Teaching and Learning with Technology at NC State University:

A Research Approach

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Abstract

NC State University's quality enhancement plan for reaffirmation of accreditation calls for evidence of the impact of technology on student learning. One campus program to bring technology into the classroom is the ClassTech Pilot Project. A review of the literature and preliminary survey data suggest approaching the evaluation of the ClassTech Pilot Project by engaging in the scholarship of teaching and learning projects.

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NC State University's quality enhancement plan, Learning in a Technology-Rich Environment (LITRE), was designed to improve student learning. One goal of the LITRE plan involves using results of many different investigations to scale successes and inform decision-making. Some of the decisions are related to the ongoing improvements of the physical learning environment in order to have well-equipped classrooms and support. The ClassTech Pilot Project is one LITRE effort to improve the physical learning environment through installation of information technologies in campus classrooms for instructors' use. Besides determining degree of use, LITRE's goals for the ClassTech Pilot Project include assessing how specific technology configurations affect teaching and help students achieve outcomes (NC State University, n.d.).

Through investigations answers to a range of questions about the ClassTech Pilot Project can be determined. One kind of question is practical: "Do instructors teaching in the ClassTech rooms use the information technologies"? Easily obtained answers help make decisions about future infrastructure installations. Another kind of questioning seeks information about abstractions: "Is student learning affected by instructors using information technologies while teaching in the ClassTech rooms"? Obtaining that answer is not as easy as it is for the practical question. Other questions tap instructors' course objectives, their student outcomes, their methods of evaluating student learning, or ways they use the technologies. The required continuous, innovative, and thoughtful investigations are challenging for all but the practical questions.

Undertaking the challenging investigations involves two important considerations. The first is to consider what is already known about the impact of information technologies in education. The second is to consider what is known about how research about information

technologies and learning can be conducted in education. It may be risky to discuss the effects of information technologies on learning and education in broad terms. Referring to a study of the effects of distance education might be perceived as not relevant to the ClassTech Pilot Project questions. But the take risk is taken because the ClassTech Pilot Project is about a broad issue: the impact of information technologies on learning at NC State University. The same rationale is offered for discussing broadly about research in education.

The Impact of Information Technologies in Education

In 1999 Thomas Russell of NC State University introduced an annotated bibliography of comparative studies showing no significant difference in the effects of technologies on education, particularly distance education. Russell offered, however, an optimistic interpretation of these studies:

> These studies tell me that there is nothing inherent in the technologies that elicits improvements in learning. Having said that, let me reassure you that differences in outcomes can be made more positive by adapting the content to the technology. That is, in going through the process of redesigning a course to adapt the content to the technology, it can be improved. The mere process is where the difference lies. (p.xiii)

Course redesigns involve adaptation of the content to the technologies, or lack thereof, and making decisions about course objectives, purposes; student learning outcomes; methods of evaluating student learning outcomes; and the means to the ends. The means usually refers to the teaching. The ends usually refers to learning, or education. But, measuring ends to compare the effectiveness of means is not as simple as articulating the course redesign process. There are no common definitions of neither learning nor standard evaluations of student learning outcomes to incorporate into an investigation. The difficulties may be circumvented by approaching the

effectiveness of means through investigations of students' attitudes toward the use of technologies in instruction (Mitra, 2002), or students' and faculty members' perceptions and preferences about using technologies (Gustafson, 2003-2004, Young 2004). No doubt attitudes, perceptions, and preferences enter into the means to ends process in, so far, ill-defined ways. Efforts to measure them would not, however, provide solid evidence about the impact on learning to advise educators on infrastructure and on incorporating information technologies in the course redesign process.

Focusing on goals, purposes, or functions of education – that first step in a course redesign process – might provide guidance toward measuring differences in outcomes. In 2004 Detweiler suggested taking a similar point of view. Although he referred to information technologies as having three "relatively inconspicuous but important" (p. B8) impacts on learning, his references are to broad, difficult to argue with, impacts. The three impacts are: increased ease in accessing information; students' familiarity with, consequent readiness, and willingness to use technologies to collaborate with others; and increased amount of information. Because specific learning outcomes are not targeted, there is less need to focus on means (lectures, laboratories, fieldwork, for example). "Instead, we can focus on the function of higher education. What purposes, what outcomes are we pursuing"? (p. B8) From Detweiler's point of view, broad goals lead to broad outcomes. Not focusing on means may make decision-making more difficult.

Once general purposes are established, information technologies can be viewed as having a role in the course redesign process. But that role is not going to equate to the means. This point may sound like the familiar advice to not let technologies drive teaching and consequently ignore pedagogical principles. Under those circumstances the consequences are undesirable.

There is evidence that students respond negatively to the misuse or ill-use of information technologies (Young, 2004). Negative responses do not, of course, equate to no learning or bad learning. As mentioned already, attitudes, perceptions, and preferences also contribute to the means to ends process. But, there is more to it than simply using technologies. Burbules and Callister (1999) explained by offering three views. Information technologies may be viewed as a panacea that "can revolutionize education as we know it" (p. 105), as "tools that can be used for good or bad purposes" (p. 106), or as "nonneutral" in that "every technology carries within it certain tendencies of how it is likely to be used and shapes the conception of purposes to which it can be put." (p. 106). The first two views were not recommended. Ascribing to the third view implies that the relationship of means to ends is to be seen "not as a given but as itself a particular way of thinking, one subject to criticism like any other." (p. 107). Thus, one's thinking about purposes can change. Burbules and Callister suggested thinking of costs and benefits as "imperfect approximations" and considering those good and bad aspects of the process. They offer the following advice:

> The blanket approach of trying to weed out the bad while retaining the good cannot take into account the complexity of learning and knowledge, and the diversity and diverse needs of learners. Rather, this is the educational challenge: helping students learn to operate in an environment that is inherently "dangerous," to deal with what may be unexpected or unpleasant, to make critical judgments about what they find. Such a task cannot be framed as simply sorting out the good from the bad and excluding all that is bad. Educationally, we need some of the bad to create some of the good. (p. 111)

This advice about making decisions about information technologies leads back to the beginning of this paper. A range of questions can be asked about the ClassTech Pilot Project.

Whether or not the equipment is used, and whether or not the attitudes toward use are favorable, can be determined. Clearly, answering questions about the impact of information technologies on learning is not as simple. To determine the impact on learning requires answering several questions: "What are the goals or purposes of higher education at the institution?" "What are the specific goals for a course"? "Are student learning outcomes aligned with course objectives"? "What are the implications of choice of means by which the ends will be achieved"? Embarking on investigations to answer these questions requires a tailored research agenda.

Research about Information Technologies in Education

In his presentation of unresolved challenges related to digital education, Reeves (2003) listed two that are pertinent to the ClassTech Pilot Project. One challenge he termed "The Poverty of Pedagogical Innovation." Recall Russell's (1999) point that the course redesign process, as the means, makes the difference in the ends. Reeves' interpretation of some of the informational technologies literature was that few faculty innovatively incorporate technologies to support learning. The second challenge he termed, "The Assessment Dilemma." Evaluations of student learning (what we have been referring to as the ends) are inadequate for tapping into what he believed students must learn. That is, "how to generate original solutions to unique problems . . . frame and resolve ill-defined problems." (p. 11-12). Although Detweiler (2004) suggested rethinking purposes, and Burbules and Callister (1999) suggested focusing on the implications of means to ends, neither outlined how to approach the recommendations deliberately and systematically. Reeves (2003), however, offered a research method that could be employed to answer the complex questions posed about informational technologies within higher education. The scholarship of teaching that he recommended is referred to by any of

several terms: "development research," "use-inspired basic research," or "design experiments." These methods differ primarily in label. They tackle complex problems through collaborations with practitioners in the contexts where the problems lie. Stokes (1997) described this kind of research, specifically "use-inspired basic research," in his book, *Pasteur's Quadrant*. The research expands the more traditional linear approach of differentiating basic from applied research. It addresses whether or not research considers useful outcomes, and whether or not there is a search for understanding without application. The quadrant named after the microbiologist researcher, Louis Pasteur, characterizes research that seeks use along with fundamental understanding.

Lagemann (2000) described the research method slightly differently for the education realm. She pointed out that there are studies designed to make intelligent decisions and studies designed to discover new ideas and relationships. She wrote that "[u]nless both types of inquiry are pursued, and pursued in close relationship to one another, efforts to better understand education and to improve it over the long haul will not be advanced. (pp. 243-244)

Currently the pervasive interest in the scholarship of teaching and learning promotes directives like Applegate's (2001):

> To take the scholarship of teaching and learning seriously is to understand that teaching is a means to an end, and that end is to engage students on and off-campus in active learning. It is not enough to simply be a good teacher. Scholars of teaching are committed to experimenting with new practices, assessing those practices, engaging in peer review, and sharing those practices with the teaching community so that their own teaching improves as does the practice of teaching generally. (p. 2)

The straightforward questions about whether faculty use the technologies in the ClassTech rooms, are satisfied with them; are satisfied with the technological support; or whether the students' reports of instructors' use corroborate can guide decision making about maintaining current and future installations of more technologies. The first wave of data indicated high satisfaction levels.

Informal discussions with instructors who taught in the ClassTech rooms revealed that they did not approach their teaching by redesigning their courses. Some recognized that it was easier to present information because the technologies were available. Some believed that the ease with which information could be presented in the classroom elevated their enthusiasm. Their enthusiasm then transferred to the students and the students were more interactive. Instructors did not, however, prepare new objectives, student learning outcomes, or evaluations of student learning. Investigation into the effects of means to ends is not possible without mechanisms to compare courses without the technologies to courses redesigned for technologies. During the entire means to ends process a thoughtful and speculative consideration of costs and benefits as well as good and bad outcomes must be incorporated. Such investigations could be undertaken through collaboration among professionals in several of NC State University's units: for example, the Information Technology Division, the College of Education, the Office of Student Affairs, faculty development units, and Fiscal Affairs.

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