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Challenges in Using Technology for theImprovement of Undergraduate Education

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Opportunities provided by new technologies such as the Internet and World-Wide Web, CD-ROM data bases, multimedia presentations, and other instructional uses of computers require considerable reflection and debate as to whether, and under which conditions, they will enhance the quality of learning and teaching. This essay begins to address this issue, but it does not include some topics, such as cost-related issues and substitutions of technology for faculty, treated in a larger paper (cited at the end).

How will technology improve undergraduate education? The claims for using technology to enhance education are considerable. For example, Niemi and Gooler (1987) note the following benefits of information technologies for learning outside the classroom: increased access to learning opportunities, access to more and better information resources, availability of alternative mediums to accommodate different learning strategies, increased motivation to learn, and, potential for both individualized and cooperative learning. In a similar vein, Massy and Zemsky (1995) contrast the potential benefits of information technology-based (IT-based) teaching and learning with the "traditional handicraft mode of education." In their view, IT-based teaching and learning has distinct advantages:

- Provides access to enormous quantities of information available through the Internet and on-line databases;

- Eases the limits of time and space for educational activities;

- Brings the best lecturers to students via multimedia so that "those of the best will drive out those of the merely good" (p. 3);

- Enables self-paced learning, sensitivity to different learning styles, and continuous assessment of progress;

- Makes the teaching and learning enterprise more outcome-oriented, which enhances the ability of institutions to stimulate experimentation and innovation;

- Increases learning productivity, especially in areas of "codified knowledge and algorithmic skills" (p. 4); and,

- Empowers students to have greater control over the learning process and benefits associated with active learning and personal responsibility.

In examining claims such as these, it is important that we not confuse access to information with either education or the ability to use information wisely, and we must consider three hidden assumptions.

Hidden assumptions in claims for the learning benefits of technology One assumption is that information and knowledge are synonymous, that is, if one has access to and acquires information, one possesses knowledge. In the broad view, information encompasses data, facts, opinions, hypotheses, beliefs, concepts, problems, procedures, and ideas. In order for information to become knowledge for students, it must be transformed and become meaningful through human interaction. In this sense, knowledge is not something external, to be imported directly; rather, knowledge is constructed as meaning and in relationship to an individual's understandings and experiences. A second assumption hidden in many arguments for using information technologies is that providing information is equal to providing education. Even if information and knowledge are treated synonymously, which they should not be, is it

reasonable to limit one's view of education as providing information? In Bloom's Taxonomy, for example, recall objectives are most directly related to providing information. What about other objectives that require students to apply, analyze, synthesize, or evaluate a concept, principle, practice, or method? Moreover, how does providing information accommodate learning objectives that focus on intellectual skills or ethical values? Student development would be short-changed if learning objectives were limited to recall and comprehension within the view of "education as providing information."

A third hidden assumption is that more information results in more learning. New information technologies, accompanied by multimedia capabilities, theoretically bring "a world of knowledge" to the student. Information, as content or subject matter, is essential for learning. However, for many learners, especially novices in undergraduate education, more information has the opposite learning effect: paralysis by overload. Quantity of information is less important than appropriate content for given objectives, students, and their learning processes. More information can result in less learning.

The assumption that more information results in more learning often is accompanied by the expectation that students interact in some meaningful way with rich information to produce new learning. However, interaction (or active engagement) by itself is not sufficient for student learning; purpose and quality of effort also are necessary. These three assumptions often are used without a sufficiently complex theory, explanation, or set of practices whereby technology-based information is a resource in learning processes that develop particular knowledge, skills, and values. Ericksen (1985) stated the case in this way:

The stimulus source of information is not a critical element in comparison to the meaning students give to a presentation, the feelings aroused, and how knowledge is used to satisfy curiosity and solve problems. The effective use of various options for presenting information puts pressure on the teacher to probe the meaning and implications of a unit of knowledge, to be a mentor in learning and in the forming of value judgments . . . . (p. 39) Both substantive knowledge and intellectual skills are required to search, locate, make

sense of, and use information for productive (and intrinsically valuable) learning and teaching.

Is the effective use of technology dependent on a paradigm shift? Beyond broad policy concerns, prospects for incorporating technology into undergraduate education are influenced by the way faculty and students think about teaching, learning, and the role of technology. Some have questioned whether the fuller uses of new information technologies can be realized without a paradigm change toward learner-centered, interactive, outcomes-oriented instruction. Such a shift requires new role definitions for both faculty (teachers) and students (learners).

A related but different concern focuses on expectations for students. Do we expect students who use new information technologies to pursue independent and self-directed learning? If so, which "learning to learn" capabilities do we assume students possess? Or, do we design instructional programs that help students use technology to develop their learning knowledge, strategies, skills, and motivations?

Some additional problems and limitations in using technology Verduin and Clark (1991) also suggest caution in assuming that benefits such as those noted above will be fully realized: *It is easy to wax rhapsodic about the future of educational media, predicting that there will be a workstation or hypermedia system in every den and that a plethora of telecommunications carrier systems will make possible virtually instantaneous audio, video, and computer communication around the world. The problem with such a rosy scenario is that only a small portion of the world's population will be able to afford such services. (P. 207)*

They would seem to agree. Consider the following technology issues, problems, and limitations they address for out-of-classroom learning: access and equity, quality of materials and programs, developmental costs, standardization, obsolescence, lack of human contact and interaction, and, continuous need for training. As Niemi and Gooler (1987, p. 107) conclude, "empowering people to understand and use information resources and technology is one of the major challenges confronting instructional designers and distance educators."

Conditions for the successful use of new information technologies Experiences of the California State University System (e.g., Baker, 1994) and other institutions strongly suggest attention to conditions for successful technological applications. The following should be carefully considered:

Workshops, seminars, demonstrations, and travel resources that provide faculty with opportunities to examine and exchange viewpoints about the roles of technology.

Time and support for faculty to adapt existing instruction and develop new instruction suitable for technology-based instruction.

Faculty development and hands-on experiences in becoming proficient in the technical aspects of using technology and distance communications.

Adequate recognition and reward systems for teaching with technology and in distance education programs.

Infrastructures and technical support in place and working well.

Serious study of student markets, programs, and courses that are best suited for distance education

Developing an institution's distance education capabilities and the availability of high-quality materials.

Making sense of technology: A conclusion and an introduction Recent literature on technology for education often uses numerous broad categorical terms somewhat indiscriminately and interchangeably. Some of these terms include educational media, communication technology, information technology, and educational or instructional technology. Consider three different uses of the term "technology":

(a) tools, including hardware, software, and systems or networks that are used in teaching and learning, but which are merely

instruments or vehicles void of substance;
(b) know-how, including methods and procedures that are used in teaching and learning processes; and/or
(c) "intelligent" tools, with knowledge components that provide interactive (and, sometimes, adaptive) instruction without external intervention.

Whether technology is treated as tools, processes, or both (which is the perspective taken here), other essential elements in a teaching-learning system must be accounted for. These missing elements and the questions they address include: students and teachers (who?); goals and objectives (why?); subject matter or content (what?); time (when and how long?); settings (where?); and outcomes (with which results?). A technology of instructional design, based on knowledge of teaching and learning within particular contexts, is often overlooked when notions of technology focus on tools and/or methods for instruction. This larger framework is necessary for assessing whether, and under which conditions, technology improves undergraduate education. What seems critical here is the need to adapt technology to learners, rather than to adapt learners to technology (Gooler, 1987). This might be accomplished through different mixes and matches of technology based on individual circumstances. As Cross (1976) argued, we must move beyond access concerns ("education for all") to concerns for the quality of education individual students experience ("education for each"). With a major emphasis on technology, do we have the knowledge, experience, resources, will, and wisdom to accomplish this goal?

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To obtain an electronic version of the paper, "Using Technology and Distance Instruction to Improve Postsecondary Education," the address is: http://www.uni.edu/teachctr/technol2.htm 21, 82-85.