country.”

– A View From the Top: Building the 21st Century Campus

legislatures, accrediting bodies, etc., who ultimately represent students, parents and taxpayers.” Revenue Generation covers activities and strategies that increase revenues, including the “increased development and marketing of distance education courses.” The Globalization section describes how institutional efforts to become established in a global economy have become increasingly important.

The emerging vision claims that administrators, faculty, staff, alumni and students are growing into “a new institutional mindset.” The Institutional Flexibility vision takes into account that “higher education is less fixed in time, place and offerings than it was in the past and is more opportunistic, more positive about measurement and more confident.” Student Mobility means that students are no longer loyal to one brand, as they “surf life and options in the real world just as they do virtually.” The Pervasive Technology vision asserts that “technology is not optional at any level,” and that faculty have to be ready “to engage as students do.” The Return on Investment vision

claims that institutions are beginning to see themselves as investing in change, with a return, as opposed to incurring more costs.

Finally, the report offers the following definition of a successful university: “A successful 21st century university is a student centered institution, unconstrained by time and place, that operates simultaneously in a local and global context, constantly measuring and communicating its progress, and continually renewing its commitment to students, community and the economic competitiveness of the country.”

To see the full report, visit www.blackboard.com/research.

Editor’s Note: Lorenzo Associates, Inc., publisher of this newsletter, provided research, content development and editing services for the publication of this Blackboard report.

EDUCAUSE Content Available Online Loaded with Informative Perspectives for Online Educators

The latest issue of the *EDUCAUSE Quarterly* has some significant articles related to online teaching and learning that should be on every online educator's reading list.

In "Faculty Adoption of Educational Technology," Franziska Zelleger Moser, a faculty member at the Institute for Business Education and Educational Management at the University of St. Gallen in Switzerland, claims that educational technology has made only "modest inroads into changing teaching in universities" throughout Europe," as well as in the U.S. Moser refers to instances of "faculty resistance" to educational technology adoption. Through research she conducted for her doctoral dissertation, Moser offers an "adoption cycle to help tackle this complex issue of technology adoption for teaching."

In "How Students Develop Online Learning Skills," Alan R. Roper, director of administration for Cybercampus, provides seven tips from successful online students who "share their

secrets for getting the most from online classes, focusing on time management, active participation and practice." The tips were synthesized from an open-ended survey answers Roper collected from 59 graduates who took at least 80 percent of their courses online.

In "Think Small! A Beginner's Guide to Using Technology to Promote Learning," Beverly R. King, associate professor of Psychology and Counseling at the University of North Carolina at Pembroke, explains how "incremental steps toward integrating technology in teaching can pay big dividends." King's article "targets the faculty member in higher education who is relatively inexperienced in the art of teaching with technology or who has been frustrated in previous attempts because of the overwhelming number of options available."

See these three *EDUCAUSE Quarterly* articles, as well as a good number of other highly informative educational-technology-related articles, at www.educause.edu/apps/eq/qm07/eqm071.asp.

Resources from Recent Annual Meeting

Another good source of recent quality information from EDUCAUSE is available inside a newly published resources section (located at www.educause.edu/Proceedings/10917) that was created based on its January 22-24, 2007 EDUCAUSE Learning Initiative Annual Meeting held in Atlanta.

The resources website features a very rich array of session materials, including two very interesting podcasts: "K-12 Students Speak Up About Technology: Are We Listening," presented by Julie Evans, CEO, Project Tomorrow-NetDay, accessible from http://connect.educause.edu/blog/carie417/eli2007_podcast_k_12_students_speak_up/16792, and "Interview with Chris Dede on Emerging Technologies and Neomillennial Learning Styles" at http://connect.educause.edu/blog/jcummings/chris_dede_on_emerging_technologies_and_neomillennial_learning_styles/16662. Dede is a Timothy E. Wirth Professor of Learning Technologies at Harvard.

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New Website with Web 2.0 Technology Features An Aggregation Network of Open Educational Resources

The Institute for the Study of Knowledge Management in Education (ISKME) - an independent, nonprofit educational research think tank based in Half Moon Bay, CA - recently launched the OER Commons, a content aggregation network for the use and reuse of open educational resources, supported by the William and Flora Hewlett Foundation. OER has metadata and pointers gathered from open educational resources worldwide. As noted on its website, "OER Commons is the first

comprehensive open learning network where teachers and professors (from pre-K to graduate school) can access their colleagues' course materials, share their own, and collaborate on affecting today's classrooms. It uses Web 2.0 features (tags, ratings, comments, reviews, and social networking) to create an online experience that engages educators in sharing their best teaching and learning practices."

OER Commons is based on alliances with a long list providers of open educational resources, including the Berkman

Center for Internet and Society, Harvard Law School; Carnegie Mellon University Open Learning Initiative; MIT's OpenCourseWare; Rice University's Connexions, Johns Hopkins School of Public Health OpenCourseWare, and many other "individuals and organizations that have been working tirelessly to make open content for all a reality."

www.oercommons.org
www.iskme.org

Expanding the Pool of Qualified Educators through Online Learning

Drexel University Online, has added three new education degree programs to its offerings: a Bachelor of Science in Education, a Master of Science in Global and International Education, and a Master of Science in Teaching, Learning, and Curriculum.

According to the National Center for Education Statistics 2008, nationwide, 2.4 million teachers will be needed in the next 11 years due to growing enrollment and class size reduction efforts. "With a growing demand for more teachers, it is important for us to provide programs for

students to gain the knowledge and skills needed to thrive in the field of education," said William Lynch, director of Drexel University's School of Education

Drexel Online enrolls about 800 education students per year. Drexel's online B.S. in Education degree program provides a strong background and preparation for students who wish to pursue careers in human resources development, corporate training, higher education and related fields.

The M.S. in Global and International Education degree program is for educators seeking to advance

and broaden their careers. Students in this program will prepare to work effectively with complex economic, political, cultural and social contexts that influence education and learning in diverse parts of the world.

The M.S. in Teaching, Learning, and Curriculum degree program will provide options for educators to expand their professional teaching-knowledge base outside of mainstream classrooms. "The goal of this program is to provide students with knowledge related to effective instruction in a variety of educational settings," said Lynch.

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Statement of Purpose: *Educational Pathways* is a print and electronic source of information with succinct and well-researched articles about the latest developments in distance learning and teaching in higher education.

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