"Beyond Early Adopter to Full Integration of Technology in the Curriculum"

A Panel Presentation from the University of Colorado System

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The core business of higher education —teaching, scholarship and research—is grounded in academic units (departments, schools and colleges) and is provided by a single resource—the faculty. Direct faculty involvement will determine institutions' success in offering appropriate technology-enhanced learning experiences to students and in managing the ever growing needs for infrastructure, resources and support. "Achieving Unit Level Vision and Commitment" was implemented by the University of Colorado to encourage academic units to undertake a systematic planning process that will stimulate several outcomes: the engagement of more faculty, opportunities for collaborative development and use of technology-based learning resources, a coherent plan for determining the appropriate fit of technology within the overall curriculum, and recognition of the needed equipment, support and training resources to support faculty and students. One anticipated byproduct is that units will better understand the "total cost of ownership" of a technology-enhanced curriculum.

Achieving Unit Level Vision and Commitment to Technology

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Since 1995, the University of Colorado has invested special funding in one-time, pilot projects to encourage faculty use of technology in teaching, learning and research. These pilot efforts, while successful as independent course activities, are at risk since they lack any unit-wide support or shared use by other faculty within the unit. Moreover, the independent nature of these "pilot" efforts do not ensure that all CU students will have opportunities to develop important skills and knowledge of technology.

In 1999, the University of Colorado System Office issued a challenge to its four campuses to identify units (departments, schools, colleges) willing to undertake a systematic planning process to integrate technology into the curriculum. Ten projects were selected to participate in the " Achieving Unit-Level Vision and Commitment to Technology" initiative (http://www.cu.edu/VPAAR/6.technology/techinitiatives/unitlevel/index.html). The ten projects are spread across CU's four campuses (Boulder, Colorado Springs, Denver, Health Sciences Center) and across disciplines (medicine, geography, linguistics, astrophysical and planetary sciences, physics, sociology, languages and cultures).

The focus of the initiative is to encourage academic units (departments, schools, colleges) to undertake a systematic planning process to integrate technology into the curriculum. It is intended that this unit-level approach will stimulate several outcomes, including the engagement of more faculty, opportunities for collaborative development and use of technology-based learning resources, a coherent plan for determining the appropriate fit of technology within the overall curriculum, and recognition of the needed equipment, support and training resources to support faculty and students.

One anticipated byproduct is that units will better understand the "total cost of ownership" of a technology-enhanced curriculum, including the needed resources to sustain new technology-based approaches to teaching and learning. Campuses and the System Office will be better informed about future information technology infrastructure and services needed to support academic programs.

For the Educause Annual Conference, a faculty panel representing three of the pilot projects – ***School of Medicine, Astrophysical and Planetary Sciences, and Geography*** -- will discuss how this strategic, unit-wide approach will impact student learning, faculty roles and relationships, technology acquisition decisions, training and faculty development needs, and campus-wide IT planning.

Promoting Integration of Informatics Competencies across the School of Medicine Curriculum

Rick Forsman, Director, Dennison Library
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The University of Colorado Health Sciences Center's (UCHSC) School of Medicine has taken strategic steps toward adopting a new view of learning by infusing information technology and related skills into its entire curriculum. In 1998 the Association of American Medical Colleges (AAMC) released a set of suggested informatics competencies that will be essential to the future practice of medicine. Based on recommendations from an internal ad hoc committee, UCHSC's medical school reorganized its large curriculum committee, creating a permanent informatics subcommittee aimed at fostering adoption of the AAMC competencies. This subcommittee has focused on identifying and addressing issues that hinder faculty in embracing information technology in their teaching. Using seed funding from the President's Office, the subcommittee is implementing a variety of methods to accelerate the incorporation of information management skills into the full breadth of the curriculum.

In seeking to educate physicians who can practice within an environment replete with and dependent upon advanced information technologies, the School of Medicine is pushing forward on a range of **key issues**, including the following:

1. The underlying goals of the entire curriculum must be updated to reflect the pervasive and essential impact of rapidly evolving information technologies.
2. All graduates must attain minimal computing and information management competencies to practice in this new and volatile health care environment.
3. Some faculty members lag behind students in their knowledge of informatics and the use of technology. Behaviors within the sociology of medicine are complex and highly resistant to modification. Faculty reward systems do not currently foster innovation with technology.
4. The implementation of new technologies and their use depend on the cooperation of many players across the campus, which requires changes to the past culture of political and decision-making autonomy for academic units.
5. Many students still arrive with the expectation that one configuration of computer hardware and software will suffice over four years or that the school will be able to tell them in advance exactly what they will need to buy 2-3 years ahead. This is unrealistic as technologies and the curriculum evolve in a fluid fashion.

Strategies being implemented:

A. Building from pilot and demonstration projects, the School is integrating informatics skills throughout the educational continuum, not just at isolated points or in a few courses. Special funding for pilots has accelerated participation.
B. In reality, all campus graduates should possess the same set of baseline informatics competencies. The School is devising models that other schools can emulate or that may result in an inter-professional approach.
C. In conjunction with other efforts to identify the 'total cost of ownership,' the school is defining methods of projecting and budgeting for the multi-year needs and costs it must accommodate over time.
D. Painful experience has convinced us that we must focus on the use of only one or two software products that provide online course management.

Information Technology Tools for Introductory Astronomy

Fran Bagenal, Professor, Astrophysical and Planetary Sciences
University of Colorado at Boulder

Approximately 1100 students take introductory astronomy courses per semester. These courses are designed for non-science majors wishing to fulfill the natural science requirements of the College of Arts and Sciences' core curriculum. The large and impersonal introductory classes we must offer do little to change the fundamental disaffection that many students feel for the sciences. Introductory astronomy courses provide an opportunity, perhaps the last in their formal education, to enhance the science literacy of CU students.

The pedagogical goals of teaching introductory astronomy are: (1) to instill an appreciation of astronomical structures and scales, from planet Earth to distant galaxies, (2) to develop an understanding of science as a continuous process of coupling experimental and theoretical inquiries, and (3) to enhance quantitative reasoning skills.

How can technology enhance learning in such courses? The current lecture format is economical for the University but is inefficient for learning. Online materials are particularly effective at engaging students – either by offering the latest exciting images and results which are not available in textbooks, or by allowing students to explore the topic at their own pace and test their understanding as they proceed. Within a decade one can imagine courses being taught in computer 'studio' classrooms with no more than 70 students sharing 35 computers, arranged so that classes can integrate short lecture presentations with hands-on activities. In the meantime, we have to consider ways of moving towards a more student-based learning environment within the constraints of large lecture halls. To facilitate such a transition, the Astrophysical and Planetary Sciences Department is galvanizing its teaching efforts by building a set of tools for Introductory Astronomy.

The project objective is to provide resources for the whole department without restricting the individual faculty's choice of content or style. The project will build three types of web-based tools: tools for study, tools for lectures, and tools for assessment.

The ***Tools for Study*** will build on existing web-based modules created by individual faculty; these resources will be expanded to include student learning modules and self-assessment tools that faculty can incorporate in their courses. An example from The Solar System can be found at http://dosxx.colorado.edu/~atlas/sess25.1.html and from Stars and Galaxies at http://cosmos.colorado.edu/astr1120/

The ***Tools for Lectures*** include the development of a searchable database of astronomy and physics demonstrations and a "best practices" guide on increasing active learning (e.g. the Mazur technique).

The ***Tools for Assessment*** will provide resources that allow faculty to efficiently construct effective means of assessing student learning, primarily by creating a database of homework, quiz and exam questions that emphasize concepts and processes rather than facts.

Since these introductory courses are designed for non-science majors, it is hoped the resulting student-based learning environment will not only enhance science literacy and quantitative reasoning skills but also instill a long-term appreciation of the scientific process.

Vertical Integration of Technology into the Geography Curriculum

Barbara Buttenfield, Associate Professor, Geography
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Departmental Vision on Teaching And Information Technology

The intention in bringing information technology into our classrooms is to enrich the classroom experience, to nourish the students, and to give them understanding and skills to continue that process on their own. Information technology can be integrated into the classroom in two ways. "Teaching about information technology" refers to classes emphasizing information technology concepts and skills. The primary focus is on the nature of the information and the mechanics of the technology. "Teaching with information technology" refers to classes emphasizing specific aspects of geography, climate, hydrology, etc. The primary focus is on the environment, and the information technology provides a mechanism to learn.

Recent advances permit us to take information technology anywhere we want. We apply information technology in GIS, digital cartography, remote sensing, and spatial modeling. Information technology helps students develop analytical skills, computational skills, critical thinking skills, and visualization skills. However, classroom experience within the Department of Geography has shown that student computer skills are uneven and can create a situation where technology becomes an impediment rather than an asset to learning.

The Department of Geography has designed a vertical approach to integrating technology into the geography curriculum at CU-Boulder. The primary objective is to implement a coordinated set of software tools taught at freshman through senior level courses in physical geography in order to make the use of technology "transparent" to students so they can concentrate on the subject material. At the freshman level, two labs will introduce students to the web, its data resources and manipulation of that data. Mapping our Changing World, a 2000 level course that introduces students to mapping techniques and GIS, was redesigned to emphasize Internet access to spatial data and mapping software. The class is intended to let students gain confidence and independence not only in searching for online resources but also in deciding which resources are most current, most valid, most reliable and informative. A capstone course at the sophomore level, to be required of all geography majors and offered to students outside of the Geography department, is being developed to provide the continuity of instruction in technological formats used in later courses.

A Showcase Project: "GIS for the Rest of Us"

Earth scientists in many units on the CU-Boulder campus have an interest in GIS technology but have not developed the technical resources or expertise to set up and maintain the application software. This project will implement Internet-based data delivery software with embedded GIS capabilities, to deliver GIS training modules and student assessment tools on the Internet, and to test these in several undergraduate geography classes.

The GIS training modules are based on a common data set describing the topography and hydrology of a watershed on Niwot Ridge, an alpine study site about 30 miles from Boulder and near the Continental Divide. Since much of the water stored in the snowpack is eventually used as drinking water for city residents, it is important to know the expected runoff volume each spring and summer. City officials use snowpack models to plan for community water use. The modules take students through prototypical tasks required of professional environmental analysts to enter GPS field measurements of snowdepth into a GIS, create a digital terrain map, and model snowpack depth, so as to predict the availability of Boulder's drinking water.

Two modules are designed to enter snowdepth field data and to model terrain; a third module modeling snowdepth with terrain and landcover is nearly complete (http://peking.colorado.edu/mercator/atlasdocs/atlas/index.html). Online logging tools are being deployed to monitor student performance and refine the modules. These modules will be tested for usability in lower division courses in Fall 2000, and also critiqued for interface design by upper division classes in Map Design and GIScience.