

EDUCATIONAL REFORM AS INNOVATION DIFFUSION: DEVELOPMENT OF A  
THEORY AND A TEST OF A MODEL USING CONTINUING PROFESSIONAL  
DEVELOPMENT AND INSTRUCTIONAL TECHNOLOGY

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University of Alberta

It must be remembered that there is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old institution and merely lukewarm defenders in those who would gain by the new ones.

--Machiavelli, 1513

The big story in the field of information technology for education and training is not what marvelous new technology we educators now have available at our fingertips. The big story is the slow takeup of this technology and the challenge this poses for educational managers.

--Mitchell, 1992

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# EDUCATIONAL REFORM AS INNOVATION DIFFUSION: DEVELOPMENT OF A THEORY AND A TEST OF A MODEL USING CONTINUING PROFESSIONAL DEVELOPMENT AND INSTRUCTIONAL TECHNOLOGY

## Abstract

Societies are engaged in a massive reformation in how we handle and use information. This represents one of those rare major revolutions on a scale comparable to the printing press, industrial revolution, and electricity. The information communication technology revolution (ICT) promises to disrupt nearly every corner of societal functioning. A subset of the ICT revolution employs digital data specifically to promote instruction and training and is called instructional technology (IT). Although IT has been around for nearly four decades, it continues to be under-used, relative to expectations, and it is not as yet a major factor in the process of educational change and reform. This in spite of the vast financial and human resources directed toward IT research and development. The author argues this situation has derived from a poor understanding of the process of change and reform. To remedy that problem, a new theory of change was developed and applied to the diffusion of IT. This theory is premised on the belief that IT represents a sophisticated innovation and the diffusion of innovation must be understood before we can successfully bring about any change and reform. The first part of this paper presents this theory of change which has been distilled from the literature on innovation diffusion. The second part documents a working model, based on this new innovation diffusion theory, which was created for reform in post secondary education. Finally, the system was applied at a major research university and results documented in a qualitative research study. The preconstructed and emergent thematic results are reported, along with implications for the theory and suggestions for future research directions.

## Overview

Modern society is in the midst of several converging forces related to this endeavor. First is the information communications technology (ICT) revolution and its related offspring, the instructional technology (IT) revolution which uses technology for instruction and training. A concomitant of the trend from a manufacturing and agrarian

society toward a service society is the increased need for education and training. Finally, there are the myriad call (not so new really) for reform of education which will prepare students for future roles in the society.

How are these forces developing and how do they relate? It has been argued that more education and training to can be accommodated by IT and the match can be driven by forces of change. The traditional approach to meeting increased needs and opportunities in education demands significantly greater investments in human resources. However, developing countries are unable to afford basic education for the majority of their populations, and developed countries are busy trying to place a spending cap on labor-intensive industries or to divest entirely through privatization.

An alternative has been proposed: to employ IT to supplement or supplant conventional forms of instruction. Part of the rationale for this suggestion has been spurred by the substantial gains in productivity from ICT and the studies which have shown that IT is a factor in increasing or maintaining achievement and attitude; increasing access to learning opportunities, and of increasing learning efficiencies (Szabo, 2001).

IT seemingly provides a powerful solution. However, studies show that IT is being used quite sparingly in education and to date has had little impact on catalyzing the reforms needed to make further headway in meeting the learning needs of society.

Why is progress in this area so slow? Huge sums of money have been committed to the visible infrastructure to support IT learning, including computers, networks, and peripheral devices to play and produce multimedia elements. Workshops have been held to train how to use the tools of IT and applications to curriculum, instruction and evaluation. Governments and corporate bodies have exerted pressure to move more rapidly into IT via grants, policies, procedures and other incentives. Funding for start up projects seems to be available in abundance.

This project hypothesizes that the lack of significant progress is caused failure to apply a valid theory of change and reform. History clearly tells us that new technologies spawn new social systems (sociotechnological systems) which demand significant changes in peoples' behaviors. Unless change theory is an integral component of

diffusing a sociotechnical innovation, key outcomes will continue to be thwarted or completely negated.

This project began with a search for powerful change theory and progressed to studies of the history of the diffusion of innovation. It led to the development of a new theory of reform, which was used to create a system of change for a particular application, that of a research university. The change system was piloted and evaluation data gathered which would inform the theory as well as the system.

In summary, there are four key assumptions on which this project is based.

1. Education and training are increasingly important to developing and developed societies and can and should be improved.
2. A radical restructuring is advocated over a system of minor adjustments.
3. Instructional technology (IT) with its deep links to the ICT revolution can play a major part in this revolution.
4. A theory of reform based on the diffusion of innovation is needed and can provide a solid basis from which to launch and sustain this revolution.

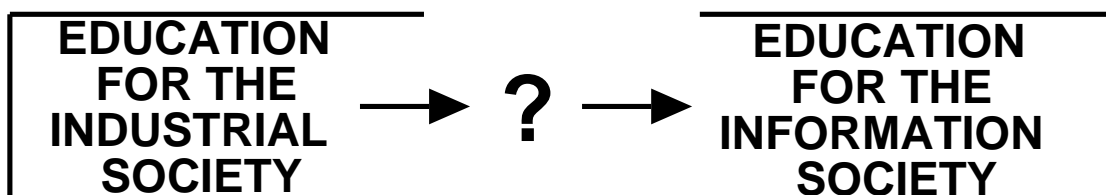
#### Problem Statement

Instructional technology is experiencing massive growth in U.S. higher education. In 2000-2001, American colleges allocated a record \$3.3 billion for administrative and academic hardware and software, an amount that is up 13 percent over last year, as reported by the Dun and Bradstreet Corporation (Olsen, 2001). The number offering Internet access in their libraries reached 100 percent this year, and distance education programs were in place at more than two-thirds of all colleges and universities. The institutional budgets of schools surveyed went up 2.5 to 3 percent, with instructional technology allocations increasing 12 percent on average (Olsen).

Seventy percent of the more than 4,000 two- and four-year U.S. colleges provided online courses last year, a 22 percent rise since 1998 and web based e-learning is the most common form of distance education. International Data forecasts that 2.2 million college students will take part in distance learning courses in 2002, compared to 710,000 in 1998 (InformationWeek [sic] Online, 2001).

Despite a huge investment by American higher education in the past 15 years (Green, 2000), a relatively small percentage of faculty use instructional technology and very few have deeply imbedded it into their curriculum. Numerous technologies from television to multimedia which have been hailed as tools to revolutionize education all have fallen far short of those promises.

Society in general and education specifically are undergoing fundamental changes which are at the same time vast, confusing, and unparalleled since World War II. These changes are largely brought about by many factors but are certainly not possible without the concomitant computer and information technology surge. Paradoxically, the technology may play a major role in settling the changes. We live in a transitory period between an industrial society, where schools evolved to prepare people for the industrial society, and an information society. What should schools look like in order to prepare society for the information society, and how do we make the transition?



The author has observed major changes hardware, software, courseware, communications, people, and learning theories during his three decades in the field of IT. But there are two trends which have remained unchanged. First, the number of educators who use instructional technology courseware has not changed risen above that expected of early adopters found in any organization (Rogers, 1995). Second, education continues to elude major changes or restructuring of educational practice related to instructional technology. The dominant mode of instruction today continues to be the self-contained classroom in which one instructor meets face to face with a group of learners and engages heavily in CHAI (chalkboard assisted instruction).

It is the author's contention that most attempts at reform through IT fail because the emphasis is placed on such relatively easily addressed factors as money, infrastructure, attention, training, professional development, growth of associations, at the

expense of ignoring or underestimating that part of the process which deals with change per se. More specifically, this work is based on the premises that IT is a disruptive and innovative technology and any reform attempts will not succeed unless they pay significant homage to the process of changing peoples' behaviors as a major component of the effort. This project began with a study of the history of successful and unsuccessful diffusion of innovations.

### Peoples' Behavior is Hard to Change

Etzioni observed "We are now confronting the uncomfortable possibility that human beings are not very easily changed after all." (Etzioni, 1972, p 45). He went on to state

The contention that personal growth and societal changes are much harder to come by than we had assumed, especially via one version or another of the educationalist-enlightenment approach, is not a joyful message, but one whose full implications we must learn to accept before we can devise more effective social programs. (Etzioni, 1972, p 47).

Individuals and institutions have a natural and rational reaction to anything disruptive and innovative; they resist it in order to preserve the comfortable systems they worked so long and hard to build. Conventional approaches to reform ignore or are unable to deal with the important aspect of professional development of human behaviour. Countless reform efforts are built on the theme "Build it and they will come." History shows this to be a successful movie theme but largely a myth. In addition, there have been many over zealous proponents of innovation who, without a grasp of history, have made inaccurate and misleading predictions about the impact of innovations. In the next section, we shall concentrate on change and reform in the educational field.

### Educators' Behavior is Hard to Change

"But why do so many of the promising and highly touted innovations fade into obscurity or later face ridicule?" (Alexander, Murphy & Woods, 1996, p. 31). In spite of the fact that most innovators pursue change for valid reasons, not simply for the sake of change (Smith, Kleine, Prunty, & Dwyer, 1986), most reforms do not succeed (Goodlad, 1984; Berman and McLaughlin, 1976; Leithwood & Montgomery, 1982). In some cases,

reform fails due to major social change (Smith, et al., 1986). Rossman, Corbett and Fireston (1988) observe that adults are experts at pretending reform is taking place without vesting any ownership in the process, especially when there are implicit sanctions against changing. Presseisen (1985) analyzed eight major reports created to address (American) educational problems which have been widely publicized (Allen, 1992; Coombs, 1985; Finn, 1991; NCOEIE, 1983). She concluded none of them proposed any serious innovation, simply adjustments to the current way of doing things. School districts undertake innovation under circumstances of unclear goals, unpredictable technology, and uncertainty in general (Morris, 1997).

Reform in education is as problematic as reform in other fields. It is becoming clear that the sociological issues associated with change and reform must be addressed on a level with that of the innovation itself.

### Instructional Technology Reform in Particular

Prominent leaders in the field of IT and school reform have offered their observation- and research-based opinions.

This persistent dream of technology driving school and classroom changes has continually foundered in transforming teaching practices. Although teachers have slowly added a few technologies to their repertoires, techno-reformers have seldom been pleased with either the pace of classroom change or the ways that teachers have used new machines.” “patterns of teacher use similar to those that accompanied earlier technologies billed as revolutionary seem to be recurring: a small cadre of determined users amid a large majority of casual and nonusers. (Cuban, 1996).

Until we reform our conceptions of learning, technologies will continue to be delivery vehicles and not tools to think with. In that capacity, they will have little substantive effect on education, as has been the case for most of the history of our field. That would be unfortunate, since as tools, context, and intellectual partner, technologies can indeed revolutionize education. (Jonassen, 1995, p 61).

In US public schools, the spending on technology amounts to no more than \$175 per student per year, mostly for hardware and infrastructure, relatively little for software and technology support. However, teacher-directed student use of computers during class, teacher professional involvement with computers, and perceptions of the effects

computers have had on their classes are more a function of the school's software than the installed hardware base (Anderson & Becker, 2001).

Technology is not the primary consideration in the innovation process, rather the matching of the social context, people, technology, and purposive action make the situation. <http://personal.clt.bellsouth.net/clt/c/b/cbcraw/lead05.htm>. Deal, Meyer & Scott (1975) have found organizational autonomy, decentralized authority, staff professionalism, and features of organizational climate such as openness, trust, and free communication to be correlates of innovative behavior.

## Educational Reform and Innovation

### Theories of Reform

There are many models of reform, indicating either a fascination, frustration, or both with change and innovation. This paper puts forward a new theory of reform, based on a study of the history of diffusion of innovation began with an examination of the offerings of prominent reform advocates such as Rogers (1995), Fullan (1991), Kotter (1996), Senge (1990) Lewin (1952), Hughes (2001), Ernst & Young (2000) and Orlikowski & Hofman (1997). Theories emanated from business, education, technology, anthropology, sociology, public health, communication, marketing, and geography; some are highly specific while others are more general.

From examination of these and other models from the literature on change and reform via innovation, a vague picture of what faces the would-be reformer begins to emerge. What seems to be lacking is a strong theoretical sense of what makes for a successful diffusion of a disruptive innovation, along with a reasoned application of the theory which may be summoned to test it.

### Change and Reform

#### What Influences Reform? Lessons Learned From Innovation Diffusion History

There are many characteristics of innovation, some of which are in opposition to conventional wisdom, and they are briefly reviewed below. Implications for a theory of reform through IT, derived from these characteristics, follows in the next main section.

## Technological Innovations Spawn Sociotechnological Systems

The diffusion of technological innovation is driven by social systems. Almost every major revolution to impact humankind has technological roots: the steam engine, printing press, computer, and so forth. From these beginnings, it is easy to miss the fact that technology is not the primary consideration in the innovation diffusion process; rather it is the matching of the social context, people, technology, and purposive action which make the change and reform. (Crawford & Strohkirch, 1997; Postman, 1983). From a study of the history of technology, Hughes observed

History suggests that everything will change in unanticipated ways. In the 1920's a number of researchers from different fields believed they were experiencing a sociotechnological revolution, but wrongly believed that new technical systems would drive social changes. Technology is malleable, that is it is shaped by social values, often directed by those with different agendas for new technologies... (Hughes, 2001, p. 19).

Innovation diffusion with respect to IT has two components: the technological and the sociotechnological. The latter is by far the most crucial to get right and yet most often ignored, as evidenced in the prevalence of the plans based on the "Build it and they will come" myth.

## Innovation Diffusion is Driven by Vision

"As for the Future, your task is not to foresee, but to enable it." Antoine de Saint-Exupéry, 1979).

Innovations follow circuitous, unpredictable paths. In the absence of roadmaps, innovations are often guided by a highly dedicated individual who possess a strong and clear vision of the future, unflagging dedication to achieving that vision and the ability to motivate others to actualize that vision. Often the innovation is given form and shape by teams of individuals who share the vision (Senge, 1990) and are empowered to bring the vision into reality.

## Innovation Diffusion is Poorly Understood

Innovation and diffusion are poorly understood; accepted as an abstract concept, they are rejected as an operational outcome. And in cases where the implications of

innovation are understood, the rational behavior of individuals and institutions, to promote stability and resist change brought about by innovation, takes over. Morris (1997) observed that instructional innovations are likely to be restricted to imitations of others or of revisions of past technologies, repackaged by academics within or closely associated with the field of education.

### Innovation Diffusion is Rarely Successful

Given the popularity of the term, one would think that most innovations become widely (i.e., successfully) diffused. The contrary is true. Mosteller studied numerous technological innovations and concluded "...we find again that when innovations are put to trial, they are successes only about half the time, and that substantial improvements are relatively rare, about one in seven." (1981, p. 883). In the area of information technology, Murgatroyd in Thompson (2001) pointed out that thirty six percent of all information technology projects fail.

The practitioner and historian of educational reform Cuban (1996) observed "...each technological innovation has had, at best, an uneven record in entering [public education] schools and classrooms." Schools have rejected or altered technologies that have been announced as revolutionary and transformative, extending as far back to the introduction of Thomas Edison's film projector in the 1910s, and including radio and television (Cuban, 1986). O'Neil, (1995, p. 7) commented "The graveyard of school reform is littered with technological innovations that failed to live up to their advance billing."

### Innovation Diffusion Takes Longer than We Believe

The innovation diffusion gap (IDG) is the elapsed time between the development of an innovative process or product and its widespread adoption. This gap is significantly longer than most people acknowledge. Once an innovation has been adopted, people quickly forget the magnitude of the adoption gap. Some examples will illustrate the IDG.

The IDG of 264 years from discovery of how to prevent scurvy to wiping it out in the British maritime trade took a terrible toll in human lives (Mosteller, 1981). One hundred and fifty years after the development of a simple pump in a Scottish mine, the

industrial revolution had transcended the IDG and became widespread in many forms around the world. A patent for the forerunner of the modern fax machine was issued in the 1840s. The first programmable electronic computer with a memory of 20 words was built in 1946, but the information technology revolution did not really start until the spread of mainframe computers in the late 1960s and the invention of the microprocessor in 1971. The laser and mouse took about 20 years from its early invention to widespread application. "It took education more than 300 years to fully take advantage of the technological revolution in movable type. And it was almost 100 years between the invention of the pencil and its wide use in schools..." (Lockard, Abrams, & Many, 1997, p. 373).

### Innovations Undergo Radical Changes During Their Lifetimes

An old proverb states 'he who predicts the future is a liar, even if he is telling the truth'. It is well known that the ultimate uses for innovations are often quite different and unexpected compared with the vision of the developer. It is unlikely the Wright brothers imagined a 747 carrying hundreds of passengers long distances when they first flew at Kitty Hawk. Alexander Graham Bell had a vision for creating a tool for the deaf-it turned out to be the telephone. Thomas A. Edison was trying to invent a dictation machine and produced the phonograph. The Internet was designed as a closed, secure system for national security during the cold war in the 1960s. It has evolved and continues to evolve into something quite different today, open and operated by many.

Tyack and Cuban (1995) proposed that innovations could be designed to be open to modification by those who must implement them. In addition, people are more likely to support and enhance goals and innovative methods which they themselves set, as opposed to those imposed by outside. In education, teachers do use innovations but adapt differently according to the needs of students (Spencer, 1996).

### Innovation Diffusion Cannot be Managed

Goals for reform 'handed down from on high' do not accommodate the unique needs, characteristics, politics, and personalities of individual departments. As such, they

are suspect or quickly discredited. Cuban (1996) refers to such individuals as techno-reformers.

To techno-reformers the answer is simple: Teachers lack the access, knowledge, and skills to use these machines properly. When teachers are thus blamed, solutions also become obvious: Provide teachers with sufficient computer hardware and software, technical assistance in using the machines, and better preparation programs. Technology-leaning policymakers, corporate leaders, and other influential noneducators, with their access to media, have framed both the problem and the solution. Teachers, then and now, remain voiceless in setting the reform agenda.

The process of innovation is messy and a strong, centralized organizational structure with controls designed to maintain organizational stability provides infertile ground to grow innovation. Nothing dampens the creative spark more than judgmental critiques of innovative efforts. Showing someone a standard way to do something runs the risk of shutting down his or her ability to think of new approaches (Shalley & Perry-Smith, 2001). It has been asserted that innovation must be led; it cannot be managed (Kotter, 1996; Senge, 1990).

The improvisation model of change management suggests that “rather than predefining each step and then controlling events to fit the plan, management creates an environment that facilitates improvisation.” (Orlikowsky & Hofman, 1997, p. 20).

### Innovation Diffusion Involves Trial, Error and Risk Taking

R & D proceeds as a combination of empirical testing and science application—it is not just simply the application of science (Hughes, 2001). While science texts and success stories glowingly inform us of the progress that has been made, they fail to reveal the litter heaps of theory, model and application testing which had to be discarded for one reason or another. Diffusion of innovation, to the extent the innovation differs from conventional thinking and organization, entails significant individual and institutional risk because it involves creating and testing new ideas and discarding those which don't work. This discarding process, which is well accepted in genetic engineering, can present a tone of failure, and innovators must be shielded from the consequences of taking risks. Very few organizations or supervisors will tolerate risk, particularly if the risk occurs within the supposed realm of expertise.

### Innovation Diffusion Progresses Through Well-Defined Stages

Innovation diffusion is characterized by passage of individuals and institutions through three stages. First, people 'play' with it, to find out its capabilities and limitations. In the second stage, they use the technology to assist them in their daily chores and responsibilities. In the third stage, they begin to use the innovation to help address new opportunities or problems which have not been addressed before the innovation, problems previously though unassailable.

Dooley (1999) summarized the concerns theory of Hord:

At the beginning of a change process, the typical "non-user" has concerns that are relatively high in *Awareness, Information, and Personal (self concerns)*. Non-users or low users are more concerned about gaining information about the innovation and about how change will affect them personally. As they begin to use the new program or innovation, concerns become more intense in the area of *Management (task concerns)*. As a teacher becomes more experienced and skilled with an innovation, the tendency is for concerns at the lower stages to decrease in intensity while those in higher stages such as *Consequence, Collaboration, and Refocusing* become more intense (**impact concerns**).

### Successful Innovation Diffusion is Hard to Define

While the diffusion of innovation is widely discussed, there are few operational definitions of the criteria for successful diffusion and whether any one operational definition can be applied to different classes of innovation, e.g., business, technology, engineering, science, education). Innovation may be said to be successfully diffused when it either becomes a widely entrenched practice among the population for which it is applicable, or disappears. Wide entrenchment is reached when the innovation is used by large numbers of people making fundamental changes in the way they conduct their activities or enterprises. Critical mass theory gives some guidelines for decision making about continued investment of time and resources. (Rogers, 1995; Markus, 1990; Oliver, Marwell, & Teixeira, 1985). Markus (1990) has argued that critical mass must include all three of institutional, faculty and student access. David and Wright (1999) of Oxford University suggests that a technology will start having a significant effect on productivity only when it has reached a 50% penetration rate.

### Resistance to Diffusion is Natural

History abounds with instances of errors in judgment about innovations becoming successfully diffused into society.

1929 "Students today depend upon bought ink. They don't know how to make their own. When they run out of ink, they will be unable to write words or cipher until their next trip to the settlement. This is a sad commentary on modern times." (Rural American Teacher)

1959 "Ball point pens will be the ruin of education in our country. Students use these devices and then throw them away! The American virtues of thrift and frugality are being discarded. Business and banks will never allow such expensive luxuries." (Federal Teacher) (White, 2001).

In addition, the studies and theories related to resistance to reform are too numerous to present here. In the academic arena, scholar C. P. Snow (1961) lamented

In a society like ours, academic patterns change more slowly than any others. In my lifetime, in England, they have crystallized rather than loosened. I used to think that it would be about as hard to change, say, the Oxford and Cambridge scholarship examination as to conduct a major revolution. I now believe that I was over-optimistic.

If a threat to the existing power structure is perceived, resistance may take the form of vested interests dominating. "Technology is malleable, that is it is shaped by social values, often directed by those with different agendas for new technologies, e.g., some with a stake in preserving the status quo and opposing activities which threaten to diminish their power base ... Most college and university administrators and some faculty envisage a technology--enabled education that reinforces their visions and vested interests." (Hughes, 2001, p. 19).

### Implications From Innovation Diffusion Studies

What are the implications from what we have learned from the history of innovation and diffusion for change and reform through the application of IT? The characteristics of innovation diffusion and their implications for practice are presented below.

1. Technological innovations create sociological systems.	Diffusion must plan to deal with both.
2. Innovations follow circuitous, unpredictable paths. In the absence of roadmaps, innovations are often guided by a strong and clear vision of the future:	A strong and shared vision of the future of an innovation precedes successful innovation diffusion. Successful diffusion is dependent upon recruiting the correct personalities.
3. Accepted as an abstract concept, rejected as an operational outcome (the rational behavior of individuals and institutions is to promote stability and resist change):	Individuals and institutions must assign innovation diffusion the significant role it deserves, over and above simple change, and act accordingly.
4. Substantial numbers of innovations fail to survive—most rarely become widely adopted:	Innovation is at odds with good stewardship, the preservation of the institution for the good of all. There is a myriad of issues that must be dealt with, and people empowered to deal with them.
5. Innovation diffusion gap is the elapsed time between the development of an innovative process or product and its widespread adoption. This gap is significantly longer than most people acknowledge:	The innovation diffusion gap is regularly often significantly underestimated, and does not fit within the limited appointment time of most administrators.
6. Many innovations undergo radical changes from their original intentions, under local control:	At the local level, individuals need to have the power to influence how the innovation is used in their sphere of interest.
7. Innovation diffusion is difficult or impossible to manage using conventional administrative tools. Innovation diffusion can't be managed-it must be led (Kotter, 1996; Senge, 1990):	Allow for new systems to evolve, free from conventional administrative restrictions, and formulate policy to support the new systems. Develop strategies to maintain the old while building the new.
8. Innovation diffusion is associated with failure. It involves testing many ideas/approaches and discarding, through trial and error, those which don't work:	A supportive atmosphere of creativity, risk-taking, trial-and-error and appropriate reward structures need to be created.
9. People pass through three identifiable stages which they encounter an innovation—play, use and create:	Provide resources, guidance and evaluation commensurate with the current stage which the individual and institution find themselves.
10. Successful innovation diffusion is hard to define:	The notion of critical mass should be invoked to ascertain when successful

	diffusion has occurred. Unconventional methods need to be considered to reach the critical mass.
11. Resistance to innovation diffusion is a normal, natural and rational response:	Understand the leadership skills needed to help people and institutions change this response.

### A New Approach to Reform Through IT and Professional Development

Analysis of the history of reform resulted in several principles which are likely to maximize the chances of successful adoption of the IT innovation. The system described in this paper attempts to honor these principles.

- Principle 1: Renewal cannot be separated from professional development of our major resource-the intellectual capability and leadership of our personnel.
- Principle 2: People most affected by the renewal must be empowered to make the decisions and generate the direction the renewal proceeds.
- Principle 3: Renewal is driven by the development of a mutually shared vision of what could be.
- Principle 4: Renewal requires commitment and sacrifices which should be visibly embraced by all affected.
- Principle 5: Renewal involves taking risks and taking risks involves making mistakes; people should be encouraged to take calculated risks, certainly not penalized.
- Principle 6: Renewal must be concentrated in areas where there is maximum leverage and conventional methods for diffusion must be questioned and replaced as necessary.

### The Training Infrastructure and Empowerment System (TIES)

The purpose of TIES was to design and test a system for change in a university environment based on a new theory of reform. The system is based upon 1) innovation change theory, 2) a workable, not just theoretical approach, 3) content taught is alternative delivery systems, 4) change methodology, 5) both top-down and bottom-up operation, 6) professional development and 7) empowerment through leadership training. TIES is summarized in a final report (Szabo, Anderson, & Fuchs, 1998).

## Vision

In keeping with the need for a guiding vision, chief academic officers (CAO), with our assistance prepares a vision, and identifies the barriers to that vision, ways to overcome the barriers, ways to communicate the vision to the whole university community and ways to show their commitment to that vision. The goal was to begin this vision-building process in an intensive retreat format.

## Empowerment to Actualize the Vision

The second major component of TIES is to empower and leverage people in the trenches to actualize the vision in their local sphere of work according to their own circumstances. This was accomplished through the creation, training, empowerment and support of department-based TIES Leadership Task Forces (TLTF)s. Design elements include for TLTFs:

1. Operate at the Department level for strategic leverage, since most decisions are made at that level.
2. Create a TLTF within each department, to include opinion leaders in the department plus departmental administrators. The work done by each TLTF would concentrate exclusively on the needs and goals of the respective department.
3. Provide training (see below), support, resources and partial release time to the TLTFs to prepare them to 1) become credible users of IT in their courses, 2) systematically train their departmental colleagues, 3) support their departmental colleagues using just-in-time principles, and 4) create long-range plans for the department to carry out the shared vision in their department.
4. Upon completion of their work, the task force members return to their changed job assignments.

TLTFs were prepared for their work in a workshop format whose goals were to facilitate team-building skills and insure that minimum competencies were present in each team. Training incorporated the best of adult learning principles and was rich in resources. It was accomplished through a series of Web-based training modules (Szabo, 1998) which could be accessed during the workshop for training and afterward for

refresher work. The modules also served as tools which teams could use in their subsequent work with department colleagues. The modules included competencies in hard and soft skills, interactive and distance technology, application of IT to curriculum, instruction and evaluation and perhaps most important, leadership skills. The Leadership Modules consisted of

- L1: Developing & Sharing A Vision for Alternative Delivery Systems
- L2: Working with Teams & the Task Force Approach
- L3: Dealing with Mental Models
- L4: Selling Your Ideas (Seek first to understand)
- L5: The Promise and Pitfalls of Innovation: Understanding Organizational Stability
- L6: Importance of Training and Continuous, Accessible Support
- L7: Long Range (Multi-Year) Planning
- L8: Reporting Project Progress

#### TIES Findings

##### Creating the Shared Vision

The first step was to garner support for the complex and unusual idea of using a model based on innovation and professional development to promote reform. Several key individuals who could provide access to the chief academic officers (CAOs) were consulted with information about TIES and their advice solicited. The primary goal was to schedule a retreat for chief academic officers to develop a vision as noted previously.

During a retreat with CAOs, limited progress was made toward the goals of examining current noteworthy applications, creating a vision for the university, and identifying the key barriers and their solutions to making the vision happen. One key outcome was to begin a dialogue on the role of IT with the deans of the university. Another outcome was the development of an updated version of the institution's technology integration plan (Learning First, 1998).

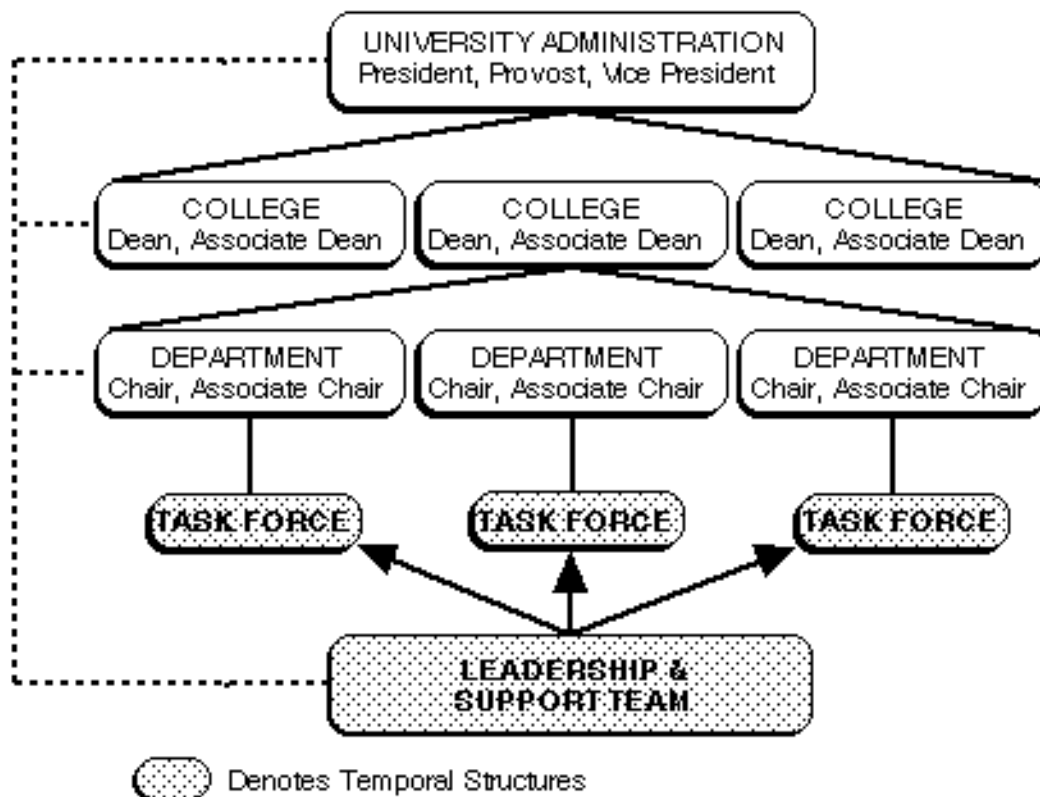
There was, however limited success in examining applications or establishing the vision and time was not available to identify the barriers or their solutions, beyond the general consensus that training of faculty needed to be a high priority. Upon return to

campus, continued work on these elements seems to have given way to more pressing issues within the institution.

It was assumed that a clear vision statement from the CAOs would significantly enhance the interest in and success of the TLTF approach. Given its absence, the decision was made to proceed with the latter with a more general mandate.

### TIES Leadership Task Forces

The figure below illustrates the relationship between the TLTFs and the university organizational structure.



Organizational structure of the TIES Leadership Task Forces

Deans of faculties and chairs of departments were approached to explain the system and the role of the TLTFs and received an invitation to participate. Six units were prepared to participate and in which there were active colleagues from previous work in IT. One had other more pressing agenda items and declined to pursue the option further. A grant provided a modest amount for each team and departments were requested to provide additional resources in support of the work of their TLTF. After numerous

meetings with several faculties and departments, the complement of five TLTFs was identified. Three were based within faculties rather than departments, due to their small size. It should also be mentioned in context that a clear vision statement from either the CAOs of the institution or Faculty was had not been formulated. In spite of this assumption violation, it was decided to proceed with the TLTFs.

The TLTF training took place during a 4 day school break in February 1998. The entire TLTF A participated, including the department chair and a faculty member who was officially on sabbatical leave. They worked enthusiastically on the training, the discussion group activities, and discussed how they could optimize their impact on the rest of the department. They also finalized their long-range plans which had been under development for some time prior to the TIES workshop.

TLTF B, on the other hand, was a no-show. No one from the team participated and the chair did not offer the courtesy of contacting the workshop coordinators that they had decided not to participate, although one participant had indicated a conflict due to a conference scheduled the same time. Of the individuals who had been named as potential team members, one was a sessional instructor and was in the process of leaving the university and another was jointly appointed with another department. The author concluded that the high need expressed for the program by the chair of this department did not translate into action and IT and/or reform was not sufficiently high in importance.

TLTF C consisted of a single individual who had recently returned from his faculty from several years at another institution. This individual was well-versed in the WWW component of IT and keenly interested in the promoting IT in general. This interest probably stemmed from two sources. First, the Dean of this Faculty specifically requested a TLTF. Second, the individual had had experience in another university where a plan for IT was imposed upon the faculty without extensive consultation and the results were quite upsetting to many and initially counterproductive. The TIES presented quite a contrast in methodology.

While the author was initially disappointed at the participation of only one individual from TLTF C, that participation was enthusiastic and subsequently this individual was reassigned to a full time position to provide IT leadership, formed a team, and proceeded to being to plan to integrate IT into his faculty.

TLTF D did not translate the specified team structure into reality. It consisted of one full time faculty member who was actively developing a WBI course for the faculty, three part time sessional instructors, and no faculty administrators. The sessionals attended approximately 1-2 days of the workshop and then discontinued participation. The faculty member participated on a part time basis, so there was no real task force developed from this faculty. The follow up activity by this group was to create a series of IT-training programs for the faculty using Power Point.

TLTF E was also at the faculty level and consisted of a seasoned IT person, also just returned from a sabbatical leave, an Associate Dean, and a sessional instructor. They also participated in the entire workshop and began to develop ideas for working with their faculty colleagues.

Subsequent to the training, the central leadership team maintained contact with the TLTFs through normal communications means plus a web conferencing system. Follow up was provided on an as-needed basis in order to permit the teams to develop their work autonomously.

#### Interviews with Stakeholders

In 2000-2001, intensive interviews were conducted with four stakeholder groups involved in TIES; two chief academic officers, two project directors, four administrators and four faculty members. This case study analysis used inductive content analysis, verified by triangulation including regular inter-subjectivity checks. This time consuming process resulted in a substantial level of thoroughness. The findings are too numerous to present here, so a distillation of several major ones will be presented.

First, neither administration nor faculty distinguished change from reform; the former exemplified by increased use of IT within the classroom; the latter by new instructional applications which supercede or extend the classroom. This is evidenced by the imprecise and mixed use of terms such as vision, goal, strategy, reform and change in interviewees' responses. Fundamental reform in the way individual, departments or the institution function was rarely discussed as an option. It may be hypothesized that one reason for limited diffusion of IT is that it is perceived as a minor change rather than as a disruptive innovation.

Second, the theoretical importance of vision in promoting innovation diffusion is not viewed with the same level of importance by senior administrators, who rely largely on administrative policy, procedures and committees to bring about change. Nor is it viewed as important by faculty and department administrators, who quickly [mis]interpret vision (where do we want to go as a faculty/department?) as strategy (how do we get there?). Subsequent to TIES, a document addressing ‘vision and strategies’ was developed for central administration but currently has not been acted upon.

At all stakeholder levels, the benefits of participating in the initiative far outweigh the drawbacks. Each participant realized some benefit, and each of these benefits certainly has played a part in the process of how smoothly the adoption of specific innovations has/will occur within these faculties. How far the diffusion process has occurred would be difficult to determine without interviewing other non-participating faculty members, however, subsequent initiatives resulting in participating faculties and departments speaks to this issue.

A strong vision for the future of IT was not developed, and of course it follows that the subsequent sharing, identification of barriers to meeting the vision and their solutions, and a commitment to the vision were not forthcoming. Instead, a draft vision statement was created, a statement which clearly indicates limits to the use of IT. The statement was not extensively vetted by administrators, and its chief architects have since moved on to different positions.

Reasons for the lack of strong vision development are only subject to speculation at this point. One possibility is that like most research universities whose stated goals are to promote research, teaching and service, the de facto emphasis is clearly on research (Aronowitz, 2000). While increasing involvement with IT for noble purposes such as increased achievement, attitudes and better access and learning efficiency is certainly a strong consideration, there are strong [er?] issues. Research, patents, corporations and other university spinoffs generate a significant amount of money, money which has become increasingly important because government funding has been significantly curtailed. It is likely that strong support for IT will carry with it significant add-on costs, divert the effort to generate significant revenues from research endeavors, and not replace revenues with the limited income from instructional materials sold.

## Conclusions and Discussion

In this study, which formally began in 1996, (Szabo, 1996) the history of innovation diffusion was consulted in an effort to inform why the promised reforms of education with respect to IT have not materialized. Several characteristics of successful innovation diffusion and implications for reform through IT were identified. Based on these characteristics, a system to start a reform effort in a specific research university (TIES) was created and operated for one year. Follow up observations and interviews reveal a mixed set of results based on prior expectations. Suggestions for modifications to the system and procedures utilized are forthcoming.

## References

- Alexander, P. A., Murphy, P. K., & Woods, B. S. (1996). Of squalls and fathoms: Navigating the seas of educational innovation. *Educational Researcher*, 25, 31-36.
- Allen, D. (1992). *Schools for a new century*. NY: Praeger.
- Anderson, R. E., and Becker, H. J. (2001). Teaching, learning, and computing: 1998 national survey. Report # 8. [On-Line]. Available: <http://www.crito.uci.edu/tlc/html/findings.html> 7 September 2001.
- Antoine de Saint-Exupéry, (1979). *The wisdom of the sands*. Translated by S. Gilbert from the French Citadelle (University of Chicago Press, Chicago, 1979; reprint of the edition published by Harcourt, Brace, New York, 1950.
- Aronowitz, S. (2000). *The knowledge factory: Dismantling the corporate university and creating true higher learning*. Boston: Beacon Press.
- Berman, P., & McLauhlin, M. (1977). *Federal programs supporting educational change: Vol. VII. Factors affecting implementation and continuation*. Santa Monica, CA: Rand Corporation.
- Coombs, P. W. (1985). *The world crisis in Education: The view from the eighties*. NY: Oxford University Press.
- Crawford, C. B., & Strohkirch, C. S. (1997). Influence methods and innovators: Technocrats and champions. *The Journal of Leadership Studies*, 4, 43-54.
- Cuban, L. (1986). *Teachers and machines*, New York: Teachers College Press.
- Cuban, L. (1996). Techno-reformers and classroom teachers. ERIC. [On-Line]. Available: <http://www.edweek.org/ew/vol-16/06cuban.h16>
- Cuban, L. (2000). What does the research say about technology's impact on education? An interview with Larry Cuban. *Tech Learning Magazine*. [On-Line]. Available: [http://www.techlearning.com/db\\_area/archives/TL/062000/archives/cuban.html](http://www.techlearning.com/db_area/archives/TL/062000/archives/cuban.html)

David, P. A., & Wright, G. (1999). *Early twentieth century productivity growth dynamics: An inquiry into the economic history of "Our Ignorance"*. Discussion Papers in Economic and Social History. Oxford University. [On-Line]. Available: <http://www.nuff.ox.ac.uk/Economics/History/> Retrieved 30 November 2001.

Deal, T. E., Meyer, J. W. & Scott, W. R. (1975). Organizational influences on educational innovation. In J. V. Baldrige & T. E. Deal (Eds.) *Managing Change in Educational Organizations*, Berkeley, CA: McCutchan Publishing Corporation, 109-132.

*Degrees of Freedom, 1998 Supplement*. (1998). Edmonton, AB: University of Alberta.

Dooley, K. E. (1999). Towards a holistic model for the diffusion of educational technologies: An integrative review of educational innovation studies. *Educational Technology and Society*, 2. [On-Line]. Available: [http://ifets.ieee.org/periodical/vol\\_4\\_99/kim\\_dooley.html](http://ifets.ieee.org/periodical/vol_4_99/kim_dooley.html)

Etzioni, A. (1972). Human beings are not very easy to change after all. *Saturday Review*, 45-47.

Finn, C. E. (1991). *We must take charge*. NY: The Free Press.

Fullan, M. & Stiegelbauer, S. (1991). *The new meaning of educational change*. 2<sup>nd</sup> Ed. New York, NY: Teachers College Press.

Goodlad, J. I. (1984). *A place called school: Prospects for the future*. New York: McGraw-Hill

Green, K. (2000). *The 2000 national survey of information technology in US higher education*. Encino, CA: Campus Computing. [On-Line]. Available: <http://www.campuscomputing.net/summaries/2000/index.html> Retrieved 30 November 2001.

Hughes, T. P. (2001). Through a glass darkly: Anticipating the future of technology-enabled education. *Educause Review*, 36, 16-26.

Jonassen, D. H. (1995). Supporting communities of learners with technology: A vision for integrating technology with learning in schools. *Educational Technology*, 5, 60-63.

Kotter, J. P. (1996). *Leading change*. Cambridge, MA: Harvard Business School Press.

Learning First (1998). Learning first: Technology integration plan update. (1998, May). University of Alberta Office of Learning Systems Support.

Leithwood, K., & Montgomery, D. (1982). The role of the elementary

Lewin, K. (1952). Group decision and social change. In E. Newcombe and R. Harley (Eds.), *Readings in social psychology* (pp. 459-473). New York, NY: Henry Holt.

Lockard, J., Abrams, P., & Many, W. (1997). *Microcomputers for twenty-first century educators* (4<sup>th</sup> ed.). New York, NY: Longman.

Markus, M. L. (1990). Toward a "Critical Mass" theory of interactive media. *Communication Research, 14*, 491-511

Mitchell, J. M. (1992). The keys to successfully managing the change to open learning. *Conference Proceedings of the ITTE Annual Meeting*. Brisbane, Australia.

Morris, D. R. (1997). Adrift in the sea of innovations: A response to Alexander, Murphy and Woods. *Educational Researcher, 26*, 22-26.

Mosteller, F. (1981). Innovation and evaluation. *Science, 211*, 881-886.

NCOEIE (1983). *A nation at risk The imperative for educational reform: A report to the nation and Secretary of Education*. Washington, DC: The National Commission on Excellence in Education.

Office of Technology Assessment (1989). *Linking for learning: A new course for education*, (OTA Publication No. SET-430), Washington, DC: U.S. Government Printing Office.

Oliver, P., Marwell, G., & Teixeira, R. (1985). A theory of critical mass: Interdependence, group heterogeneity, and the production of collective action. *American Journal of Sociology, 91*, 552-556.

Olsen, F. (2001). Survey finds another increase in campus spending on information technology. *The Chronicle of Higher Education*. April 4, 2001. <http://www.chronicle.com/>.

O'Neil, J. (1995). On technology and schools: A conversation with Chris Dede. *Educational Leadership, 53*, p 6-9.

Orlikowski, W. J. & Hofman, J. D. (1997). An improvisational model for change management: The case of groupware technologies. *Sloan Management Review, 39*, 11-21.

Postman, N. (1993). *Technopoly: The Surrender of Culture to Technology*. New York: Vintage Books.

Presseisen, B. Z. (1985). *Unlearned lessons*. Basingstoke: Falmer.

Rogers, E.M. (1983). *Diffusion of Innovations* (4th ed.), New York: The Free Press.

Rossmann, G., Corbett, D., & Firestone, W. (1988). *Change and effectiveness in schools: A cultural perspective*. Albany, NY: State University of New York Press.

Senge, P. M. (1990). *The fifth discipline: The art and practice of the learning organization*. New York, NY: Currency Doubleday.

Shalley, C. E. & Perry-Smith, J. E. (2001). Effects of social-psychological factors on creative performance: The role of informational and controlling expected evaluation and modeling experience. *Organizational Behavior and Human Decision Processes, 84*, 1-22.

Smith, L. M., Prunty, J. P., Dwyer, D. C. and Kleine, P. F. (1987). *The fate of an innovative school*. Lewes: Falmer.

Snow, Charles P. (1961). *Science and government*. Cambridge, Mass.: Harvard University Press.

Spencer, D. A. (1996). Teachers and educational reform. *Educational Researcher*, 25, 15-17.

Straessens, K. (1991). The professional culture of innovating primary schools: Nine case studies. *A paper presented at the annual meeting of the American Educational Research Association*, April 3-7, 1991, Chicago.

Szabo, M. (1996, June). *Change in the use of alternative delivery systems through professional development within colleges and universities*, Paper presented at the annual meeting of Ed-Media/Ed-Telecomm 96. Boston, MA. [On-Line]. Available: <http://www.quasar.ualberta.ca/IT/research/Szabo/Change.html>

Szabo, M. (1998). *Modules for the training, infrastructure and empowerment system*. [On-Line]. Available: [http://www.quasar.ualberta.ca/edmedia/TIES/Ties\\_home.html](http://www.quasar.ualberta.ca/edmedia/TIES/Ties_home.html)

Szabo, M. (2001). Survey of Instructional Technology Research or, If Instructional Technology Effectiveness Were a Crime, Would There Be Enough Evidence to Convict it? [On-Line]. Available: <http://www.quasar.ualberta.ca/edmedia/readingsnc/Nrefsza.html>

Szabo, M., Anderson, T., & Fuchs, A. (1998). *A Change System: The Training, Infrastructure and Empowerment System (TIES)*. Final Report to Alberta Advanced Education and Manpower: Learning Enhancement Envelope I. [On-Line]. Available: [http://www.quasar.ualberta.ca/IT/research/Szabo/TIES\\_FinalReport.html](http://www.quasar.ualberta.ca/IT/research/Szabo/TIES_FinalReport.html)

Thompson, R. (2001). Much tech spending a waste. (2001, October 25). *The Financial Post*, p. fp4.

Tyack, D., & Cuban, L. (1995). *Tinkering toward utopia: A century of public school reform*. Cambridge, MA: Harvard University Press.

White, J. A. Integrating computers in education. (What's It Really Like Out There?). [On-Line]. Available: <http://www.coedu.usf.edu/jwhite/eme2040/integrate2.html> Retrieved 2 October 2001.