Technology and teaching : the adoption and diffusion of technological innovations by a community college faculty
by Arlene Hazel Parisot

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University

Abstract:
Current practices of faculty members of a public community college were described in relation to the adoption and diffusion of technology as an instructional tool. Data were collected from faculty of Bellevue Community College between December 1994 and February 1995.

Teaching style information was collected using the Principles of the Adult Learning Scale (PALS) to determine the frequency with which respondents practice an action that a teacher of adults might exhibit in a classroom. Learning style information was collected using the Learning Styles Inventory (LSI) to determine the dominant mode of learning. Qualitative information was collected through interviews based on naturalistic inquiry and guided by Everett Rogers' model of diffusion of innovation to characterize the respondents' use of technology, perceived impact on the teacher's role, and factors which encourage or discourage use of technology. Student learning outcomes and technology became a secondary issue raised through the interview process. The PALS instrument was completed by 20 respondents, 21 completed the LSI, and 27 were interviewed..

The PALS respondents were characterized as being strongly teacher-centered in their classroom orientation. A definitive pattern for LSI respondents was not identified although many of the scores fell in the abstract conceptualization quadrants of the LSI Type Grid. Information from the interviews supported Rogers' model of diffusion of innovation.

This study concluded that the faculty at Bellevue Community College were teacher-centered rather than learner-centered and that technology can be a catalyst for faculty to reflect upon practice and can stimulate a move toward a learner-centered teaching methodology. It also concluded that factors which encourage use of technology are role modeling, faculty involvement in decision-making, provision of training for support personnel, and technical support. Factors which discourage adoption are time and attitudinal barriers. There were implications that adoption of technology would be enhanced if faculty could be assured that the use of technology would have a positive impact upon student learning. Finally, it was concluded that not all faculty would adopt technology.

Recommendations were made in the two general areas of new knowledge which has implications for educational practices and knowledge which is confirmed from the existing literature.

TECHNOLOGY AND TEACHING: THE ADOPTION AND DIFFUSION OF TECHNOLOGICAL INNOVATIONS BY A COMMUNITY COLLEGE FACULTY

by

Arlene Hazel Parisot

A thesis submitted in partial fulfillment
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APPROVAL

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Arlene Hazel Parisot

This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

4/20/95
Date

Gary J. Conta
Chairperson, Graduate Committee

Approved for the Major Department

4/21/95
Date

Duane Mellinger
Head, Major Department

Approved for the College of Graduate Studies

5/7/95
Date

R L Brown
Graduate Dean

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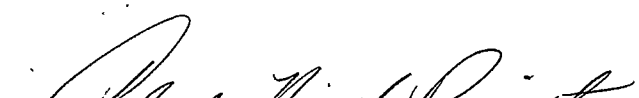
Signature 

Date April 18, 1995

I would like to dedicate this thesis to my mother, Hazel M. Taylor, who was my role model, my friend, and my sustenance.

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ABSTRACT

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CHAPTER 1

INTRODUCTION

Technology and Change

Institutions of Higher Education

During the past decade, higher education has been confronted with an acceleration of instructional technologies designed to increase efficiency, expand productivity, and ultimately enhance the student's total learning experience. Maintaining currency with technological change characterized by new media, new methods, and new materials is a challenge for all institutions of higher education. "We are challenged daily with rapid technological change. . . . Change itself has become the rule not the exception" (Gibson, 1992, p. 167)." Yet, this change has not been aggressively embraced by higher education. It has been suggested that General Motors has not entered into more partnerships with colleges and universities because "their speed is deceptive . . . .they are slower than they look" (Roueche, 1993, p. 4).

Adding to the challenge of technological change, higher education is also serving a learner whose lifestyle has changed. "Learners increasingly attend on a part-time basis and view learning as a lifelong imperative" (Gibson, 1992,

p. 167). Educational institutions are faced with changing roles. The new roles focus on facilitating learning rather than content, providing a flexible environment, and developing delivery methodology reflective of the learner's goals (Gibson, 1992). To address these issues as well as those raised by the introduction of technology into the teaching and learning process, it will be necessary to be forward thinking in development of a technology plan compatible with mission, resources, and learner needs. This is the challenge which higher education faces.

The Community College and the Challenge of Technology

As a viable member of the higher education system, the community college has taken a strong lead in attracting students. Recent data indicate that 43% of all American postsecondary students taking courses for college credit and 51% of all first-time American college students are enrolled in community colleges (Boggs, 1993-94, p. 4).

This influx of students into the community college system is attributed to the decrease in access to a college or university due to prohibitive costs or enrollment caps. This occurs at a time when the need for education and training is a necessity to obtain viable employment. To remain competitive in a global economy, 80% of the population must be provided with the "basic reading, writing, computational, information processing, teamwork, and learning skills that

will allow them to continuously adapt to the press of new technology and knowledge" (Roueche, 1993, p. 4).

The 1,300 community colleges of today evolved from the junior college of the early 1900's with a major part of their mission to prepare students to complete a four-year degree program. The relevance of this mission must be measured in terms of the issues facing America today such as the escalating costs for higher education, the need for job training, and the changing demographics of our population. This is a time for America's community colleges to reposition themselves as the ultimate problem solvers in a nation struggling with complex societal problems (Wynne, 1993). This repositioning effort is occurring when community colleges are "grappling with eroding budgets, demographic shifts, and diversity," and it is a time for community colleges to "get serious about technology's role on our campuses--its place in relation to curricula and how it will impact those of us who teach those who learn" (Phelps, 1994, p. 25).

Community colleges of today view themselves as a cost-effective alternative in providing the education and training necessary to enter today's competitive technology-driven job market. This view necessitates that community colleges also revisit their academic structure to determine its effectiveness in meeting the needs of the population it serves. "Can we really be on the cutting edge of economic recovery and economic development as long as we cling to what may be

described as an outmoded academic model--a model more suited to the convenience of the institution than to business, industry or the student returning to acquire new job skills?" (Phelps, 1994, p. 25). Integrating technology into the instructional delivery process has the potential to promote modeling of the competencies and skills expected of the employee in today's technologically driven employment market.

Teaching With Technology

Instruction in higher education is experiencing a metamorphose. The introduction of technology has stimulated new ideas about teaching and learning. Instruction on the higher education campus has followed traditional formats based on pedagogical methodology emphasizing techniques utilizing lecture, assigned readings, and audiovisual productions in the delivery of content. Higher education has relied on instructional approaches encompassing the lecture followed by group discussions, a lecture followed by a hands-on laboratory, seminars or small-group discussions for more advanced topics, and the typical library assignment, paper writing, and examination (Apps, 1988). The introduction of educational technology could conceivably revolutionize this process and change the perception and practice of teaching in higher education. The model for implementing these new instructional technologies comes from the business world and not from education, and higher education has done little to

learn about teaching and learning. Moreover, the university's instructional mode has scarcely changed over the past 50 years (Apps, 1988). Business and industry have learned that adults can learn in a multitude of ways through diverse technological formats. Higher education should take the lead of business and industry and encourage the integration of technology into instruction. As this direction could subsequently impact traditional methodologies, the issue of designing faculty development programs to encourage the use of new instructional approaches would need to be addressed.

For the faculty member faced with the challenge of integrating technological applications into a changing teaching methodology, integration may represent diverse levels of complexity. Technological application may be as simple as using a computer to as complicated as making technology resources central to the teaching process. Within the past decade, computers have become the norm rather than the exception in the arena of learning and teaching. Currently, instructional use of computers encompasses "enhancing traditional teaching techniques to supporting entirely new modes of learning" (Berger, 1993, p. 5).

The Impact of Technology on Instructional Approaches

As computer technologies expand and as these technologies are increasingly employed as viable instructional tools, the teaching style of faculty interacting with these technologies

will need to be re-examined. Teaching style is the behavior that the teacher demonstrates in the classroom and is a "pervasive quality that persists even though the content that is being taught may change" (Conti, 1985, p. 7). The faculty member who has used a traditional methodology successfully may question the effectiveness of teaching and learning via the electronic medium. The standard approach that educational institutions have initiated to integrate complex instructional technologies into the classroom has been to buy these technologies and simply make them available to the educator. From this view, "there is little more to be done except to let teachers get on with practicing their craft as they have always done" (Moore, 1993, p. 6). The expectations are that conventional classroom methodologies can be reproduced to incorporate new delivery mediums. This approach may be destined to failure because the technology used in a new delivery mechanism may change the way in which both teacher and learner interact, thereby altering the teaching and learning transaction.

Many studies have cited faculty resistance to instructional technology as a primary barrier to the continued growth of technology utilized as an instructional tool (McNeil, 1990). The "attitudinal issues--how people perceive and react to these technologies--are far more important now than structural and technical obstacles in influencing the use of technology in higher education" (p. 2). This can be

evidenced by the scenario that has taken place in secondary schools across the nation time and again. When a new technology was introduced into a system, "teachers would be lauded; the principal singled out for praise; the school would be featured in newspapers and magazines. But such noteworthy praise and articles only have underscored how rarely teachers have used machines in their classrooms since the 1920's" (Cuban, 1986, p. 51). The problems may lie in the individuals themselves; that is, it may be with teachers and principals hostile to technology or with the clogged bureaucracy which stifles the most persistent innovator. What has been true for the secondary educational system may also be true of higher education.

Technology and in particular the computer as an instructional tool have become a part of the fabric of higher education, but assuring acceptance by those who are expected to use the technology may not necessarily be effortless to accomplish. Integration of new technologies into the instructional process by faculty may equate to the success or failure of integrating and diffusing technology throughout the instructional realm. In order for technology to become an integral part of the instructional environment, these attitudinal issues--how people perceive and react to the use of technology--will need to be confronted.

Adoption and Diffusion Process

Everett M. Rogers' (1983) theory of diffusion of innovation suggests that the presence or absence of certain characteristics can predict whether or not an innovation will be adopted and can also predict the rate of diffusion of an innovation throughout the system. It is this rate of adoption of the innovation which determines the success or failure of the effectiveness of the technology being introduced. Rogers suggests that for an innovation to be adopted it must be perceived to be better than its predecessor (relative advantage), compatible with the needs and value system of the adopters (compatibility), relatively simple and easy to understand (complexity), able to be tested and tried prior to commitment (trialability), and able to be seen prior to adoption (observability) (p. 211).

In terms of adoption and use of new approaches to the delivery of instruction in higher education, faculty training and development are primary concerns. It has been suggested by Lindquist (1978) that the role of ownership and values and the extent to which the innovation fits the environment are important considerations for adoption and, therefore, for diffusion to occur. These concepts were formulated following a series of case studies involving innovations in higher education. Lindquist identified five components necessary for successful change: (a) ownership by those whom it affects; (b) linkage to both informational and interpersonal resources;

(c) leadership that is guiding, involving, and initiating rather than authoritarian, influential, and dogmatic; (d) an actively open environment that seeks out and listens to disparate opinions; and, finally, (e) material and psychic rewards that foster self-esteem and personal development. Both Rogers and Lindquist have presented criteria to be considered in predicting adoption and diffusion of an innovation within diverse environments and the components necessary to effect change.

Issues Related to Change

The criteria set forth by Rogers and Lindquist have comparable expectations. For an innovation to be accepted, it must involve ownership and be meaningful to the adopter; it should be achievable, thereby promoting self-esteem throughout the learning process; and it should be initiated by facilitory leadership. In view of these criteria and in the process of evaluating how innovation can be introduced into a system, it is important to examine the issues related to behavioral change.

"Learning means change" (Kidd, 1973, p. 15). This statement embodies the essence of learning and implies that as learning occurs, change will also occur. As a reaction to the fear of change, the learner may be reluctant to engage in new learning tasks. The learner's reluctance to enter into a new situation may be a response to the real or practical limit of

one's ability or potential capacity, or it may be a response to the psychological barriers which individuals design for themselves. Human beings are adept at constructing limiting beliefs that say such things as "you can't teach an old dog new tricks" and "you can't change human nature."

Transforming the teaching and learning processes as a result of the introduction of technology as an instructional tool implies a change for both teacher and learner, but for the teacher it is a dual challenge. Adapting to technology may require a flexibility not only in teaching style but also in learning style. Learning style is the characteristic way in which a learner operates within the learning situation (Bonham, 1988). A certain kind of content calls for one learning style over another (p. 12). As an example, math requires a sequential approach, but art requires a holistic approach to the learning process. Reluctance by faculty to learn how to use a new technology may be a result of an incompatibility of learning style to the task.

Motivation

The barriers to learning correlate to the attitudinal issues of how people accept change within the work and/or organizational setting. Introducing technology into the workplace demands change of work behaviors and orientation. What can motivate the adult learner to engage in tasks which require such changes? "Recent research on motivation has

focused especially on how certain thoughts, perceptions, and meanings of the situation to the person affect how or whether the person will invest time or talent" (Maehr & Braskamp, 1986, p. 35).

Cognitive theories of motivation argue that what is important are the thoughts, perceptions, and feelings that an individual has at the moment of behaving. Present thought and past experience related to the situation are critical to the outcome. These thoughts are of two kinds: (a) thoughts about self and (b) thoughts about the situation (p. 36).

When examining the motivational components necessary for the adult learner to engage in situations which require change, it is important to analyze the thoughts that the individual constructs regarding the self and the situation. Thoughts about self center on the judgment of significant others, feelings of self-confidence, and self-determination. Thoughts about the situation focus on whether it is considered a viable option and whether it is acceptable in relation to the individual's value system and the social environment in which the situation would occur. The thoughts and perception the individual holds toward himself or herself as well as the situation are important considerations in regard to designing activities to promote faculty acceptance of technology as a instructional tool.

Statement of the Problem

Change is a pervasive force in current postsecondary educational institutions. As these institutions position themselves to adapt to rapid technological change which impacts both the teaching and the learning environment, little has been done to understand the changing role of faculty in adapting to technology and to the psychological and physical environment in which adoption of these new technologies could occur. Yet faculty are the pivotal element in implementing any new technological change. Therefore, the examination of the experiences of faculty members as they accept or reject this new role in regard to the delivery of instruction is necessarily beneficial to the future design of faculty development programs for integrating instructional technology into the teaching process.

Purpose of the Study

The purpose of this study was to describe the current practices of faculty members of a public community college in relation to the adoption of technology as an instructional tool and to the diffusion of this innovation throughout the educational institution. This process was examined in relation to the faculty's demographic characteristics, learning style, teaching style, perceptions of technology as

a viable instructional tool, and conditions or influences which would encourage or discourage use of technology.

Research Questions

The following research questions directed this study:

1. What are the demographic characteristics of faculty interviewed regarding their use of technology as an instructional tool?
2. What are the learning styles of faculty interviewed regarding their use of technology as an instructional tool?
3. What are the teaching styles of faculty interviewed regarding their use of technology as an instructional tool?
4. What influence does integration of technology into the instructional environment have in regard to the role of the teacher in the classroom?
5. What conditions or influences would encourage use of technology as an instructional tool?
6. What conditions or influences would discourage use of technology as an instructional tool?
7. How is technology being used by faculty interviewed for this study?

Assumptions

The assumptions upon which this study was based related to the integration of technology into the educational arena. It was assumed that the Information Age has become a way of life and has created an ever increasing demand to integrate technology into many facets of society. This is also true for higher education. The challenge to higher education will be

to integrate technology throughout the instructional environment as a means to meet the diverse needs of the population it serves and also to be economically efficient in the process.

The growth of technology in education will place additional demands upon institutions to provide the resources and training necessary to assure faculty acceptance of technology as a viable instructional tool. Faculty acceptance will be the key to successful integration of technology into the teaching and learning process. Additionally, new technologies will provide alternative instructional delivery mechanisms that will have the potential to change the teaching and learning process.

Delimitations of the Study

This research was limited to the technologies utilized by the faculty of Bellevue Community College, the setting of this study. These technologies included personal computers (MAC and DOS/Windows) with a variety of software packages, multimedia with CD-Rom drives, authoring software such as powerpoint and toolbook, graphics calculators, and specialized technologies pertinent to specific disciplines such as music, art, and physical education.

Definitions

Adopter Categories are the five classifications of the members of a social system on the basis of innovativeness:

(a) Innovators, (b) Early Adopters, (c) Early Majority, (d) Late Majority, and (e) Laggards (Roger, 1983, p. 22).

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Diffusion is a special type of communication concerned with the spread of messages that are new ideas (Rogers, 1983, p. 5).

Change Agent is an individual who influences clients' innovation decisions in a direction deemed desirable by a change agency (Rogers, 1983, p. 28).

Communication Channel is the means by which messages get from one individual to another. Interpersonal channels are more effective in forming and changing attitudes toward the new idea and thus in influencing the decision to adopt or reject a new idea (Rogers, 1983, p. 17).

Innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption (Rogers, 1983 p. 11).

Innovation-Decision Process is the mental process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation (Rogers, 1983, p. 20).

Learning Style is the characteristic way in which a learner operates within the learning situation (Bonham, 1988, p. 12).

Opinion Leadership is the degree to which an individual is able to influence other individuals' attitudes or overt behavior informally in a desired way with relative frequency (Rogers, 1983, p. 27).

Teaching Style is the distinctive qualities of behavior that are consistent through time and carry over from situation to situation (Fischer & Fischer, 1979, p. 245).

Technology is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a designed outcome; it usually has two components: (a) a hardware aspect, consisting of the tool that embodies the technology as material or physical objects, and (b) a software aspect, consisting of the information base for the tool (Rogers, 1983, p. 12).

CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

> In a keynote address at the 1991 Leadership 2000 conference, Terrel Bell, former U.S. Secretary of Education, argued that almost no progress had been made in improving our schools since the 1983 publication of Nation at Risk, primarily because teachers were not provided with the tools they needed to make a difference--instructional technology. (Doucette, 1994, p. 202)

Bell viewed technology as the catalyst for improving student learning by helping teachers to individualize instruction and empower students. "While a decade of experimenting with computer-related technologies to improve instruction has yielded a thousand points of innovation and initiative, technology has yet to transform teaching and learning in the community college or anywhere else" (p. 202).

Several areas are related to understanding the process by which faculty at a community college adopt technology as an instructional tool and the diffusion of that technology throughout the educational institution. These include (a) the use of technology in higher education and its impact on the teaching and learning process; (b) examining diffusion theory in regard to adoption and diffusion; and (c) delving into

learning, attitudinal, and motivational issues related to behavior change in using technology as an instructional tool.

Technology in Higher Education

> You are invited to step into what well could be the most important decade of human history--the 1990's. It is the end of a century, the end of a millennium, and the end of many aspects of our current way of life. The 1990's will introduce us to the new age of technology, the new learning age, and it will bring rich possibilities as well as challenges for colleges and universities. (Parnell, 1990, p. 3)

The New Learning Age

The 1990's have given society a new technological base upon which the nature of work will be transformed and in turn the nature of the educational system with the inherent responsibility to prepare its citizenry for this new work environment. Higher education is faced with the challenge to blend technology into the fabric of the teaching and learning process.

Dale Parnell (1990) has explored the impact of technology upon higher education and believes that "for education the technological breakthrough of the century will likely arrive in the form of simulated learning utilizing a new technology like the interactive compact disc" (p. 240). Parnell sees simulation learning as a reachable reality and not as a futuristic dream. It is already a part of the education and training program of business and industry and is particularly

used by the military. The Army National Guard has used a Synthetic Flight Trainer for helicopter pilots. This program simulates problem-solving situations which do not endanger the life of the pilot. For Parnell, the impact of this type of learning through technology is that it simulates a learning situation in which the student can apply knowledge to a real-life experience.

Christopher Dede (1987) views this technological evolution as one in which data processing and information systems will be replaced by sophisticated devices for "knowledge creation, capture, transfer, and use" (p. 23). The concept of "cognition enhancers" (p. 23) helps learners to understand how they can use emerging technology. The cognition enhancer combines the complementary strengths of a person and an information technology. Cognition enhancers are of two categories: empowering environments and hypermedia. Empowering environments divide human labor and therefore enhance human accomplishments. The machine handles routine tasks while the human attends to higher-order thinking activities. Examples of empowering environments include such things as databases, spreadsheets, spell checks, and desktop publishing. Hypermedia is "the framework for creating an interconnected, web-like representation of symbols (text, graphics, images, software codes) in the computer" (p. 24). The result is similar to human long-term memory as people

store information in the form of symbolic, temporal, and visual images that are related by association.

With the introduction of such enhancers, the implications for curriculum and the teaching/learning process are profound. As a result of the widespread use of cognition enhancers, Dede (1989) believes that a partnership between people and an enhancer (tool) will allow the machine to take over the basic cognitive skills (routine tasks) and free the individual to engage in higher level thinking skills such as creativity, flexibility, decision making, and evaluation/synthesization. Assessment of achievement will concentrate on higher-order skills; "learning-while-doing" (p. 25) will become more significant in occupational education; and an emphasis on group task performance, problem solving, as well as collaborative learning will also become more important.

Dede (1989) sees workplace skills shifting toward an emphasis on group task performance, problem solving, and collaborative learning. If this is true, education must take the responsibility to teach these skills in the instructional environment. "Students in conventional classroom settings have few opportunities to build skills of cooperation, compromise, and group decision making; shifts in teaching must occur so that computer-supported collaborative learning becomes a major type of student interaction" (p. 25).

Perelman sees the 1990s not as the Learning Age but as the Knowledge Age and views the technological revolution as

having the potential to "render education obsolete" (Roe, 1994, p. 8). This new era--the Knowledge Age--requires that workers and managers sort through multitudinous data, make connections, and create new solutions; that is, they will use group task performance and higher level thinking skills to solve problems. Perelman believes educational institutions are not organized for learning. "To the extent that learning does occur, it is often the wrong kind for most people. As an example, total teamwork is required for cooperative problem solving in business, while teamwork in American education is most often viewed as cheating" (p. 9). Perelman does not believe that the concept of learning as practiced by educators today fits with what the "Knowledge Age economy really wants people to do" (p. 9). Perelman's views are supported by the rapid change taking place in technology, production techniques, computers, robotics, and telecommunications. Dale Parnell (1990) in Dateline 2000 estimates the half-life of new knowledge is between 5 and 10 years and the skills needed in business and industry are changing as rapidly.

The challenge to higher education is to recognize that "education's very stock in trade--knowledge--has fundamentally changed, and with it, society's needs and expectations for its colleges and universities also have changed" (Roueche, 1993, p. 4). Higher education must examine its mission and make the adjustments necessary to meet the needs of the society it serves.

Technology, Teaching, and Learning

> Have you ever wondered why it took twenty years for the overhead projector to make it from the bowling alley to the classroom?
>
> Anonymous

"We seem to persist in the notion that technology will eventually make some profound difference--if we can only figure out what computers have to do with students and teachers" (O'Bannion, 1994, p. 201). If applied in creative ways, information technology has the potential to revolutionize the educational process. This could occur if information technology were used to "increase the number of students an individual faculty member can teach;" if "colleges were to provide sophisticated, organized learning experiences driven by information technology for large numbers of students that are monitored or supported by a teacher or teacher's aide;" and if "colleges were to design and provide sophisticated, organized learning experiences driven by information technology for large numbers of students that stand alone without any assistance from teachers or teacher's aides" (p. 17). "Only those activities that actually change the nature of the interaction between students and faculty qualify as transformational" (p. 215).

O'Bannion (1994) echoes the sentiments of the 1980s description of new educational technologies for the future which predicted "formal instruction will no longer be the result of a course prepared exclusively by an individual and

delivered by a program or institution to a group of students. Rather, courses will be developed by teams and delivered in a variety of ways to individual consumers" (Strange, 1981, p. 15).

As technology becomes an integral part of the instructional environment, it is important to not lose sight of the human factor and to assure that "the design of technology systems works for learners, rather than to require learners to adapt to the requirements of technology" (Gooler, 1987, p. 72). Concern is expressed in respect to the trend toward knowledge transfer being managed by technology rather than human teachers. "There is enormous potential as well as huge dangers in this type of learning. The dangers will inevitably dominate unless we see technology as part of an overall system rather than permitting it to develop in terms of its own dynamics" (Theobald, 1994, p. 21). Again, focus should be on the design of technology in meeting the needs of the learners and not on learners adapting to meet the needs of technology. It is the responsibility of instructional designers to protect the integrity of the learner as the learning and teaching process is transformed through technology.

Project Odyssey "re-engineered" the teaching and learning process by combining a "radically different, but sound, pedagogy with an effective use of technology" (Privateer & MacCrate, 1992, p. 76). Project Odyssey "offered a

pedagogically determined, technological solution that better reflected the learning process" (p. 76). The goal of this project was to "transform Humanities 110, an introductory interdisciplinary general education course with 120 students per semester, from a disenfranchised lecture class with average attrition and attendance rates (25% to 30%) into an active, self-directed learning experience based on an Information-Problem Solving-Applications (IPA) strategy" (p. 76). This project essentially transformed the course from an instructor-centered, one-dimensional mode of presentation to a student-centered, multi-dimensional, active learning environment. By joining a student-centered pedagogy with a complementary technology, Project Odyssey may have rehumanized the learning experience.

What will ensure that a project of this quality and relevance will persist and spread throughout an instructional environment? According to MacCrate of Project Odyssey, "Right now we depend on the technological entrepreneurs on the faculty to take the lead. You can't expect all faculty members to drop everything they have done for years and adopt a new technology. But some elements of instructional technology would certainly blend with their teaching style" (Watkins, 1991, p. A26).

Teaching Style

What is teaching style? Teaching style can be defined as a hypothetical construct which is associated with various identifiable sets of teacher behaviors (Conti, 1985). It is a useful tool to "understand and perhaps explain certain important aspects of the teaching-learning process" (Fischer & Fischer, 1979, p. 254). Teaching style refers to the traits and qualities that a teacher displays in a classroom that are consistent in various situations (Conti, 1989). There are alternative views regarding the phenomenon of teaching style and how it is conceptualized into practice. Some view teaching style as an "external teacher characteristic" (Conti, 1989, p. 3), which includes modeling ideal teacher behavior, choosing strategies based on desired student outcomes, and linking dimensions of teaching style to equivalent dimensions of learning style.

The alternative view is that teaching style is internal in nature (Conti, 1989). This internal characteristic is determined by the values which the teacher brings to the instructional environment and molds the teacher's beliefs about the purpose of education, the structure of curriculum, the role of the teacher, and the nature of the learner (p. 4). These beliefs are based upon basic philosophies regarding "the way in which education should be conducted and the general principles that guide practice" (Beder, 1991, p. 37). Teaching style as an external characteristic is defined

through the strategies and methods which are utilized; teaching style as an internal characteristic is defined through the "range of behaviors in which the teacher can operate comfortably according to a certain value system" (Conti, 1989, p. 4).

Teaching Style and Technology

As the tools of information technology become more available within the classroom environment, new ways of generating and exchanging information have emerged. As technology becomes a part of instructional methodology, does this change how teachers perceive their role in the classroom?

There are common factors related to the use of technology in the classroom (Florini, 1989). "Technology-based instruction is essentially mediated-instruction, therefore the technology is interposed between student and teacher and student to student" (p. 49). Teacher independence may be impacted due to the need to interface with technicians and program developers. Some degree of collaboration and cooperation may be needed to successfully utilize technology thereby requiring the teacher to take a team approach in the delivery of instruction. This may impact teacher independence. Loss of flexibility may result as the technology may demand longer planning timelines and may not be conducive to spontaneity. Each technology may have its own idiosyncracies which make it more or less applicable for

particular uses. What are the implications for teaching style and technology?

> A personally constructed model can help teachers make effective instructional use of information technology without sacrificing important aspects of their teaching style. The development of this model would require that teachers recognize their own teaching style; become familiar with the medium's characteristics, understand the specific institutional circumstances in which the technology is used; and develop a sense of appropriate use of the technology" (Florini, 1989, pp. 51-52).

Diffusion of Innovations

> The gee-whiz futurists are always wrong because they believe technological innovation travels in a straight line. It doesn't. It weaves and bobs and lurches and sputters. (Naisbitt, 1982, p. 41)

The Tradition of Diffusion Research

In reviewing diffusion research, it would be advantageous to ask the questions which Everett Rogers (1983) also asked in his treatise on diffusion. Where did diffusion research come from? How did it grow to prominence, recognition, and use?

Diffusion research has a long and varied history. This tradition is associated with Gabriel Tarde, a French social psychologist as well as a judge who was prominent at the turn of the century. Tarde made several generalizations regarding diffusion of innovation and is best known for his concept of the "Laws of Imitation" and the "S Curve-Rate of Adoption." Tarde noticed that adoption would take off in an S curve when "opinion leaders" in a system accepted the idea. It was his

observation that adoption occurred first with an individual closely associated with the new idea, and then it would spread from higher- to lower-socio status individuals. Ideas that were similar to ones already accepted were the more likely to be adopted. These insights relating to the concept of diffusion of innovation have been validated by subsequent research.

The British and German-Austrian diffusionists who followed Tarde's footsteps and were anthropologists by training had similar viewpoints. It was their claim that all innovation spread from the original source. This idea argued against the concept that there was an existence of parallel inventions. That parallel inventions occurred throughout history has been demonstrated. It was not the concept of original source that gave this group prominence. Rather, it was that their actions brought attention by social scientists and anthropologists to the theory of diffusion. These are the roots of diffusion research.

Rogers (1983) viewed the rise of diffusion research traditions as a major breakthrough in the way of looking at something. It represented a revolutionary paradigm. The traditions include a foundation in anthropology, sociology, education, medical sociology, communication, marketing, and geography.

Diffusion research grew from the methodology used in anthropological investigation. The anthropologist had the

advantage of seeing a phenomenon from the respondent's viewpoint, could gather data over time, and primarily examined cross-cultural diffusion rather than diffusion within a social system. The tradition referred to as "Early Sociology" (Rogers, 1983, p. 50) was primarily concerned with innovation which contributed to social change and utilized quantitative analysis using primary and secondary sources.

Rural sociology formed the intellectual paradigm for diffusion research and was primarily agricultural research. In 1964, 45% of diffusion research was in rural sociology, but by 1981 this represented only 8% As the United States has transformed from an agrarian-based economy to one that is service and information oriented, so has diffusion research. A classic rural sociology diffusion study on hybrid corn by Ryan and Gross led later diffusion scholars toward such research questions as: (a) What variables related to innovativeness? (b) What was the rate of adoption of an innovation? (c) What factors explained this rate? This paradigm also established the methodology of "one-shot" interviews for gathering data (Rogers, 1983). As a result, rural sociology diffusion studies led to insight into the communication strategies necessary to diffuse new ideas rapidly throughout a system. It also asked the hard question of what are the consequences of technological innovations in relation to the impact on the societal structure? This

question focuses on the need to be technologically responsible and considerate of the human factor.

Education was not a late-comer in the diffusion research tradition, but has been limited in its impact upon this field of knowledge. In the 1920-30s, Dr. Paul Mort (1953) conducted a study which looked at local control over school finances as opposed to federal or state control and upon its influence on innovativeness. This study pointed to the educational cost per pupil as being the best predictor of innovativeness and indicated that there was a definitive time lag for widespread adoption. Schools typically would lag 25 years behind an innovative practice. Carlson (1965) analyzed the spread of modern math which diffused over a period of five years, a relatively short timespan in relation to the rate of adoption of most innovative practices. This study focused primarily on interpersonal networks and the importance of opinion leaders.

Education diffusion publications numbered 23 in 1961 (5% of all diffusion work), 71 in 1968 (6%), and 336 in 1981 (11% of all diffusion publications (Rogers, 1983, p. 62). Education's contribution to the field has been distinctive in that the studies project an organizational view rather than an individual. Teachers belong to the educational organizations and often make "collective and/or authority innovation-decisions" (p. 62) or individual decisions which are influenced to some degree by the organization.

Contributions of Diffusion Research

What is the appeal and value of diffusion research? Diffusion research embodies a conceptual paradigm that crosses many disciplines. Tracing the spread of an innovation through a system gives "life" to a behavioral change process (Rogers, 1983, p. 89). Because innovation is occurring throughout modern society, applications of diffusion theory and research are found in many places, and knowledge regarding diffusion of innovations has come to be regarded as a useful field within the social sciences (Rogers, 1983, p. 90).

Criticism of Diffusion Research

Diffusion research has suffered from "pro-innovation bias" (p. 92) which implies that an innovation should be adopted and diffused by all members of a social system. It assumes that the innovation is good for all members of the system and does not account for individual perceptions of the innovation nor understands the individual's situation, problems, or needs. Rogers (1983) indicates that this criticism of diffusion research can be overcome if the researcher does not always think of diffusion research as a backward look, but rather investigates the process as it is occurring. A researcher could investigate the broader context in which an innovation diffuses by looking at the environment in which it occurs as well as the existing practice(s) it might replace. It is also important to understand the

motivations for adopting an innovation by asking the question, "Why?" The diffusion investigator should see an innovation though the eyes of the respondent. These are the steps that could be taken to avoid pro-innovation bias (Rogers, 1983, pp. 95-98).

The Innovation-Decision Process

The innovation-decision process is "the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of the decision" (Rogers, 1983, p. 163). This process is conceptualized in five stages as illustrated in Figure 1, Rogers' Model of Innovation-Decision Process (p. 165).

Rogers' (1983) Model of Innovation-Decision Process begins with the Knowledge Stage when the individual (or unit) is made aware of the innovation and gains some understanding of its function. This event may occur as happenstance or by design depending upon the innovation and/or the situation in which it is presented. There is argument as to whether this stage is a passive activity or whether it is more active in that the individual (or unit) seeks information regarding the innovation. During this phase, the information that is sought is of three types: software information which answers such questions as "what is the innovation and how does it work?";

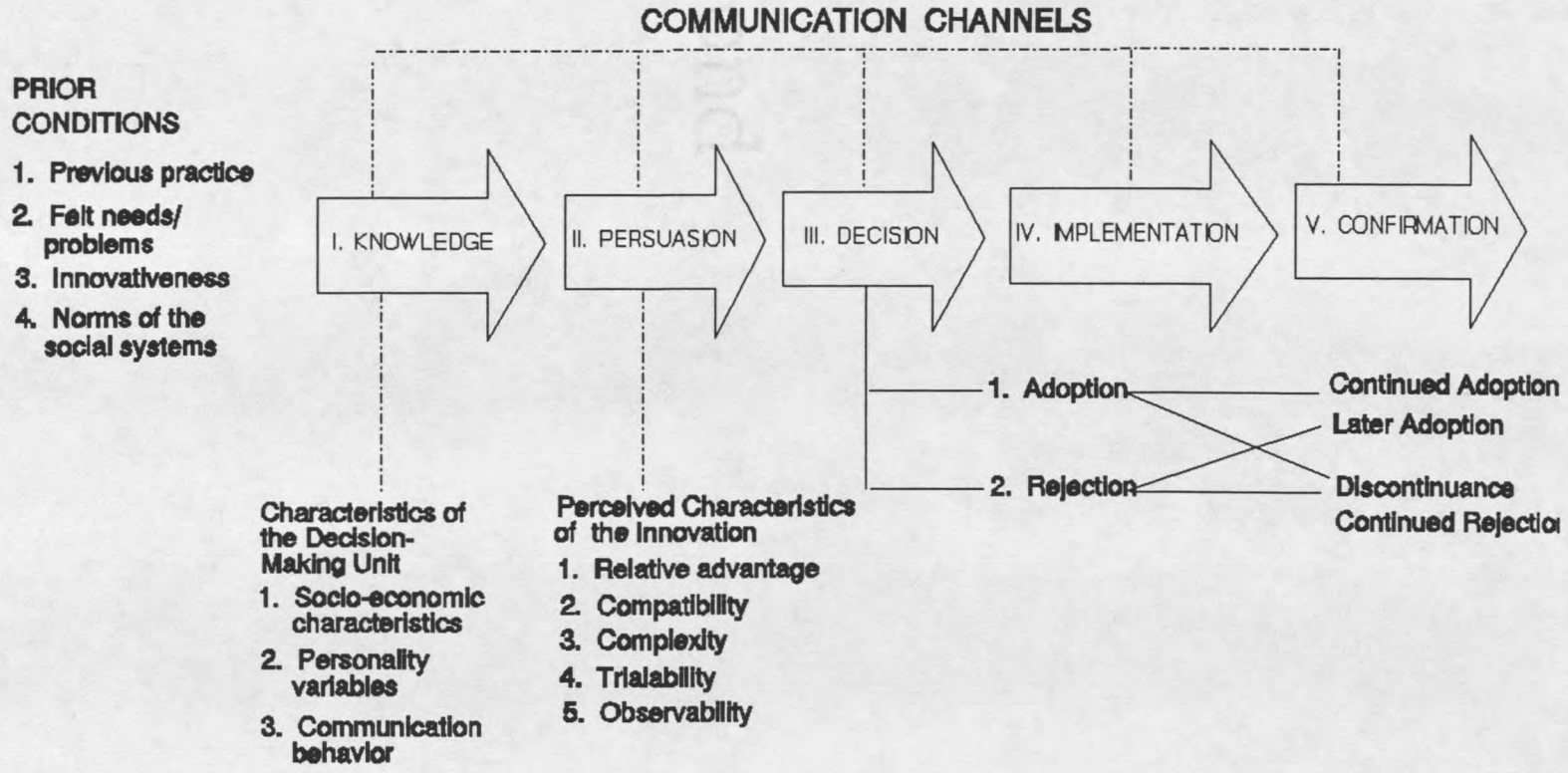

Figure 1. A Model of Stages in the Innovation-Decision Process.

how-to-knowledge which consists of information necessary to use an innovation properly; and principles knowledge which provides the underlying functioning principles of how the innovation works (p. 167).

Another aspect of this stage focuses on the characteristics of those categorized as "early knowers of an innovation" (Rogers, 1983, p. 168). Early knowers tend to have more education, higher economic status, more exposure to mass media and interpersonal communication channels, more contact with change agents, and more social participation, and to be more cosmopolite (pp. 168-169). A change agent is an individual who influences clients' innovation decisions in a direction deemed desirable by a change agency (p. 168).

In the Persuasion Stage, the individual (or unit) forms a favorable or unfavorable attitude toward the innovation. It is at this point that the attitude toward the innovation is affective rather than cognitive, as it is in the Knowledge Stage. The important questions asked at this stage are: (a) What are the innovation's consequences? and (b) What will its advantages and disadvantages be in my situation? It is at this point that an overt behavioral change will occur (Rogers, 1983, pp. 169-171).

The Decision Stage occurs when the individual (or unit) takes steps toward making a choice to adopt or reject the innovation. Most individuals do not adopt an innovation without trying it first. Although for some individuals, trial

by a peer can substitute for the individual's own need to try the innovation prior to adoption (Rogers, 1983, pp. 172-173).

The Implementation Stage is the point at which an individual (or unit) puts an innovation into use. This stage implies overt behavior as the new idea is implemented. This stage is important in that it is one thing for adoption to occur but quite another to actually use the innovation. The questions asked during this phase include: (a) Where do I obtain the innovation? (b) How do I use it? and (c) What operational problems am I likely to encounter, and how can I solve them? It is at this time that the change agent has a responsibility to provide the support necessary to ensure success. This stage ends when the innovation becomes institutionalized or a regular part of the adopter's day to day operation (Rogers, 1983, p. 174).

The Confirmation Stage is the terminal stage in the innovation-decision process. At this stage, the individual (or unit) seeks reinforcement for the innovation-decision already made, but risks reversing the decision if conflicting information about the innovation is received. The adopter seeks to reduce dissonance but will react to information that leads to questioning the merit of the innovation. At this point, the adopter may possibly discontinue use of the innovation. The change agent has a special responsibility at this time to provide messages to the adopter in support of the innovation (Rogers, 1983, pp. 184-185).

The validity of these stages is evidenced by research from an Iowa study by Beal and Rogers (1960) that indicated these were the stages that most farmers recognized that they went through during the process of adopting an agricultural innovation. Other studies (Copp, 1958; Mason, 1962; & Wilkening, 1956) substantiated Beal and Rogers. These studies revolved around farmers and did not reflect other kinds of innovations.

Communication Channels and the Diffusion Process

Rogers (1983) points to the importance of communication channels during the various stages of the innovation-decision process. The communication channel is the means by which messages transfer from one individual to another. These channels are categorized as (a) interpersonal or mass media in nature or (b) originating from either localite or cosmopolite sources. An example of a cosmopolite source is a doctor traveling to an out-of-town medical specialty meeting. Cosmopolite and mass media channels are more important at the Knowledge Stage, and localite and interpersonal channels are more important at the Persuasion Stage. Interpersonal channels are more effective in forming and changing attitudes toward the new idea and thus in influencing the decision to adopt or reject a new idea (Rogers, 1983, pp. 197-200).

In regard to adopter categories and communication channels, mass media and cosmopolite channels are more

important to earlier adopters than later adopters. That these channels are used by early adopters is reasonable in that early adopters must depend upon outside sources for their information and consequently become the interpersonal and localite channels for later adopters (Rogers, 1983, pp. 201-202).

Attributes of Innovations

Rogers (1983) has developed a comprehensive set of characteristics of innovations. These characteristics include relative advantage, compatibility, complexity, trialability, and observability. A detailed description of this general framework is as follows:

1. Relative advantage is expressed as the extent to which an innovation is thought to be better than the practice or idea which preceded it. This advantage may be seen from various viewpoints such as economic or social and has implications as to the rate of adoption. The "relative advantage of an innovation, as perceived by members of a social system, is positively related to its rate of adoption" (Rogers, 1983, p. 218).

2. Compatibility is considered the degree to which an innovation is believed to be consistent with existing values, past experiences, and needs of potential adopters. Compatibility or incompatibility of an innovation may stem from sociocultural values and beliefs, previously introduced

ideas, or client needs for innovations. As with relative advantage, "the compatibility of an innovation, as perceived by members of a social system, is positively related to its rate of adoption" (Rogers, 1983, p. 226).

3. Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use, and this may be expressed on a complexity-simplicity continuum. The "complexity of the innovation, as perceived by members of a social system, is negatively related to its rate of adoption" (Rogers, 1983, p. 231).

4. Trialability is based on the extent to which an innovation can be tried on a limited basis. This ability to experiment with a new idea or practice reduces uncertainty. "The trialability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption" (Rogers, 1983, p. 231).

5. Observability is determined by the degree to which the innovation is observable to others. This is based upon the concept that some innovations are easily observed and communicated to others, whereas some innovations are difficult to describe to others. "The observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption" (Rogers, 1983, p. 232).

In defining the attributes of an innovation, it is important to know that much diffusion research has focused on technological ideas. Rogers (1983) views technology as:

> A design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome. A technology has two components: (a) a hardware aspect that consists of the tool that embodies the technology as material or physical objects, and (b) a software aspect that consists of the information base for the tool. (p. 12)

Rate of Adoption

The rate of adoption is the speed at which an innovation is adopted by members of a social system. It is usually measured by determining the number of individuals who accept a new idea or practice in a specified period of time. Rogers (1983) determined that 49% to 87% of the variance in rate of adoption is explained by the five attributes, but other variables are also important to the adoption process. These other variables include (a) type of innovative-decision, (b) communication channels, (c) nature of the social system, and (d) extent of change agent's promotion effects.

There are three types of innovation-decisions: optional, collective, and authority. Each of these influences the rate of adoption. "We generally expect that innovations requiring an individual-optional innovation-decision will be adopted more rapidly than when an innovation is adopted by an organization" (p. 233).

Communication channels (mass media or interpersonal) used to diffuse an innovation influence the rate of adoption. If interpersonal channels must be used to create awareness-knowledge, as frequently occurs among later adopters, the rate

of adoption will be slowed (p. 233). This becomes a complex issue. Petrini et al. (1968) found differences in communication-channel use on the basis of the perceived complexity of innovations among Swedish farmers. Mass media channels were satisfactory with less complicated innovations, and personal contact with extension change agents was more important for innovations that were perceived to be more complex.

The nature of the social system is another variable to consider in regard to the adoption process. Of particular importance is are the norms of the system and the degree to which a communication network structure displays a high degree of interconnectedness. This is demonstrated by the "diffusion effect" (Rogers, 1983, p. 234). This effect is the cumulatively increasing degree of influence upon an individual to adopt or reject an innovation. This may result from activation of peer networks about an innovation in a social system.

> For example, when only 5% of the individuals in a system are aware of a new idea, the degree of influence upon an individual to adopt or reject the innovation is quite different from when 95% have adopted. In other words, the norms of the system toward the innovation change over time as the diffusion process proceeds, and the new idea is gradually incorporated into the lifestream of the system. (pp. 234-235)

The extent of the change agent's promotion efforts also impacts the rate of adoption of innovations. This is not a direct influence. "There is a greater pay-off from a given

amount of change agent activity at certain stages in an innovation's diffusion" (p. 234). When an opinion leader is adopting an innovation, there is greater response to the change agent's efforts.

Adopter Categories

> To innovate is not to reform.
> Edmond Burke (1796)

As some people are more predisposed to accept and use new ideas or practices than others, Rogers (1962) described adopters according to specific categories based on level of innovativeness. At the time Rogers developed his descriptions, a number of other diffusion researchers had also attached various adjectives to describe adopters. This was especially so for those determined to be innovative. These descriptors varied from Progressists, Hightriers, Experimentals, Lighthouses, Advance Scouts, and Ultraadopters; those thought to be the least innovative were called Drones, Parochials, and Diehards (Rogers, 1983, p. 242).

Recognizing the need for standardization of terms, Rogers (1983) developed the following adopter categories as ideal types and as a framework for synthesizing research findings.

1. Innovators are described as venturesome. These individuals desire to try new ideas and usually will go out of their social circle into more "cosmopolite" social relationships (p. 248). This individual may not be the most respected

within the social system but will play a major role in the diffusion process.

2. Early Adopters are considered respectable in that they are more integrated into the social system than innovators. These individuals rely on "localite" social relationships (p. 249) and have a greater degree of opinion leadership in that potential adopters will look to these persons for advice and information. They serve as "role models for many others of a social system" (p. 249).

3. Early Majority will adopt new ideas before the average member of the social system and are deliberate in their efforts. These individuals usually do not hold leadership positions, but interact frequently with their peers. "They follow with deliberate willingness in adopting innovations, but seldom lead" (p. 249).

4. Late Majority are seen as skeptical and adopt new ideas after the average member of the social system. Their acceptance may be based more on economic necessity as well as increasing pressures from peers.

5. Laggards are traditional in their mindset and are the last to adopt an innovation. They are not opinion leaders and they are the most localite in their social relationships. These individuals use the past as their point of reference and are extremely suspicious of innovators and change agents. This term has been criticized as being especially negative,

but as Rogers (1983) asserts, any name would soon take on a negative connotation by diffusion scholars.

These categories are important in that they suggest that change agents should use somewhat different approaches with each adopter category, thus following a procedure of audience segmentation, a diffusion strategy in which different communication channels or messages are used with each audience segment (p. 262).

Opinion Leadership

Opinion leadership is a term mentioned throughout this discussion of diffusion theory and especially in reference to adopter categories. Opinion leadership is "the degree to which an individual is able informally to influence other individuals' attitudes or overt behavior in a desired way with relative frequency" (Rogers, 1983, p. 271). These are the individuals who influence the opinions of others in regard to innovations and also influence the rate of adoption throughout a social system.

The generalizations related to the characteristics of Opinion Leaders fall into four areas: (a) communication, (b) accessibility, (c) socioeconomic status, and (d) innovativeness (Rogers, 1983). Opinion Leaders differ from their followers by their manner of external communication. Opinion Leaders are considered to have greater exposure to mass media, are more cosmopolite, and have greater change agent contact.