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ABSTRACT

This paper examines characteristics of early and later adopters of educational technology among college faculty and suggests models for encouraging wider diffusion of technology for teaching and learning. Using Rogers' (1995) theory of diffusion of innovations, the paper examines: (1) the characteristics which distinguish early adopters from others; (2) the implications of developing a long-term plan for campus-wide activities based on the characteristics of early adopters; and (3) the alternatives to such a plan. The paper finds different characteristics and roles for each of the five categories of adopters under Rogers' diffusion theory. Especially noted is the "chasm" between early adopters, who are interested in the technology itself, and later adopters, who are concerned primarily with teaching and learning and view ease of technology use as critical and want proven applications with low failure risk. Such studies suggest that case study research of individuals who are both early adopters of instructional technology and excellent teachers are needed. The paper concludes that to achieve adoption by mainstream faculty, campus-wide planning and investment in the human infrastructure is needed, including training and support which capitalizes on the opinion leadership and persuasive qualities of early adopters. (Contains 47 references.) (DB)

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# Bridging the Gap Between Early Adopters' and Mainstream Faculty's Use of Instructional Technology

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Abstract

At this point in time, evaluation of the success of educational technology seems to depend largely on how well "early adopters" make it work for teaching and learning. This paper examines the characteristics of early adopters using Rogers (1995) diffusion of innovations theory in order to explore three questions: 1) what differentiates early adopters from others, 2) what are the implications of developing a long-term plan for campus-wide activities that is based on the characteristics of early adopters, and 3) what alternatives are there other than building from such pioneers? A number of system-wide initiatives have been implemented at various higher education institutions which provide models for encouraging wider diffusion of technology for teaching and learning, and bridging the gap between early adopter success and more mainstream adoption.

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## Introduction

Higher education is an information intensive institution involved in providing the changing future qualifications required by the work force and society. Universities have a responsibility to include computer knowledge, skills and literacy in some form as part of a student's education, and therefore have invested large sums of money into information technology (IT). It should be stressed that IT has no aim in itself (Bull, Dalinga-Hunter, Epelboin, Frackmann, & Jennings, 1994). It is the changing, increasing or even overwhelming role and importance of information which is the underlying and driving force for the development of IT. The advances in the supporting technology may significantly change the potential and use of information. Those involved in higher education are directing their efforts towards collecting, using, processing and delivering information. Research information is the 'raw material' and 'final product' of research processes. Research findings need to be communicated, and IT supports, influences and changes this dissemination process. Teaching and learning rely on the transfer and processing of information. IT may support and increase the efficiency of this interaction or even modify educational processes, especially with regards to distance education and "anytime, anywhere" access (Daniel, 1997). Recent estimates indicate that American colleges and universities invest billions of dollars per year acquiring IT (Geoghegan, 1994). Formal evidence linking this investment to higher productivity (Schwalbe, 1996) and changes and improvements in the teaching and learning process is accumulating (Kulik & Kulik, 1980, 1987; Ehrmann, 1995), and new research approaches and methodologies have been developed to adequately study the unique issues involved in educational technology (Clark, 1989; Reigeluth, 1989). Integrating technology into the teaching-learning transaction has been found to transform the teacher's role from being the traditional "sage on the stage" to being a "guide on the side", and student roles also change from being passive receivers of content to being more active participants and partners in the learning process (Alley, 1996; Repp, 1996; Roblyer, Edwards, & Havriluk, 1997). IT is currently being used in higher education for information access and delivery in libraries, research and development, as a medium of communication, and for teaching and learning. Increased access to and use of the Internet is making a unique contribution to the teaching and learning process (Shaw, 1994) and will be an important part of future strategies to provide services to increased number of students (Daniel, 1997). However, despite research and testimony that technology is being used by more faculty, the diffusion of technological innovations for teaching and learning has not been widespread, nor has it become deeply integrated into the curriculum (Geoghegan, 1994). No more than five to ten percent of faculty utilize information technology in their teaching as anything more than a "high tech" substitute for blackboard and chalk, overhead projectors, and photocopied handouts (Reeves, 1991). Mainstream faculty seem hesitant or reluctant to adopt computer technology for their teaching tasks. The evaluation of the success of educational technology still seems to depend largely on how well "early adopters" make it work. Given the size of investment in instructional technology in higher education, the increased demand for distance education in the future, and the demonstrated effectiveness with some educational outcomes, it seems reasonable to investigate why the integration of technology for teaching and learning is so appealing to some faculty, and not to others.

This first topic examined in this paper are characteristics of early adopters using Rogers' (1995) diffusion theory. Focus will be on early adopters of instructional technology in higher education and what differentiates them from mainstream faculty. Also discussed are the incentives and barriers that may impede or promote the diffusion and adoption of innovations in instructional technology. The second major topic of this paper is an examination of the implications of developing a long-term plan for campus-wide integration of technology that is based on the characteristics of early adopters. There is growing recognition of the need to provide a different support infrastructure for mainstream faculty than for early adopters of technology for teaching and learning. A number of system-wide initiatives have been implemented at various higher education institutions which provide models for encouraging wider diffusion of technology for teaching and learning, and bridging the gap between early adopter success and more mainstream adoption. Finally, this paper concludes with an examination of the alternatives to building from the successes and characteristics of early adopters.

## What Differentiates Early Adopters From Others?

Descriptions in the literature suggest that faculty who are innovators or early adopters of instructional technology for teaching and learning are intrinsically motivated, self-taught, "lone-wolves" and experimenters (Wertheimer & Zinga, 1997), who are confident and efficacious (Snelbecker, 1995), comfortable with constant change, attracted to challenge, risk takers, and excellent teachers whose use of technology appears to be a natural extension of their area of expertise (Hadley & Sheingold, 1993). Individuals in this group have often used technology to "reengineer" (Hammer & Champy, 1993), or transform the teaching-learning transaction, thus changing teacher and student roles (Roblyer, Edwards, & Havriluk, 1997). What differentiates the early adopter of instructional technology from other faculty members? Diffusion theory provides an approach to discussing the differences between early adopters and others.

### Diffusion of Innovations

A conceptual framework for analyzing of the characteristics of adopters is provided by Everett Rogers' (1995) theory of the diffusion of innovations. Rogers' (1995) defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). The four main elements are the innovation, communication channels, time, and the social system. Rogers (1995) defines an innovation as an idea, practice or object that is perceived as new by the individual, and diffusion as the process by which an innovation makes its way through a social system. For our purposes, the innovation is instructional technology for teaching and learning, and diffusion is the extent to which all faculty have adopted this innovative methodology. Because individuals in a social system do not adopt an innovation at the same time, "innovativeness" is the degree to which an individual is relatively earlier in adopting new ideas than other members of a system. Word processing is becoming a ubiquitous technology on campuses. Faculty who used text editors twenty years ago have a higher degree of innovativeness than faculty who started using word processing yesterday. When an innovation has been adopted by most or all of the members in a social system or adopter category, diffusion has reached the saturation point. Geoghegan (1994) suggests that this saturation point has been reached with early adopters of instructional technology. When new ideas are invented, diffused, and are adopted or rejected, leading to various consequences, social change occurs (Rogers, 1995). This social change can be planned or spontaneous; a physics department invents a new network interface and protocol for exchanging leading edge information among physicists versus the spontaneous and exponential demand for access to the Internet with the advent of the World Wide Web.

**Adopter Categories**

The time element of the diffusion process allows us to classify adopter categories and to draw diffusion curves. Based on Rogers (1995) diffusion theory, the adoption of an innovation usually follows a normal, bell-shaped curve when plotted over time on a frequency basis (Figure 1). If the cumulative number of adopters is plotted, the result is an S-shaped curve. Many human traits are normally distributed; physical traits such as height or weight; behavioral traits such as intelligence or learning of information. Hence, Rogers (1995) reasons, a variable such as the degree of innovativeness is also expected to be normally distributed. Rogers' classification model offers several advantages for describing the adoption patterns of individuals in a group: (1) it is easy to use, (2) it offers mutually exclusive and exhaustive standardized categories, by which results can be compared, replicated, and generalized across studies, and (3) because the underlying distribution is assumed to be normal, continued acceptance of an innovation can be predicted and linked to the adopter categories (Mahajan, Muller, & Srivastava, 1990).

Rogers (1995) suggests that the adoption of a new idea results from information exchange through interpersonal networks. The first adopter of an innovation discusses it with other members of the system, and each of these adopters pass the new idea along to other peers. The diffusion curve begins to level off after half of the individuals in a social system have adopted, because each new adopter finds it increasingly difficult to tell the new idea to a peer who has not yet adopted, for such non-knowers become increasingly scarce. The segment of the diffusion curve between 10 to 20 percent adoption is "critical mass" or the "heart of the diffusion process" (Rogers, 1995) and represents the transition from the "early adopter" level of innovativeness to the "early majority".

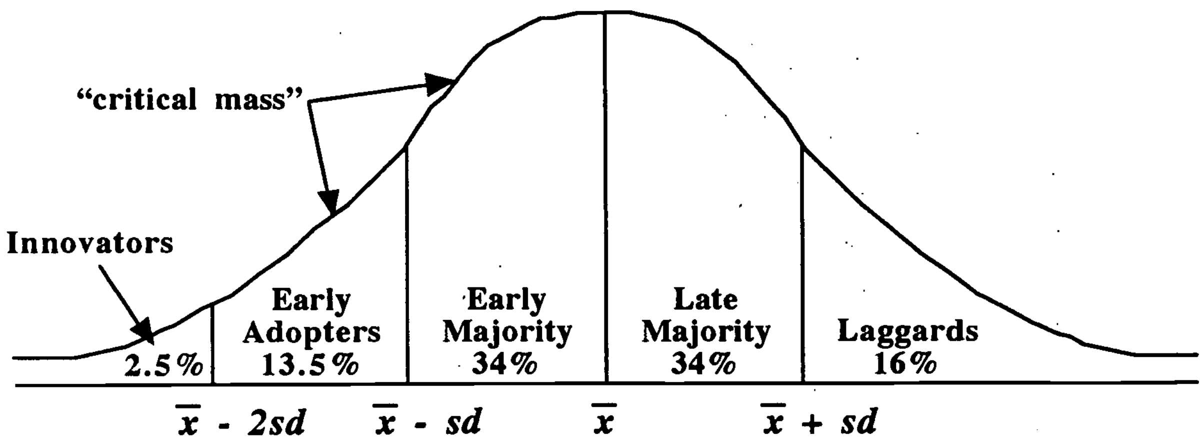


Figure 1. Adopter Categorization on the Basis of Innovativeness (Rogers, 1995)

Having been abstracted from empirical investigations and market research, the five adopter categories Rogers (1995) describes along the continuum of innovativeness (i.e., innovators, early adopters, early majority, late majority, and laggards) are "ideal types" designed to make comparisons possible based on characteristics of the normal distribution and partitioned by the mean and standard deviation. Ideal types are not simply the average of all observations about an adopter category, exceptions can be found, and pronounced breaks do not occur between each of the five categories. A different diffusion curve can be generated for each type of computer application to compare percentage of diffusion. Personal use of word processing is almost completely diffused because it has been adopted by a majority (> 90%) of faculty (Geoghegan, 1994), whereas presentation software and email use in classrooms is just beyond "critical mass" at 20 percent adoption (Green, 1996). Levels of college student (33%) and home (40%) computer ownership have passed the early adopter stage, with faculty ownership (50%) diffusing into the late majority (Green, 1996). Research comparing both the adoption of various technologies and the extent to which they are used effectively by university faculty for teaching and learning would generate different diffusion curves. Future empirical research might also build and extend upon Rogers' (1995) adopter categories to more accurately reflect and describe faculty innovativeness with technology (i.e., reflective observers rather than late majority; conscientious objectors rather than laggards). Semantic considerations aside, the following summary descriptions provide a useful starting point to differentiate Rogers' (1995) adopter categories.

Innovators (INs) are venturers who identify and explore new frontiers without map or guide. Their interest in new ideas leads them out of local peer networks. Communication patterns and friendships among a clique of INs are common even if they are geographically separated. INs usually have control of substantial financial resources to absorb the possible loss from an unprofitable innovation. They have an ability to understand and apply complex technical knowledge in their field. For example, one might find a majority of computer technology innovators in faculties of engineering and computer science. INs are able to cope with a high degree of uncertainty about an innovation at the time of adoption, and are willing to accept an occasional setback when a new idea proves unsuccessful. While an innovator may not be respected or supported in their social system, they play an important promotional role in the diffusion process: that of launching a new idea in the system by importing the innovation from outside the system's boundaries.

Early adopters (EAs) are a more integrated part of the local social system than innovators; localites rather than cosmopolites. EAs have the greatest degree of opinion leadership in most systems, and potential adopters look to them for advice and information about the innovation. The EA is considered the "individual to check with" before using a new idea, and are generally sought by change agents to serve as local evangelists for speeding the diffusion process. A change agent is an individual who influences potential adopters' in a direction deemed desirable by a change agency (Rogers, 1995). Because EAs are not too far ahead of the average individual in innovativeness, they serve as a role model for many other members of a social system. The EA is respected by peers, embodies successful, discrete uses of new ideas, and makes judicious innovation-decisions. The EA is the "heart of the diffusion process" because they decrease uncertainty about a new idea by adopting it, and then convey a subjective (i.e., hunch or gut feeling) and or objective evaluation of the innovation to peers through interpersonal networks. EAs differ from later adopter across a number of personality variables. EAs have more empathy, less dogmatism, a greater ability to deal with abstractions, greater rationality, greater intelligence, a more favorable attitude toward change, a better ability to cope with uncertainty and risk, a more favorable attitude toward science, less fatalism, and higher aspirations for formal education and occupations than do later adopters.

Taken together, the early majority (EM) and the late majority (LM) represent the "mainstream". The EM adopts new ideas just before 50% of the members of a system. They interact frequently with their peers, but seldom hold positions of leadership in a system. The EMs unique position between the very early and relatively late to adopt makes them an important link in the diffusion process. As one-third of the members in a system, they provide inter-connectedness in the system's interpersonal networks. The EM may deliberate for some time before completely adopting a new idea. Their innovation-decision period is relatively longer than that of the innovator and early adopter. They may follow with deliberate willingness in adopting innovations, but seldom do they lead. The LM is a skeptical one-third of a social system, and adopts new ideas after the median (i.e., 50th percentile) member of a system. Adoption may be both an economic necessity and as a result of increasing network pressure from peers. Innovations are approached cautiously, the LM do not adopt until most others have done so, and system norms must definitely favor an innovation before they are convinced. Their relatively scarce resources mean that most of the uncertainty about a new idea must be removed before the LM feels that it is safe to adopt.

Laggards (LGs) are the last in a social system to adopt an innovation. The point of reference for the LG is the past, decisions are often made in terms of what has been done before, and these individuals interact primarily with others who also have relatively traditional values. LGs tend to be suspicious of innovations and change agents. Their innovation-decision process is relatively lengthy, with adoption and use lagging far behind awareness-knowledge of a new idea. Resistance to innovations on the part of LGs may be entirely rational from the LGs' viewpoint, as their resources and confidence are limited and they must be sure that a new idea will not fail before they adopt. The LGs' precarious economic position forces the individual to be extremely cautious in adopting innovations. System-blame may more accurately describe the laggards' situation.

Information has been collected by researchers in an attempt to characterize individuals at the tail end of the distribution as a specific personality type. Rosen and Maguire (1990) conducted a meta-analysis to examine the personality characteristics of computerphobics, and found that none of the six common beliefs characterizing the computerphobic (i.e., they are female rather than male, older rather than younger, and possess other types of anxiety) represent reality. With regard to the current discussion of early adopters and innovation adoption patterns, it seems likely that computerphobics represent the tail-end of the distribution and are small in number. Rosen and Maguire (1990) state that the computerphobic group, who are acutely or severely phobic and exhibit all of the classic signs of an intense anxiety disorder, is actually quite small (<10%). We might extrapolate this finding to the faculty population to conclude that the number of faculty who resist technology because they are phobic are small in number. Therefore, treatments for computerphobics need not be a large part of a campus-wide strategy to integrate technology.

**Rogers' Diffusion Theory: Related Contexts**

Researchers have validated Rogers' theory by investigating the diffusion of various innovations. Dickerson & Gentry (1983) found that early adopters of home computers displayed similar characteristics to adopters of other innovations: middle-aged, higher income, more education, an opinion leader and information seeker. They found that early adopters of home computers have had more experience with a variety of technical products and services than non-adopters. Consistent with Rogers' proposition that the more compatible the innovation is with the adopter's background, the more likely it is to be adopted, the two experiences which best predicted adoption of the home computer are those related to functions (i.e., games, programming) superseded by the home computer. In a study of school counselors, Casey (1995) describes innovators as advanced, self-taught "power users" who are authoring programs using programming languages, and the laggards as "technophobes" who avoid computer technology at all costs. He believes most counselors fall somewhere between these two extremes. Casey's (1995) early adopters were more mainstream than the innovators, effective at amplifying promising developments engineered by innovators, and eager leaders who provided workshops and publications for peers while struggling with the slow pace of mainstream acceptance.

Ram & Jung (1994) looked beyond diffusion patterns to investigate adopter characteristics with regards to *use innovativeness* with personal computers. *Use innovativeness* is the degree to which an adopter uses a previously adopted product to solve a novel consumption problem. Early adopters are found to have higher usage variety that do later adopters, which may be a result of their higher involvement with the innovation. In other words, early adopters are likely to be more use innovative and capitalize on the wide variety of uses to which a computer can be put, be more aware of its various features and capabilities, and seek different uses for their computers than do later adopters. Early adopters, like expert computer users, use more options, features and software on their computers, whereas the early and late majority, like novice users, use less options to start with. Ram & Jung (1994) suggest that later adopters are more intimidated with new technology and need different kinds of support than early adopters, such as additional training and user-friendly manuals. Another appropriate strategy may be product differentiation through simplification: create a no-frills computer for the later adopters, rather than trying to make them as diversely accomplished as the early adopters are with the fully loaded model (Ram & Jung, 1994).

**Newbies and Enthusiastic Beginners**

There is a growing number of computer-using faculty who are not necessarily highly skilled, or computer literate in the traditional sense, but are very enthusiastic about adopting technology because they see the potential of newer tools, such as e-mail and the World Wide Web, for their students. Communication technologies may be the proverbial carrot that entices mainstream faculty to adopt technology for teaching and learning (Foa, 1993). Once they are intrigued by e-mail and the Web they may start asking questions about other technologies (Gilbert, 1996). These enthusiastic beginners see technology as a methodology for doing neat and exciting things with their students rather than being fascinated with the technology itself. With the development of graphical interfaces, technology has become more transparent and user friendly. However, there are still barriers that may constrain use by enthusiastic beginners, and a fairly steep learning curve to climb before integration becomes effortless. User friendliness is a seductive term that does not represent current technology reality. Computers are still not well-designed, fault-free, and easy to use. In fact, software manufacturers seem to be swinging from a "user friendly" simple design with few features but great functionality, to a more complicated, feature-rich design. Donald Norman (1993) must be having a field day examining the thousands of new, and often poorly mapped, features and capabilities of current software! For example, Microsoft Word is a powerhouse 16 MB word processor with thousands of features that will probably never be used by the average user. Because of their use innovativeness, early adopters might maximize their investment in such a program by utilizing many of its capabilities. However, later adopters may not need a feature-rich program to start with, and may be intimidated by all of the bells and whistles.

**Early Adopters of Instructional Technology**

Results from a faculty survey (Jacobson & Weller, 1988) indicate that early adopters, with self-reported good-excellent computer skills, had different perceptions about obstacles to computer use than did later adopting, mainstream faculty with poor-fair computer skills. While a majority of faculty agreed that lack of funds for hardware and the lack of technical support were obstacles, a larger percentage of mainstream faculty viewed the lack of technical support as more problematic than early adopters. EAs were more self-sufficient with regards to support and wanted more access to hardware resources for experimentation. Although the EAs reported acquiring computer use mainly through self-training and assistance from colleagues, both EAs and mainstream faculty felt that a lack of training was an obstacle to widespread use of computers. Jacobsen & Weller (1988) found that although the reported use of some computer applications was quite low, enthusiasm for adopting additional innovations was quite high across both groups. These findings suggests three trends: (1) that the use of computers for one purpose may encourage enthusiasm for further computer use, (2) that mainstream faculty may be limited adopters because of the lack of technical support and training, and (3) that colleague supported training is a viable way to encourage diffusion of computer applications and use. There appears to be an opportunity to capitalize on the early adopter's knowledge and skill base, and somehow share this with mainstream faculty who have concerns about support and training.

Hamilton & Thompson (1992) provide a good summary of the personality characteristics early adopters have in common in their study of the adoption of an electronic network for educators. A communications network was established to create an electronic link between student and practicing teachers and the education faculty at a college to: decrease the isolation often experienced by student and practicing teachers, to make faculty expertise readily available, and to increase faculty awareness of any problems in the field. EAs in this study shared similar levels of education, social status, and social participation, had a cosmopolitan outlook, accessed information from mass media, belonged to wide interpersonal communication networks, displayed a high degree of innovation information seeking, possessed positive attitudes toward change and risk, and had similar aspirations and neutral attitudes toward fatalism. EAs played an important role in this diffusion process because their adoption was visible to the early majority and influenced their subsequent adoption. Hamilton & Thompson (1992) suggested that network developers should seek out EAs who will enhance the diffusion process.

Often, the individuals who have integrated technology for teaching and learning have done so in a university climate that has provided little or no external recognition or incentive for either excellent teaching or technology implementation (Sammons, 1993). There is no professional training requirement for university teachers as far as their teaching is concerned (Laurillard, 1993), faculty members receive little or no formal training on using computers for teaching and learning, and the annual review process often fails to recognize innovative teaching as part of the merit system (Sammons, 1993). Instead, faculty rely on colleague support and self-teaching. A faculty member may combine teaching and research with technology. However, development time for computer-based teaching materials may extend over years, with little reward for the final product. In fact, many universities have a policy which requires the developer to share or give copyright of software products to the institution (Reeves, 1991). It appears that system-wide changes will be needed in the reward system and training for faculty members in order to encourage broader diffusion of instructional technology in the mainstream.

**Excellent Teaching and Early Adoption**

The following study examines the early adopter profile with respect to teaching methods. Phillip, Flores, and Sowder (1994) studied mathematics teachers who were identified as early adopters of innovative teaching methods, and found their characteristics to be similar to those summarized by Rogers. Early adopters focused on problem solving, conceptual relationships and understanding, and communication in mathematics. These characteristics are similar to the "discrete and successful use of new ideas" described by Rogers. Teachers had a comprehensive knowledge of the mathematics they were teaching, which is consistent with "higher rationality, higher intelligence" of early adopters. These teachers participated in their own professional growth by attending conferences and inservice programs, completing graduate studies, and seeking encouragement and support for their reform from peers and administration, suggesting that these early adopters were involved in and contributed to a rich interpersonal network.

Characteristics of exemplary teaching apply directly to the effective use of technology in undergraduate teaching. It may not be the case that "early adoption of instructional technology" and "excellent teaching" are qualities that exist in the same faculty member. Rob Chandhok, from Carnegie Mellon University, reminds us that "there are plenty of innovators in education that make no use of technology at all" (Gilbert, 1995, p. 33). Universities have to design technology integration plans that focus both on excellent teaching and adopting various technologies to support teaching. Early adopters of technology who are also excellent teachers have much to contribute to this planning process. Kearsley (1996) suggests that excellent teaching should be our first priority, because adopting technology will not improve poor teaching. He argues that in the absence of knowledge about and enthusiasm for the discipline, student participation, explicit expectations, well-defined course structure, and an enjoyable learning environment, technology will not enhance learning to any degree. If cases are found where early adoption and excellent teaching exist in the same individual, then it is worth profiling this expertise for the benefit of other faculty members who wish to develop both their technology and teaching knowledge and skills. Books have been written about and by excellent higher education teachers. Case study research that profiles individuals who are both early adopters of instructional technology and excellent teachers would fill a need by providing role models and guidance in this innovative, constantly changing, and exciting area.

### A Prototypical Model of the Early Adopter of Instructional Technology

The research on early adopters defines the general characteristics common to all members of this subgroup. However, it is worth remembering that early adopters are, at the same time, unique and variable individuals who may resemble each other much less than they resemble the general subgroup characteristics. Although early adopter categories are useful to describe general group characteristics and trends, there is a need for more focused and careful description of individuals within this category. For example, one can imagine that early adopters possess various and different: levels of ability and skill, beliefs and visions about the value of computers, specific personality traits, levels of risk-taking behavior, motivations to learn about technology (internal, external, environmental, opportunity), development patterns (self-taught, peer teaching, courses), and have implemented computers in different environments, under different conditions (i.e., vendor, department and self support) and with different expectations. Indeed, an interesting question worth further investigation is whether early adoption depends on personality or environment. It appears that there is a need to develop a model, similar in nature to Sternberg and Horvath's (1995) "Prototypical Model of the Expert Teacher" which allows for variability among experts, against which one can compare early adopters of instructional technology to better understand their commonalities and differences.

## Developing Long-Term Plans for Campus-wide Diffusion

Universities are in a situation where there is widespread adoption of instructional technology by innovators and early adopters, but limited adoption by mainstream faculty (early and late majority). It is apparent from descriptions of early adopters and the "early-late majority" mainstream, that these two groups have different characteristics, motivations, and needs.

Therefore, campus-wide integration plans cannot be developed on the assumption that mainstream faculty will naturally use computers as readily and easily as the early adopter. In the relatively short period of time that instructional technology has been used on campuses, many hard lessons have been learned and it is up to each and every "learner" to share those lessons (Reeves, 1991). This knowledge sharing process can be made more efficient and widespread through institution level commitment and support of IT.

**Blaming Faculty**

Previous explanations for why universities were "stuck at the barricades" between early adopters and mainstream faculty focused on blame. Mainstream faculty were blamed for being stuck in traditional methods of course delivery, were labeled as resistors and charged with negative attitudes towards technology (Gordon, 1983). These explanations were based on a poor understanding of the difference between early adopters and mainstream faculty. Administration and management, sometimes the early adopters themselves, wondered why mainstreamers were not jumping on board and getting with the technology program. The challenge for faculty and administration is not to assign blame nor to attempt to fix faculty attitudes. Academics are trained to be critical (in the best sense of the word) and may be expected to make demands for justification of resource allocation (Noblitt, 1997). Because of their independent nature, academics might be skeptical when technicians rather than faculty direct the use of educational technology (Gilbert, 1995). The challenge is to draft integration plans and design new educational systems within the logic and meaning of the emerging paradigms that are informed by our growing understanding of the complexity and interconnectedness of faculty social systems, communication channels, and patterns of diffusion. A different support infrastructure is needed for mainstream faculty than that which sufficed for early adopters. Recognizing that mainstreamers have different characteristics, and therefore needs, does not suggest that there is no role for early adopters in developing long-term plans for campus-wide adoption. Quite the opposite. Early adopters have discovered and overcome barriers in their attempt to integrate this innovation, and have developed and contributed to a collective knowledge base concerning instructional technology. The main change agencies, management and administration, should capitalize on this valuable human resource that exists on campus. Strategies to encourage EAs to share their expertise with the mainstream might include changes to the reward structure, release time for training, forging links with Teaching Development units, creation of training materials, and supporting symposia and conferences.

**"Critical Mass" and the "Chasm" Between Early Adopters and Mainstream**

According to Green's (1996) annual Campus Computing Survey, adoption of technology for classroom use has risen between 1994 and 1995. E-mail use has almost doubled to 20 percent, use of presentation software is over 25 percent, and the use of multimedia resources and CD-ROM-based materials has risen to just under 10 percent. Green (1996) suggests that the use of information technology is approaching the "critical mass" level, described by Rogers (1995) as the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining. However, Green (1996) also indicates that of all the issues surrounding the adoption of technology for teaching and learning, institutions rated "user support and training" as the most important. Unfortunately, the investment in instructional development (that is, providing assistance to faculty eager to use technology in their classrooms) has remained flat over the last six years. Although infrastructure supports innovation, and many campuses have taken steps to replace obsolete equipment and provide access to multimedia capable computers, technical assistance and user support are the most critical catalysts for adoption and integration of instructional technology (Green, 1996).

Geoghegan (1994) describes what he refers to as a "chasm" between early adopters and the early majority, such that the innovation is never adopted by the mainstream. He contrasts early adopters, who are risk takers, more willing to experiment, generally self-sufficient, and interested in the technology itself, with early majority faculty who are more concerned about the teaching and learning problems being addressed than the technology used to address it, view ease of use as critical, and want proven applications with low risk of failure. Geoghegan (1994) suggests that critical mass is insufficient by itself to support continued diffusion because of the lack of institutional support for: (1) developing instructional software, (2) plans for further integration of computers into the curriculum, (3) shortages of equipment and facilities, and (4) unrealistic expectations based on innovators' and early adopter's successes. Early adopters (EAs) make an innovation visible to the mainstream and decrease uncertainty about the innovation. EAs are more experienced with technology and have higher use innovativeness, thus capitalizing on technology's many features and options. They seek different uses of technology to solve novel problems and contribute to new and better uses of technology. However, by making adoption look relatively easy, they may disguise the extensive knowledge and skills that mainstream faculty will need in order to adopt. Geoghegan (1994) believes that without wide-spread institutional support, the successes of early adopters will not effectively and efficiently diffuse into the mainstream. A survey conducted by Spotts & Bowman (1993) at Western Michigan University supports Geoghegan's (1994) view that mainstream faculty have different needs. Factors identified by more than half of the faculty as important in influencing their use of instructional technology were: availability of equipment, promise of improved student learning, funds to purchase materials, compatibility with subject matter, advantages over traditional (existing) methods, increased student interest, ease of use, information on materials in their discipline, compatibility with existing course materials, university training in technology use, time to learn the technology and comfort level with the technology. An additional factor identified by Ehrmann (1995), "The medium is not the message", may also contribute to the mainstream's hesitance to adopt. Communications media and other technologies are so flexible that they do not dictate methods of teaching and learning. The mainstream needs direction on where to start with flexible technologies that can be integrated in any number of ways. Administrators assume that once faculty get access to technology they will easily, automatically, and quickly change their teaching methods and course materials to take advantage of IT. The chief culprit for this belief is the varied use by innovators and early adopters and basing expectations for mainstream faculty adoption on this use innovativeness.

## Institutions as a Change Agency

Administrative types have to be convinced to let go of the infrastructure-driven "if you build it, they will come" approach to technology integration on campus if they want to address the chasm between early adopters and mainstream faculty. Faculty and administration have a deep mutual dependency. The top-down program advocate needs convincing exemplars to justify large investments in technology at a moment when funds are scarce, and the bottom-up project advocate and enthusiastic beginner needs a well-conceived and reliable working environment for successful implementation of innovative concepts (Noblitt, 1997). Change agents in the administration (from the president, to deans, to directors of service units), and opinion leaders (i.e., early adopters) and mainstream faculty, need to sit down to discuss strategies for bridging the gap. Universities traditionally have flat organizational structures with loosely coupled organizational units to provide the primary services of higher education (Bull, et al., 1994). Initiatives for the innovative use of instructional technology (IT) in teaching and learning tend to come from early adopter individuals and research units. With the reduction in size and price of computing resources and the required investment, decision-making for IT investment more easily fits the traditional organizational structures of higher education with decentralization and local responsibility for decisions. However, these individual initiatives and efforts, as well as decentralized investments in IT, scattered all over an institution, or scattered all over the institutions within one province or country, are insufficient by themselves to fully develop the potential of instructional technology for teaching and learning (Bull, et al., 1994). Critical mass is just not enough. Early adopters might be committed and enthusiastic in developing new technology-based teaching methods and computer assisted instructional software. However, to make these efforts more widespread and their results used more comprehensively, incentives, training, support and reward structures "from above" are needed to build a strong human infrastructure (Daigle and Jarmon, 1993), as well as providing the technological infrastructure (i.e., networks, hardware and software) to drive integration. IT investments for teaching have to be ahead of what is the state of the art in the world of work, as higher education prepares for the future. These ever-new investments cannot be left to uncoordinated departmental or individual initiatives, as they often exceed respective budgets (Bull, et al., 1994). Management has to recognize that to cause change they will have to address the reward system and commit to system-wide investment in IT in order to address the needs of mainstream faculty. The key to diffusion will be training and support. Without investment in the human infrastructure, nothing of sustainable value will be achieved (Foa, 1993).

**Rogers' Stages of Adoption**

Brace & Roberts (1996) describe a campus-wide approach to technology integration based on Rogers' (1995) stages of adoption that targets mainstream faculty's needs. Innovations are likely to gain more rapid acceptance if they are perceived as having high relative advantage, or as being better than the idea they supersede (Rogers, 1995). Innovations with a high compatibility with existing values, past experiences and needs of potential adopters also have an advantage. Individuals pass from (1) knowledge of an innovation, (2) to persuasion, (3) to a decision to adopt or reject, (4) to implementation, and then (5) to confirmation of this decision (Rogers, 1995). The strategies described by Brace & Roberts (1996) are aligned with Rogers' (1995) different stages of adoption: (1) to build awareness of the possibilities and advantages of technology, early adopters from various disciplines demonstrated how they developed multimedia applications and used them in their courses, and the university sponsored yearly technology conferences and symposia, (2) ready access was provided to up-to-date, stable and reliable technology, as well as providing each faculty member with a personal desktop computer, (3) training was made available through developmental workshops, orientations, and one-on-one sessions, (4) technical support for both hardware and software was provided by service units for acquisition, installation, information and implementation, and (5) funding was provided for release time and summer grants, and recognition was provided through incentives and encouragement. Although no data were provided to evaluate the success of this integration plan, the implications seem clear: instead of relying on "critical mass" and seredipidous diffusion to bridge the "chasm" between early adopters and mainstream faculty, those who propose wide-scale adoption of a technology-based curriculum must find a way to combine innovation with a responsible, campus-wide plan for implementation (Noblitt, 1997). Rogers' (1995) stages of adoption will be used to frame the following discussion of the contribution that early adopters can make to a campus-wide technology integration plan.

### (1) Knowledge of an Innovation and (2) Persuasion to Adopt

Ghandi had a vision about freedom and moved a whole country to follow in his footsteps. One or two such visionaries are needed on campus, who believe in the value of information and instructional technology, and also possess the leadership characteristics needed in order to effect real change by somehow converting the masses. A campus-wide culture that promotes adoption of technology can be developed by leaders at each level of the organizational structure. Those at the executive levels are the hardest to convince to take the lead in using technology, perhaps because many belong to the pre-computer generation (Foa, 1993). Characteristics that are beneficial to long-term planning are capturing the vision and enthusiasm for innovation displayed by early adopters, and channeling this into system wide initiatives that benefit all faculty. The biggest challenge is cultural: in computing organizations and cliques, the "techies" are at the top of the pecking order and like to tinker with technology, while the "teachies" regard technology as a possible solution to a teaching and learning problem (Gilbert, 1995). What is needed is some way to get the "top-down" folks, the "techies", and the "teachies" to talk to one another. Starting with the president, and including vice-presidents, deans, and directors of each division, a technology-rich culture can start from changes to communication channels. For example, to promote e-mail use (and take advantage of the campus network) ensure that every faculty member, including the president, has a computer, network access, and thorough training in how to use the email system. Then, instead of using the paper-based, internal "snail-mail" system to distribute news and information, ensure that the president, deans, department heads, and directors put news or information on the system and nowhere else (Foa, 1993). This commitment will require management and administration to abandon the "real men don't type" approach to communication. When new ideas are adopted, leading to various consequences, social change occurs (Rogers, 1995). E-mail and the Internet are already attractive to mainstream faculty, and are fully diffused among early adopters. If campus leaders demonstrate their commitment to information technology by adopting changed communication channels, they will start a ripple effect throughout the institution, and indeed, maybe within themselves. And, the use of computers for one purpose encourages future computer use and questions about other technologies (Broholm, 1993).

A role for early adopters in the knowledge and persuasion stages of adoption is to share what they have learned about instructional technology with the mainstream through in-house and across discipline demonstrations, campus conferences and symposia. Rogers (1995) posits that mass media channels, as knowledge creators, are often most important for informing people about an innovation, while interpersonal channels are more important in persuading someone to adopt a new idea. Early adopters play an important role in further diffusion because of their role as opinion leaders in communication channels and social systems. The transfer of ideas in a social system is most effective when participants belong to the same groups or are drawn together by the same interests (Rogers, 1995). Shared meanings and mutual language mean communication is likely to result in greater knowledge gain, attitude formation and change, and overt behavior change. Generally, faculty who are homophilous (degree to which a pair of individuals who communicate are similar) develop stronger communication relationships with each other than those who are heterophilous (not alike on the categorical variable of interest) (Valente, 1996). The similarity may be in certain attributes, such as being in the same faculty or department, type of computer used, and the like. When two individuals share common meanings, beliefs, and mutual understandings, communication between them is likely to be effective (Valente, 1996). Change agents and later adopters may have difficulty developing trust and finding common ground if their beliefs about adoption are dissimilar. Early adopters share characteristics and attributes that make communication between early adopters of instructional technology effective (i.e., informal networks composed of Mac users, web-course developers, interface designers, and so on). Interpersonal diffusion networks are mostly homophilous. However, in order for instructional technology to diffuse into the mainstream, interdisciplinary early adopters and mainstreamers have to exchange knowledge. Heterophilous network links often connect two cliques, thus spanning two sets of socially dissimilar individuals in a system (Broholm, 1993). These heterophilous links are especially important for exchanging information about innovations, as is implied in Valente's (1996) description of the strength of "weak ties"; there is a higher information exchange potential in communication channels when the communicators are heterophilous (Valente, 1996). Homophilous diffusion patterns cause new ideas to spread horizontally, rather than vertically, within a system. For example, a computer science professor uses web-based publishing as a communication network in a senior class, or a computer engineer discovers a new algorithm to compress video images to a fraction of their current size. It is more likely that the computer science professor will tell other computer science professors, and the programmer will share knowledge of the new algorithm with other programmers who speak his/her language (i.e., horizontal), than either of these innovators immediately sharing their findings with an educator who is intrigued by using video segments and on-line journals on a class web page (i.e., vertical). Homophily therefore can act to slow down the rate of diffusion in a system, thus requiring the work of change agents with various opinion leaders in a system. New ways must be found to encourage more heterophilous communication in the current university structure of disciplines and specializations that encourage homophilous exchanges.

Gilbert (1996) promotes the development of institution wide, collaborative communication networks encourage and promote the diffusion of information technology. He provides guidelines for forming a local Teaching, Learning, and Technology Roundtable (TLTR) that would include two categories of faculty (both early adopters and mainstream), representatives from service organizations (such as library, computing centers, faculty teaching development office, student affairs, facilities management), the Chief Academic Officer and or President, student representation, and a TLT Roundtable Coordinator. The TLTR would be responsible for developing integration plans that address the needs of current, mainstream adopters, by capitalizing on the knowledge and skills of early adopters, and the support structures of various campus organizations. No individual faculty member can find or know all teaching options using information technology that may be used for a particular course; mechanisms for sharing valuable information among faculty and others must be provided (Gilbert, 1996). Mainstream faculty have to contribute their point of view, different motivations, and needs so that a common ground can be reached between early adopter fluency and skill and campus-wide requirements. By organizing a TLTR, heterophilous communication would become part of the university's culture and technology implementation and integration strategy.

There is valuable information to be gained from the early adopter's knowledge and skill as a technology user and integrator and the mainstream's reaction to being new users. For example, from a human-computer interface (HCI) perspective, we can determine from early adopters' experiences what obstacles or incentives within the computer systems themselves encouraged the development of their competence (Bannon, 1991; Weber, 1990). Bannon (1991) discuss the need for both novice and expert user input when designing computer systems. Valuable information can also be obtained from first time learners experiences with computer systems or applications (Howard, 1994). Bannon (1991) also suggests there is much to be learned from an examination of how expert users became competent, skilled users of a system. They can provide information on the obstacles and incentives there are within a system to encourage the growth of competence. In the same way that designers should include both novice and expert users' perspectives and feedback when developing systems or applications, administration should include both early adopter and mainstream faculty in the development of technology integration plans and strategies.

**(3) Making a Decision to Adopt or Reject, and (4) Implementation**

The main reasons that mainstream faculty hesitate to adopt are the lack of effective training and support. A number of different approaches to maximize the communication impact of early adopter knowledge and skill on training come from the literature. Brace and Roberts (1996) suggested developmental workshops, orientations, and one-on-one training sessions. However, integration plans have to take into account that early adopters are faculty members with teaching, research, and service workloads much like other faculty. Much of the training and daily support have to come from other service units on campus. Most institutions did reasonably well in the past 10 years at developing support services appropriate to the character and needs of early adopters, however, proportionally more support will be required, and those providing it will need better and more varied interpersonal skills and sensitivity to deal with the easily bruised egos of faculty who with no "special propensity for technology" (Gilbert, 1996) that characterizes the early adopter.

One way service units can capitalize on the knowledge of early adopters is by including them in the development of training modules that can be used by service units for workshops (Foa, 1993). This approach must address release time and the merit system for early adopters, and the increased financial and human resource needs of service units. Gilbert (1996) suggests involving undergraduate students in the mainstream faculty development plan. Many undergraduates have better skills and knowledge about information technology than most faculty and staff members Gilbert, 1996). Student assistants can help increase the use of information technology for teaching and learning, and alleviate some of the financial and human resource costs of support units, resulting in a win-win situation for the institution, faculty, and students. Students benefit by developing both instructional and technological skills that increase their employment marketability. Another option for increasing the quality and availability of support services while holding down costs is to engage early adopter faculty as peer mentors (Gilbert, 1996) and thus increase the impact of their opinion leadership. Stipends, release time, and professional recognition through the merit system can be used to provide incentives for this type of knowledge sharing and interpersonal communication between heterophilous groups.

**(5) Confirmation of Decision to Adopt**

Roundtable discussions between different representatives and stakeholders on campus must recognize the importance of on-going support and recognition of integration efforts by mainstream faculty. Integration takes time, there are a number of barriers and pitfalls, and progress often seems painfully slow. Faculty members and educational institutions are more likely to participate in gradual change rather than making a sudden, diametrically opposite choices (Gilbert, 1996). Smith (1996) adequately summarizes an *iterative technology integration process*, which includes awareness and interest, planning and design, support and development, refinement and delivery, assessment, and research. Faculty will want to assess whether their uses of technology for teaching and learning are having any effect. Roundtable discussions have to focus on the successes and failures in order to make relevant changes to the process. It will take time to move through the iterative integration cycle, to implement and then assess the results of innovative efforts, and conduct research on the relative benefits. Recognition must be provided at each step through incentives and encouragement.

### Alternatives to Campus-Wide Plans That Build From Pioneers

It seems apparent that there is much we can learn from early adopters about possible uses of technology. As opinion leaders, early adopters can persuade other faculty to adopt. An alternative to learning from the experiences and characteristics of early adopters is to maintain the status quo and rely on natural diffusion patterns of adoption based on critical mass. Individual efforts will continue to be scattered throughout an institution, and eventually these may be adopted by the mainstream. This is not a completely negative scenario for early adopters. A collective administrative effort that is developed "top-down" may stifle creativity and initiative by imposing arbitrary and bureaucratic organizational constraints, such as defining policies about the "right-way" to integrate technology for teaching and learning. Early adopters will continue to flourish in a status quo model because of their interpersonal networks. Few instructional technology theories, laws, and principles have stood the test of time and rigorous validation. The field is still new and constantly evolving because of technological advancements and developments that present new challenges to researchers and educators. Early adopters will continue to exchange information and develop their knowledge and skills as they wrestle with these challenges. However, a status quo approach ignores the different needs and characteristics of the mainstream. Enthusiastic beginners may be discouraged by unexpected technological barriers and the lack of training and on-going support. By not studying and learning from early adopters we can continue with "business as usual" and attempt to maintain campuses as they exist now. Administration can focus mainly on technological infrastructure, and individual departments can continue to ignore faculty training and support.

An alternative, which deserves additional research and more commentary, is to rely on the increased interrelatedness of various disciplines as they investigate common (but complex) questions to do with technology. Faculty, who are experts in their diverse fields, are often self-constrained by their homophilous, horizontal communication social systems. However, technology seems to be a catalyst for bringing the basic and applied research findings of different disciplines to bear on common questions that require contributions from each part of science in order to better understand the whole. Communication technology facilitates this interdisciplinary exchange. For example, computer scientists were pioneers in investigating the nature of artificial intelligence. Investigations into programming a machine to think, however, requires an understanding of the nature of thinking. Computer science has not traditionally focused their research efforts on teaching and learning, and human development, but an investigation of artificial intelligence demands a better understanding of the human mind, and results in the growth of such disciplines as cognitive science. Software development teams need to include individuals with graphics skills, content expertise, programming knowledge, and instructional designers. Disciplines, although still distinct, are becoming more interrelated as they investigate common (but complex) questions to do with technology. Basic and applied research from across disciplines is needed to untangle this complicated set of knots.

## Conclusion

In three main sections, this paper discussed the characteristics that differentiate early adopters from others, the implications of developing a long-term campus-wide plan based on the characteristics of early adopters, and summarized some alternatives to building from such pioneers. Characterizing the early adopter of instructional technology using diffusion theory has provided information that can be used by universities interested in campus-wide integration of technology for teaching and learning. Identifying the unique concerns that shape the mainstreams' decisions to adopt led to understanding that a different support infrastructure is needed for mainstream faculty to integrate technology for teaching and learning. If campus-wide integration plans are developed on the assumption that everyone will naturally use computers as readily and easily as the early adopter, then they are bound to fail. This paper identified the need for campus-wide planning and investment in the "human infrastructure" by providing training and support, opening heterophilous communication channels, providing a technological infrastructure, and capitalizing on the opinion leadership and evangelistic qualities of early adopters to promote further adoption by the mainstream.

There is still a great deal to learn about early adopters of instructional technology as a subgroup of the faculty population. There is a need for case study research that profiles individual early adopters of instructional technology who are excellent teachers to provide role models and guidance in this innovative, constantly changing, and exciting area. An interesting question worth further investigation is whether early adoption depends on personality or environment. A prototypical model of the exemplar of this category is needed against which one can compare individual early adopters and better understand their commonalities and differences.

This paper did not address the complex and interesting pedagogical concerns related to integrating technology into teaching and learning, about which many books have been written (Heermann, 1988; Laurillard, 1993; Roblyer, Edwards, and Havriluk, 1997). However, discussion did yield useful guidelines for the design of professional development initiatives for mainstream faculty who are beginning to integrate computer technology into their post-secondary teaching. Developing awareness that the adoption of information technology for teaching and learning is a complex, barrier-ridden, and time-consuming process will help institutions understand that expectations for campus-wide technology integration will not materialize overnight, and must allow for a cyclical and iterative implementation and evaluation process. Faculty support in the form of incentives, rewards, time, access, and additional personnel in support units (i.e., campus computing and media centers, library system) will be necessary to improve chances of success, excellence, and efficiency. Early adopters are the exception, rather than the rule. However, we can learn from exceptions and unique experiences, and take from these an understanding of the necessary strategies to encourage mainstream adoption.

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