DOCUMENT RESUME

ED 428 675 IR 019 336

AUTHOR	Jacobsen, D. Michele
TITLE	Adoption Patterns of Faculty Who Integrate Computer Technology for Teaching and Learning in Higher Education.
SPONS AGENCY	Social Sciences and Humanities Research Council of Canada, Ottawa (Ontario).
PUB DATE	1998-06-00
NOTE	9p.; In: ED-MEDIA/ED-TELECOM 98 World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications. Proceedings (10th, Freiburg, Germany, June 20-25, 1998); see IR 019 307.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Adoption (Ideas); Change Strategies; College Faculty; *Computer Uses in Education; Educational Change; *Educational Technology; Foreign Countries; Higher Education; Incentives; *Information Technology; *Instructional Innovation; Tables (Data); Teacher Attitudes; Teacher Surveys; Use Studies; World Wide Web
IDENTIFIERS	Barriers to Innovation; Conceptual Frameworks; *Technology Integration; *Technology Utilization

ABSTRACT

This paper reports on research that builds and extends a diffusion of innovations framework and adopter categories in order to accurately reflect and describe faculty innovativeness with technology for teaching and learning. A World Wide Web-based survey was used to collect information from 76 faculty members from across disciplines at two major North American universities regarding technology use patterns, computer experience, use of technology for teaching, general self-efficacy, changes to teaching and learning, incentives, and barriers. Data were analyzed for the differences between early adopters and mainstream faculty, the rate of adoption of educational technology by faculty, resulting changes to the teaching and learning environment, the incentives and barriers to integrating technology, preferred methods for learning about technology, and methods for evaluating the outcomes of integration. One figure presents the continuum of innovativeness; tables present data on changes to teaching and learning, and rates of agreement with statements about changes to postsecondary teaching and leaning, incentives, and barriers to integration. Contains 27 references. (Author/DLS)

Adoption Patterns of Faculty Who Integrate Computer Technology for Teaching and Learning in Higher Education

D. Michele Jacobsen
Educational Psychology, University of Calgary, Calgary, Alberta, Canada
dmjacobs@acs.ucalgary.ca

Abstract: Why is the integration of technology for teaching and learning so appealing to some faculty, and not to others? The present investigation builds and extends upon Rogers' (1995) diffusion of innovations framework and adopter categories in an attempt to accurately reflect and describe faculty innovativeness with technology for teaching and learning. Information collected from faculty across disciplines at two major North American universities is analyzed for the differences between early adopters and mainstream faculty, the rate of adoption of educational technology by faculty, resulting changes to the teaching and learning environment, the incentives and barriers to integrating technology, preferred methods for learning about technology, and methods for evaluating the outcomes of integration.

Introduction

Recent estimates indicate that colleges and universities invest billions of dollars per year for the acquisition of computer technology [Geoghegan, 1994]. Instructional technology [IT] may support and increase the efficiency of the teaching-learning transaction or even modify educational processes, especially with regards to distance education and "anytime, anywhere" access [Daniel, 1997]. 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 are being developed to adequately study the unique issues involved in educational technology [Bull, et al, 1994] [Clark, 1989] [Reigeluth, 1989]. In some cases, 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 *also* 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 effectively in higher education for information access and delivery in libraries, research and development, as a communication medium, 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 in very diverse locations [Daniel, 1997].

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]. Estimates suggest no more than five to ten percent of faculty utilize technology in their teaching as anything more than a "high tech" substitute for blackboard and chalk, overhead projectors, and photocopied handouts [Reeves, 1991]. Although there is a growing number of faculty who are very enthusiastic about adopting technology because of the potential of newer tools for their students, there is still a large number of faculty who seem hesitant or reluctant to adopt technology for their teaching tasks. Explanations for limited adoption may be found in the many barriers that still constrain use by enthusiastic beginners; *user friendliness* is a seductive term which misrepresents current technological reality. While acknowledging improvements in current design, computers and peripherals are still not well-designed, fault-free, and easy to use. As such, 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.

Diffusion of Innovations

A conceptual framework for analyzing faculty adoption of technology patterns is provided by Everett Rogers' [1995] theory of the diffusion of innovations, which defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system". 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 innovation. 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. Based upon empirical investigations and market research, [Rogers, 1995] describes five adopter categories along the continuum of innovativeness [Figure 1] which are *ideal types* designed to make comparisons possible based on characteristics of the normal distribution and partitioned by the mean and standard deviation.

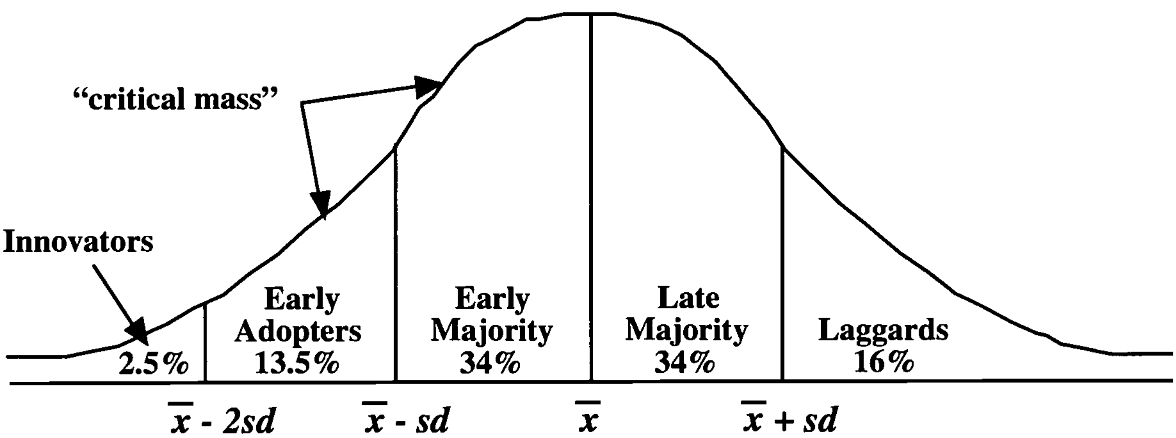

Figure 1: Adopter Categorization on the Basis of Innovativeness [Rogers, 1995]

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, but that "critical mass" alone, the segment of the diffusion curve between 10 to 20 percent adoption or the "heart of the diffusion process" [Rogers, 1995], is not enough to stimulate adoption by the mainstream [i.e., 84% of the population]. Geoghegan [and Wertheimer & Zinga, 1997] contrast 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 them, view ease of use as critical, and want proven applications with a low risk of failure. Early adopters make an innovation visible to the mainstream, decrease uncertainty about an innovation, are more experienced with technology and have higher *use innovativeness* [Ram & Jung, 1994], 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, early adopters may disguise the extensive knowledge and skills that mainstream faculty will need in order to adopt. Universities are in a situation where there is widespread adoption of instructional technology by innovators and early adopters, but limited adoption by mainstream faculty. It is apparent from various descriptions of early adopters and the mainstream [Geoghegan, 1994] [see Jacobson & Weller, 1988], 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. Research into the adoption patterns of various technologies by higher education faculty will give insight into strategies for encouraging more widespread adoption.

Methodology

The present investigation surveyed faculty members from across disciplines at two major North American universities. Items gathered information about technology use patterns, computer experience and use of technology for teaching, general self-efficacy [Schwarzer & Jerusalem, 1995], changes to teaching and learning, incentives, and barriers, using a web-based survey instrument [http://www.acs.ucalgary.ca/~dmjacobs/phd]. Invitations to participate were distributed using paper-based mail, e-mail, and a campus newspaper. To solicit a representative sample, paper-based versions of the survey were also made available to potential participants. Complete data was obtained from 76 subjects (38.2% female, 61.8% male), 55 of whom completed the web-based survey and 21 the paper-based version. Subjects were on average 45.5 years old, had an average of 12.5 years experience as faculty member, and hold various academic ranks within their institution [i.e., 19.7% assistant professor, 35.5% associate professor, 26.3% professor, 18.4% lecturers and sessionals]. Over 65% of participants hold appointments that are tenured or leading to tenure. The majority of respondents teach 100 or less students per semester, and represent a range of academic disciplines: Agriculture, Continuing Education, Education, Engineering, Environmental Design, Fine Arts, General Studies, Humanities, Kinesiology, Management, Medicine, Nursing, Science, Social Science, and Social Work.

Computer Use in Classrooms and Faculty Expertise

According to the Annual Campus Computing Survey [Green, 1996], adoption of technology for classroom use has risen between 1994 and 1995; e-mail use has almost doubled to 20%, presentation software use is over 25%, and the use of multimedia and CD-ROM-based materials is just under 10%. The present study indicates that the adoption of technology for classroom use is even greater in 1997. Faculty were asked to indicate whether they had ever used any of 44 types of computer software and tools in a course they taught. Word processing is used by 60% of faculty, spreadsheets by 38%, charting & graphing by 36%, databases by 34%, presentation software by 34%, and 18% have used CD-ROM-based materials. A number of faculty use instructional courseware for teaching: tutorials 18%, drill & practice 14%, simulations 17%, and games 6%. E-mail is used by 67% of faculty in their teaching, on-line databases or library catalogues by 46%, newsgroups by 21%, listservs by 29%, and FTP by 23%. Newer technologies, like the World Wide Web, have been adopted for searching & browsing by 56% of faculty, and by 36% for web page creation and editing. It seems fair to suggest that communication technologies are the proverbial carrot that entices mainstream faculty to adopt technology for teaching and learning [Foa, 1993]. Once faculty are intrigued by e-mail and the Web, they may start asking questions about other technologies [Gilbert, 1995]. Faculty rated their level of expertise [i.e., 0.none, 1.a little, 2.fair, 3.substantial, 4.extensive] with 44 types of computer software. Findings indicate that faculty tend to develop a level of personal expertise with a particular computer technology before attempting to integrate it into their teaching [i.e., these technologies have been personally adopted by late majority].

Software/tool	A little(1) - Fair(2)	Substantial(3) - Extensive(4)	Total Adoption	Mean	SD
Word processing	14.5 %	81.6 %	96.1 %	3.20	1.07
Spreadsheets	39.5 %	30.3 %	69.8 %	1.60	1.36
Charting & graphing	42.2 %	25.5%	67.7 %	1.50	1.38
Databases	52.7 %	22.4 %	75.1 %	1.50	1.22
Presentation software	36.9 %	21.0 %	57.9 %	1.30	1.37
CD-ROM materials	47.4 %	18.5 %	65.9 %	1.30	1.23
E-mail	19.7 %	75 %	94.7 %	3.00	1.10
On-line databases or library catalogues	50 %	36.8 %	86.8 %	2.10	1.28
Newsgroups	39.5 %	19.7 %	59.2 %	1.20	1.32
Listservs	39.5 %	25 %	64.5 %	1.50	1.44
FTP	46.1 %	26.3 %	72.4 %	1.60	1.35
WWW searching and browsing	36.8 %	55.2 %	92.0 %	2.60	1.25
Web page creation	30.2 %	22.4 %	52.6 %	1.20	1.48

Changes to Teaching and Learning

[Hadley & Sheingold, 1993] indicated that significant changes can take place as teachers integrate computers into instruction. Faculty were asked to use a five-point scale (1.strongly agree, 2.agree, 3.neutral, 4.disagree, 5.strongly disagree) to indicate their level of agreement with statements about how the integration of technology may change the teaching and learning environment. Faculty most strongly agreed with the following five statements:

Statements - Changes to Post-Secondary Teaching and Learning	Mean	SD
Faculty will spend more time preparing materials and resources for instruction.	1.77	1.00
Faculty can expect more from students in terms of their pursuing and editing their work.	2.05	0.84
Faculty will spend more time acting as a guide and facilitator with individual students.	2.44	1.19
Faculty are better able to tailor students' work to their individual needs.	2.48	0.95
Faculty can be more comfortable with students working independently.	2.59	1.21

While four of these statements describe benefits to student learning, it is also clear that faculty can expect to invest additional time preparing materials and resources when they integrate technology into teaching and learning. When asked to elaborate on the nature of changes they have observed as a result of using technology in teaching, one person confirmed that "*it increases preparation time in the short run [first year or two], but allows for rapid changes/updates in web materials in the long run*". So, the investment of time can yield returns. Technology can also appeal to some students, and not to others: "*Some of my graduate students are frustrated when I ask them to try to use new technological tools...those who have an open mind and flexible learning style like using technology enhanced instruction; others do not and resent the demand on their time to change. Some of the more shy and quiet students blossom in terms of their learning when technology is introduced*". The next comment touches on the fundamental changes that technology integration seems to require of teachers and learners: "*I still struggle with students who are conditioned to a system of grades and dependency ...who are reluctant to take responsibility for their own learning. However...a small number of students do seem to be catching on to the idea that they are in charge of their learning and willingly take risks*". New tools both provide and require a new approach to teaching and learning.

Incentives to Integrate Technology

Given the time and effort required to integrate technology into teaching, different reasons tend to motivate and keep faculty engaged with this task. Some incentives are more important for encouraging faculty members to integrate technology in their teaching [Hadley & Sheingold, 1993]. Using a five-point scale (1. strongly agree, a major incentive, 2.agree, 3.neutral, 4.disagree, 5.strongly disagree, not an incentive), faculty indicated the extent of their agreement with twelve incentive statements. The following five reasons emerged as the most important incentives:

Incentive Statement	Mean	SD
I get personal gratification from learning new computer knowledge and skills	1.80	0.84
Computers are a tool that help students with learning tasks, such as writing, analyzing data, or solving problems.	1.82	0.98
By integrating technology, I am helping students to acquire the basic computer education they will need for future careers.	1.92	1.01
Technology tools enable students to help each other and cooperate on projects.	2.22	0.97
Computers enable me to make a subject more interesting.	2.28	0.97

While four of the highest rated incentives have to do with providing enriched learning opportunities for students, the number one incentive for integrating technology is the personal gratification one gets from learning new computer knowledge and skills. When asked to elaborate on the incentives for using technology, one person wrote, "*I am convinced that I can provide a better introduction to complex subject matter using interactive, computer-based technology than I can using either the traditional classroom or any paper-based medium*".

Barriers to Integrating Technology

Many faculty are highly motivated to integrate computers for teaching and learning. Although many have developed impressive expertise in using computers in their classrooms, to a greater or lesser extent, all faculty experience barriers when they attempt to integrate computers in their teaching. Faculty used a five-point scale (1.strongly agree, a major barrier, 2.agree, 3.neutral, 4.disagree, 5.strongly disagree, not a barrier) to rate the significance of twenty barriers, adapted from [Hadley & Sheingold, 1993], to the use of computers for teaching and learning in the campus environment. The following six statements describe barriers that most faculty agreed were impediments to integrating technology on campus:

Statements - Barriers to Integration	Mean	SD
Faculty members lack enough time to develop instruction that uses computers.	1.50	0.82
There are problems scheduling enough computer time and/or resources for different faculties' classes.	1.78	0.89
Financial support for computer integration from administration is inadequate.	1.80	0.86
There are too few computers for the number of students.	1.86	0.94
There is inadequate financial support for the development of instructional uses of computers.	1.88	0.93
The reward structure does not recognize faculty for integrating computers for teaching and learning.	2.06	1.26

In response to a request to elaborate upon barriers that may prevent or discourage faculty from using technology in their teaching tasks, 58 faculty submitted responses. The most common explanation for non-adoption was the perceived lack of time to learn how to use technological tools as well as learning new methods for teaching. Several faculty identified "faculty complacency" as a reason for non-adoption, and suggestions were made that many faculty will not adopt unless they are forced to by formal administrative expectations. Some faculty pointed to the importance of research over teaching in annual merit reviews, and the absence of recognition for the use of technology for effective teaching and learning. A faculty comment confirms that "*the barriers are not specific to computers but are the general lack of any reward whatsoever for effort put into teaching excellence*". Among many faculty, there is the perception that technology is still an unproved instructional intervention: "*Due to the fact that there is insufficient data to support the efficacy of computerized teaching, only the risk takers in academics are prepared to spend the time developing courses for this medium*". Hence, early adopters integrate despite risk.

Learning About Technology

Individuals tend to have preferred methods for learning more about technology. Faculty were asked three questions for which they were asked to rank the importance of different methods for learning about technology, getting help and support, and accessing information about innovations. In terms of media and methods for acquiring NEW computer application skills and knowledge, faculty ranked the following from *most* to *least* important in descending order: [1] hands-on experimenting and trouble shooting, [2] mixture of manuals and hands-on, [3] hardcopy materials, books, etc., [4] on-line manuals, [5] workshops and presentations, and last, [6] structured courses and guidance. A good number of Technology Integration Plans suggest that faculty need more workshops and courses in order to acquire the knowledge and skills they need to adopt technology. However, future plans for professional development should be informed by faculty member's expressed preferences for more hands-on experimentation and trouble shooting.

In terms of HELP or ASSISTANCE with using computers, faculty ranked the following sources of support from *most* to *least* important in descending order: [1] colleagues on campus, [2] one-on-one assistance, [3] experienced graduate students, [4] media center support staff, [5] hot-line, or telephone assistance, [6] outside professionals trained in technology use, and last, [7] colleagues at another institution. Faculty prefer to get help from colleagues and graduate students, and want one-one-one assistance, rather than relying on outside professionals or colleagues at another institution. Combined with the preferences expressed in the first part, it appears that the most successful professional development would be to have just-in-time, one-on-one access to colleagues and experienced graduate students when one runs run into trouble experimenting and playing around with new technologies.

Faculty were asked to rate the importance of various sources of information for keeping abreast of changes and innovations in the area of computers. From *most* to *least* important in descending order, are: [1] colleagues on campus, [2] an informal network of friends and family, [3] innovative graduate students, [4] on-line computer newsgroups & websites, [5] conferences, demonstrations and workshops, [6] colleagues at another institution, [7 tie] popular computer magazines, [7 tie] popular newspapers and television, [8] hardware and software stores, vendors, suppliers, and also [9] hardware and software catalogues and brochures. The highest ranked source of information is a colleague, followed closely by friends, family, and innovative graduate students. Faculty prefer to learn about changes and innovation from people they know and to which they have immediate access. Five sources of information that were ranked "not important" or "neutral" sources of information about changes and innovations in the area of computers, from least important: [1] department chair, [2] university administration, [3] refereed computer journals, [4] publications from major computer vendors, and [5] on-line computer journals. Faculty apparently do not look "up" for information about technology innovations, nor do they rely on vendors or refereed journals.

Discussion

Previous explanations for why the majority of faculty did not adopt technology for teaching and learning focused on blame. 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 faculty who readily adopt technology for teaching, and those who do not. The challenge for researchers interested in the adoption of technology is not to assign blame nor to attempt to fix faculty attitudes. The challenge instead is to draft technology 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 clearly needed for mainstream faculty than that which sufficed for early adopters of technology. 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.

The present research provides additional support for three trends identified by [Jacobson & Weller, 1988] to describe faculty adoption patterns: [1] 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 technologies. Administration has to be convinced to let go of the infrastructure-driven "if you build it, they will come" approach to technology integration if they want to address the gap between early adopters and mainstream faculty. Critical mass alone is insufficient to drive further adoption. 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]. To make the efforts of early adopters more widespread and their results used more comprehensively, incentives, training, support and reward structures "from above" are needed to build a strong human infrastructure [Foa, 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]. If the integration of technology for teaching and learning is a valued institutional goal, administration must recognize that in order to drive change they will have to address the reward system and commit to system-wide investment in IT. The key to diffusion will be training and support. Without investment in the human infrastructure nothing of sustainable value will be achieved [Foa, 1993]. One final thought: it may not be the case that *early adoption* and *excellent teaching* qualities exist in the same person. Universities must include an emphasis on excellent teaching in their technology integration plans. 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 without excellent teachers, 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.

References

[Alley, 1996] Alley, L. R. (1996). Technology precipitates reflective teaching: an instructional epiphany. *Change*, 28(2), 49-54.

[Bull, et al., 1994] Bull, G. M., Dalinga-Hunter, C., Epelboin, Y., Frackmann, E., & Jennings, D. (1994). *Information technology: issues for higher education management*. London: Jessica Kingsley Publishers.

[Clark, 1989] Clark, R. E. (1989). Current progress and future directions for research in instructional technology. *Educational Technology, Research and Development*, 37(1), 57-66.

[Daniel, 1997] Daniel, J. S. (1997). Why universities need technology strategies. *Change*, 29(4), 11-17

[Ehrmann , 1995] Ehrmann, S. C. (1995). Asking the right questions: what does research tell us about technology and higher learning? *Change*, 27(2), 20-27.[Online] Available: http://www.learner.org/content/ed/strat/eval/ACPBRightQuestion.html

[Foa, 1993] Foa, L. J. (1993). Technology and change: Composing a four-part harmony. *Educom Review,* 28(2), 27-30.

[Geoghegan, 1994] Geoghegan, W. H. (1994). Whatever happened to instructional technology? Baltimore, MD: Paper presented at the 22nd Annual Conference of the International Business Schools Computing Association [Online]. Available: http://ike.engr.washington.edu/news/whitep/whg/wpi.htm (July 25, 1997).

[Gilbert , 1995] Gilbert, S. (1995). An "online" experience: Discussion group debates why faculty use or resist technology. *Change*, 27(2), 28-45.

[Gordon , 1983] Gordon, S. P. (1983). Faculty training and development in academic computing. *Journal of Computer-Based Instruction*, 10(1-2), 51-54.

[Green, 1996] Green, K. (1996). The coming ubiquity of information technology. *Change*, 28(2).

[Hadley & Sheingold, 1993] Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education*, 101, 261-315.

[Jacobson & Weller, 1987] Jacobson, M. J., & Weller, M. H. (1987). A profile of computer use among the University of Illinois humanities faculty. *Journal of Educational Technology Systems*, 16(2), 83-98.

[Kearsley, 1996] Kearsley, G. (1996). Teaching excellence: The foundation for technology effectiveness. *Educational Technology Review*, 6, 24-27.

[Kulik, Kulik & Cohen, 1980] Kulik, J. A., Kulik, C. C., & Cohen, P. A. (1980). Effectiveness of computer-based college teaching: A meta-analysis of findings. *Review of Educational Research*, 50(4), 525-544.

[Kulik & Kulik, 1987] Kulik, J. A., & Kulik, C. C. (1987). Review of recent research literature on computer-based instruction. *Contemporary Educational Psychology*, 12, 222-230.

[Noblitt, 1997] Noblitt, J. S. (1997). Making ends meet: a faculty perspective on computing and scholarship. *Educom Review*, 32(3), 38-43. Also, [Online] Available: http://www.iat.unc.edu/publications/monitor/issue7/index.html (April 15, 1997).

[Ram & Jung, 1994] Ram, S., & Jung, H. (1994). Innovativeness in product usage: A comparison of early adopters and early majority. Psychology & Marketing, 11(1), 57-67.

[Reeves, 1991] Reeves, T. C. (1991). Implementing CBT in higher education: Unfulfilled promises and new directions. In Shlechter, T. M. (Ed.) *Problems and Promises of Computer-Based Training*. New Jersey: Ablex Publishing.

[Reigeluth, 1989] Reigeluth, C. M. (1989). Educational technology at the crossroads: New mindsets and new directions. *Educational Technology, Research and Development*, 37(1), 67-80.

[Repp, 1996] Repp, P. C. (1996). Technology precipitates reflective teaching: The evolution of a red square. *Change*, 28(2), 49, 56-57.

[Roblyer, Edwards, & Havriluk, 1997] Roblyer, M. D., Edwards, J., and Havriluk, M. A. (1997). *Integrating educational technology into teaching*. New Jersey: Prentice-Hall.

[Rogers, 1995] Rogers, E. M. (1995). *Diffusion of Innovations.* (4th ed.). New York: Free Press

[Schwalbe, 1996] Schwalbe, K. A. (1996, March). A study of the relationship between investments in information technology and institutional outcomes in higher education. (Doctoral Dissertation, University of Minnesota, 1996). *ProQuest - Dissertation Abstracts,* AAC 9621911.

[Schwarzer & Jerusalem, 1995] Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy Scale. In J. Weinman, S. Wright, & M. Johnston (Eds.), *Measures in health psychology: A user's portfolio.* Causal and control beliefs (pp. 35-37). Windsor, UK: NFER-NELSON.

[Shaw, 1994] Shaw, M. L. G. (1994). Women, scholarship and information technology: a post-modern perspective. *Transactions of the Royal Society of Canada: Series 4, 5*, 112-131.

[Wertheimer & Zinga, 1997] Wertheimer, R., & Zinga, M. (1997). Attending to the noise: applying chaos theory to school reform. Paper presented at the 1997 annual conference of the American Educational Research Association. [Online] Available: http://info.pps.pgh.pa.us/publications/articles/chaos/chaosfin.htm (April 1997).

Acknowledgments

Financial support for this research has been made available by the Social Sciences and Humanities Research Council of Canada.

NOTICE

REPRODUCTION BASIS

☒ This document is covered by a signed "Reproduction Release (Blanket) form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☐ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").

EFF-089 (9/97)