

# The Open Learning Initiative, Scientifically Designed and Feedback Driven eLearning

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## INTRODUCTION

The Open Learning Initiative (OLI) at Carnegie Mellon University is a new evolutionary form of eLearning that derives from a particular tradition in using information and communication technologies (ICT) to deliver instruction. That tradition is distinctive in that it is based on rigorous and consistent application of research results and assessment methodologies from scientific studies of human learning when creating digital learning environments. The tradition is, in fact, a comparatively small part of the overall eLearning landscape. ICT-based learning tools are typically driven by the mere opportunity of leveraging technological possibilities, e.g. the “webifying” traditional textbooks, campus-wide laptop requirements, and podcasting of traditional lectures, or by intuitions of individual instructors about the potential effectiveness of particular eLearning strategies, e.g. an intuition that computer-based graphical simulations of the central limit theorem in statistics will help novice learners understand the meaning and implications of that theorem. While these non-scientific strategies, especially those based on instructor intuitions based on years of experience, have sometimes produced effective eLearning interventions, the success rate is destined to be low because they are not based on well-confirmed theory about learning and they seldom are subjected to any meaningful formative or summative evaluation to provide feedback about whether and how they are working and how they need to be modified to be more effective. The general failure of computer based pedagogical strategies, especially online classes, to bring transformative change to education is evidence of the limited success of these dominant strategies. (For some arguments for over-simplistic thinking in the eLearning domain see: Zemsky and Massey, 2005)

OLI courses also occupy and extend a second distinctive niche in the eLearning tradition. That niche is characterized by using information technology as

*the primary mode for delivering instruction to novice learners.* It should be distinguished from the niches occupied by “learning objects” which tend to target the learning of specific ideas or skills (Mortimer, 2002) and by “OpenCourseWare” which provides access to digital materials used to supplement traditional pedagogical strategies (Long, 2002). We believe the niche of eLearning environments that provide a preponderance of the performance of instruction will grow in importance as the world increasingly looks to information and communication technologies to address the problem of access to, affordability of, and accountability for the effectiveness of education.

A third niche in which the OLI is embedded is the “open educational resources” (OER) movement. (Hylén, 2006) While there have been open educational resources of various kinds for a long time (everything from public libraries to the public lectures on college campuses to educational television), the advent of the Internet substantially changed the possibilities for providing open access to educational materials and instruction. MIT’s OpenCourseWare project brought particular attention and focus OERs. Today, sources ranging from the Internet Archive to Apple™ Computer’s iTunes U™ to the Universal Library to individual colleges and universities provide freely available educational materials on the web. The OLI is part of this movement in that all OLI courses are freely available to individual learners anywhere in the world. The OER movement is heterogeneous and self-organizing. However, increasingly, through the help of many individuals, institutions, and foundations such as the William and Flora Hewlett Foundation (which funds the OLI) and the A.W. Mellon Foundation, delivering open educational resources has become part of the strategic thinking of the world’s educational leaders when they consider how to meet the access and quality demands we will face this century.

## BACKGROUND

Since the advent of the computer, there have been many efforts to use computer technologies to provide direct instruction to students. The lessons delivered by the PLATO system on mainframe computers are an early, and enduring, case of using computing to provide instruction. (Sherwood, 1975) The emergence of powerful personal computers created the opportunity for colleges and universities, commercial vendors, and individual instructors to engage in development of what we now call eLearning tools. Anyone who has long worked in this field knows that most of the tools were developed when a single faculty member, who had some interest in computing, had an idea about how use technology to help students understand particularly challenging topics in their disciplines. During the last third of the 20<sup>th</sup> century, very few of these faculty and surprisingly few of the university and vendor efforts turned to the growing body of research in what came to be known as “cognitive science” to inform their designs. Also, little or no effort was made to engage in either formative or summative evaluation of most of the eLearning interventions. This is hardly surprising since there were seldom resources available to engage in such evaluation. One of the hypotheses that have driven the Open Learning Initiative is that the failure of eLearning to produce a transformational change in education is, in large part, because the efforts have not been based on research results from the learning sciences and have not been meaningfully evaluated in ways that would produce continuous improvements in the interventions. (Twigg, 2001)

Although the mainstream of eLearning work over the last 40 years has not been scientifically based or rigorously evaluated, there have been exceptions. Work on intelligent tutoring systems by a number of groups (Anderson, et al., 1989; Gertner, et al., 2000) has been based on making the computer play the role of an individual tutor for novice learners. That, in turn, required the inventors of these computer-based tutors to develop a keen understanding of how novices to the subject matter learned the various concepts and skills involved. Knowledge of these learning processes came from research in human learning, i.e. in cognitive science broadly construed. (For an example of this kind of research, see: Chi, M.T.H., et al., 1981)

Of particular importance to the development of OLI methodologies is the work of John Anderson and

his colleagues at Carnegie Mellon, which focused on understanding human learning. Their studies and theories of human cognition, including distinctions between the ways novices and experts solve problems, became the basis for designing online learning environments that would individualize feedback for students learning subjects such as computing programming and algebra. One form of these tutors is the Cognitive Tutors developed at Carnegie Mellon. (Anderson, et al., 1995) The Cognitive Tutors were heavily evaluated and continuously improved. Their success as an eLearning intervention is well documented. Work on improving the approach continues. The generalization of the lessons from this work in intelligent tutoring is not that Cognitive Tutors are the only way to use ICT to improve education. Rather, the lesson is that results from research on human learning, what we call “the learning sciences” must guide the design of educational interventions using technology in order for ICT-based learning to finally have the long hoped for transformational impact on education. Perhaps the best single source for understanding how many of in the field have come to that conclusion is 2004 U.S. National Research Council report titled “How People Learn.” (Bransford, et al., 2000)

## SCIENTIFICALLY DESIGNED ELEARNING: THE OPEN LEARNING INITIATIVE

The Open Learning Initiative (<http://www.cmu.edu/oli>) delivers scientifically designed, formatively and summatively evaluated, and iteratively improved eLearning. In these ways, it is a model of the kind of eLearning this article is about. One set of products of the OLI work is a portfolio of on-line courses in a variety of subject areas that are designed to provide a learner who is a novice to the subject all that he or she needs to master the materials presented in that course. Subject areas currently covered include statistics, engineering statistics, chemistry, French, biology, economics, and formal logic. This portfolio will be extended to cover other subject areas. The courses are not simply collections of materials created by individual faculty to support traditional instruction like most of the OpenCourseWare materials. The OLI creates online courses that fully enact instruction for a given topic so that a novice learner can acquire the ideas and skills from the OLI

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