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Prediction of and differences in computer use: universal adoption of notebook computers at three undergraduate institutions

Therese Anderson Corwin
Iowa State University

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Prediction of and differences in computer use: Universal adoption of
notebook computers at three undergraduate institutions

by

Therese Anderson Corwin

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY

Major: Education (Curriculum and Instructional Technology)

Major Professor: Michael R. Simonson

Iowa State University
Ames, Iowa
1998

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Major Professor

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For the Major Program

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For the Graduate College
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ABSTRACT

The universal availability of computers through the adoption of notebook computers for faculty by the University is an organizational answer to the adoption of computer technology by faculty. The researcher studied solutions to this problem through a survey of faculty at three undergraduate institutions that adopted notebook computers for their faculty and students.

Participants completed a Computer Technology in Teaching (CTIT) questionnaire composed of the above measures as well as demographic and computer-related questions. Faculty received the questionnaire prior to the adoption of notebook computers on three undergraduate campuses. The faculty received the same questionnaire one year later. During the interim between the questionnaires, the three campuses adopted notebook computers for all faculty. One of the campuses also adopted notebooks for all students.

In the first phase of the study the dependent variable, Level of Computer Use, was determined using responses to the second questionnaire. The independent variables: age, academic rank, innovativeness and subjective norms, were drawn from responses to the first questionnaire. Two variables—Subjective Norms and Innovativeness—were significant predictors of the faculty's levels of computer use. The last variable, academic rank and age, did not add to the predictive value beyond that indicated by Subjective Norms and Innovative Scale.
The second phase of the study dealt with changes on the three campuses over a one-year period. Indicators of this change included: computer anxiety, faculty and student use of technology, frequency of software use by faculty and level of computer use. Technology use by students and faculty, and frequency of software use by faculty all increased significantly. Other variables showed significant change of individual institutions.

The results of this study might provide guidance for educational institutions that plan extensive implementations of computer technology. It may be especially useful for small undergraduate institutions. The results show that the use of computer technology will diffuse quickly among faculty on campuses with appropriate environments that support faculty with training and infrastructure.
CHAPTER 1. INTRODUCTION

The implementation of an educational innovation is at best a complex and dynamic process. How and if undergraduate faculty use, adopt, and incorporate an innovation into instructional routines is difficult to understand and predict. Using the diffusion/adoption theory as a research model, this research investigated the universal adoption of notebook computers by faculty in three small undergraduate institutions of higher education. A detailed examination of this type of organizational adoption is important because the use of notebook computers in the educational arena is a new but growing innovation. Understanding if the adoption takes place and what happens on a university campus if it does will enable other organizations to make decisions concerning the adoption. If changes occur in teaching and the changes are determined to be positive and create a better learning environment the results of this research will be of interest to other educational institutions. This chapter includes a background review of relevant information, the problem studied, research questions to be answered and limitations of the study.

Theorists of diffusion of innovations have adapted a research tradition based on a series of investigations on a similar topic in which successive studies are influenced by preceding inquiries. According to Rogers (1995) education ranks fourth among the main diffusion traditions in terms of the number of publications; 359 as of 1994 (9 percent of all diffusion publications, p. 42). Rogers
also states that diffusion research in education has an ever growing potential
collection stemming from the fact that organizations are involved in the
educational adoption decisions. Further research is necessary to determine what
effect organizational adoption may have on the diffusion process.

Of the eight main dependent variables of diffusion research discussed by
Rogers (1995), four were determined to be relevant to the research in this study
and were used to assess the degree of adoption and use. These four were:

1. Rate of Adoption - “Innovations perceived to be the most economically
    rewarding and least risky are adopted more rapidly. The complexity,
    observability and trialability of the innovations are less highly related to
    the innovations’ rate of adoption.” (Rogers, 1995, p. 88)

2. Innovativeness - The most popular of diffusion research topics, 58 percent
    of all the empirical generalizations reported in diffusion publications deal
    with innovativeness (Rogers 1995). It is for this study determined by
    Hunt, Joseph and Cook’s (1977) definition: a person’s predisposition
    toward the acceptance of innovative behavior.

3. Opinion Leadership - The success or failure of diffusion strategies depends
    partially on the role of opinion leaders and their relationship with change
    agents.

4. Consequences of Innovation - The changes that occur to an individual, to
    an organization, or to a social system as a result of the adoption or
    rejection of an innovation. (Rogers, 1995).
The research in this study was applied to the innovation of notebook computers on university campuses. The computers were distributed to all full-time faculty and some part-time faculty at three, four-year, undergraduate institutions of higher education. The first institution, Valley City State University (VCSU), had 54 full-time faculty and approximately 1100 students. The faculty received the notebooks in February of 1996. The second institution, Mayville State University (MaSU), had 37 full-time faculty and about 750 students. The faculty received notebooks seven months later, in August of 1996. The third institution, Jamestown College (JC), with 51 full-time faculty and approximately 1100 students also distributed notebooks to their faculty in August of 1996. The entire student population at VCSU received notebooks for the fall semester of 1996. The plan was that all students at MaSU would receive notebooks in the fall of 1997. The third institution, Jamestown College had no plans to distribute notebooks to its students.

There is limited research pertaining to the organizational adoption of the notebook computer. Of the 2,215 four-year public and private institutions in the United States, only two other four-year universities could be found which, at the time of the study, were investing in notebook technology for the entire population of the institution. The other two institutions included the University of Minnesota Crookston, Crookston, Minnesota and Waldorf College, Forest City, Iowa. Because notebook computers are a growing innovation it is important to add to the awareness concerning its diffusion. The intent of this study was to
investigate in some detail the factors that affected the adoption and the changes that occurred on the campuses because of the diffusion of notebook computers.

The decision to adopt the notebook computers by VCSU and MaSU was not authoritative, but rather a collective decision. Rogers and Shoemaker (1971) defined a collective decision as one where individuals in a social system adopt or reject by consensus and where all must conform to the system's decision. A technology planning process was undertaken by the universities a year prior to the notebook acquisition. A campus-wide committee including both faculty and staff considered the technology in place at the universities and the needs of the personnel and students on the campus. The conclusion of the assessments by the committees was that the needs of the campuses could not be met by the existing architecture of technology and that future State budgets would not even provide maintenance at the present level. Leasing notebook computers offered a practical answer.

At Jamestown College, the decision to provide notebooks for faculty was administrative, primarily made by the President and Vice President of Academic Affairs. This type of decision is called an authority decision and defined by Rogers and Shoemaker (1971) as an innovation decision forced upon the members of the adoption unit by someone in a super-ordinate power position.

Notebook or laptop computers are relatively new and can be considered a technological innovation. Because they only became available in the mid 1980s, very little research concerning their use in education has been reported.
Nevertheless, a great deal of research is available dealing with computers in education. The importance of computers in American Education is well documented (Becker, 1993; Sheingold & Hadley, 1990; United States Office of Technology Assessment [OTA], 1988). Researchers also agree that the key to effective educational use of computers is not just in their presence, but in the way in which they are used in classroom (Becker, 1994; Solmon & Garner, 1986).

Students on the VCSU campus received their computers during the period of this research. The faculty at MaSU were aware that students would be receiving notebook computers in the succeeding fall after the completion of the study. Both institutions made infrastructure changes to allow for computer use in many classrooms by both students and faculty. However, at JC faculty did not have this expectation nor did the college undergo the infrastructure changes to allow for computer use in existing classrooms. Therefore, differences in the adoption patterns were expected at the three institutions.

**Background**

The study was conducted beginning in the winter of 1995-96 at three North Dakota institutions of higher education, including Valley City State University (VCSU), Mayville State University (MaSU) and Jamestown College (JC). The three institutions distributed notebook computers to all of their faculty between February and August of 1996. Methods of gathering data in the study included:
• A questionnaire was dispensed in February and March of 1996,

• A second, similar questionnaire conducted during February and March of 1997.

• On the VCSU and MaSU campuses, focus groups were conducted and two sets of syllabi were gathered for examination.

**Diffusion of the use of notebook computers**

The meaningful components of this study included:

• VCSU and MaSU made the decision to provide every full-time faculty member a notebook computer,

• Both institutions had plans to provide leased computers for every student and to network their campuses and classrooms,

• Training was provided to the faculty at both institutions in the computer’s software.

• VCSU’s students had their notebooks for six months prior the second administration of the questionnaire.

• At MaSU students were to get computers six months after the questionnaire was administered the second time.

• Although VCSU and MaSU operate independently, they maintain a partnership through which they share several administrative positions including President, Vice Presidents of Academic Affairs and Business Affairs, Comptroller, and Grant writer. Both universities went through a
technology planning process on their campuses prior to acquiring the notebooks. As a result of decisions made during the planning process, multimedia presentation equipment and student network connections were added to classrooms and all buildings were networked. Software and hardware was standardized to allow for ease of training and ease of help desk support.

- The third institution, Jamestown College, is not a state institution but has several characteristics that are similar to the other two institutions including number of full time faculty less than 60, number of students less than 1500, type of administrative structure, and major offerings in education and business curriculums. JC made the decision to provide notebooks administratively and did not provide for computer use in classrooms.

Although much of the research on the diffusion of innovations is concerned with individuals, many innovations today are adopted by organizations. The innovation, notebook computers, could not be adopted by the faculty until the universities decided to lease the notebooks and build the network. Thus, this type of innovation-decision is called a “contingent innovation-decision” by Rogers (1985) who described it as the type of innovation-decision in which choices to adopt or reject can only be made after a prior innovation-decision. Hence, the notebooks and their training in their use would not have been available to 100% of the faculty had the universities not made the
initial commitment. The adoption was organizational innovation, because all full-time faculty at each of the three institutions received notebook computers simultaneously.

While there was a tendency until the 1970s simply to transfer to the study of organizations the models and methods of innovativeness originally developed for individuals, more recent studies focus on the process of innovation in the organization. Research by Van de Ven and Rogers (1988) concluded: “the intellectual intersection of innovations and organizations has indeed become a popular dwelling spot for contemporary research activity” (p. 642). With more computer-based innovations finding their way into educational organizations (Becker, 1993; Comtex Scientific Corporation, 1995), the results of research concerning such adoption have become valuable. Concerning innovations in organizations, Rogers (1995) noted:

An important turning point in the history of research on innovation in organizations occurred with publication of the book *Innovation and Organizations* by Gearak Zaltman and others (1973). . . . [after this publication] the main dependent variable of study often became implementation, putting an innovation into use, rather than adoption (the decision to use the innovation). (p. 389)

The present study adhered to the use of the dependent variable discussed above. Through the use of tools such as Level of Computer Use assessment and Stages of Concern questionnaire, this study assessed the implementation of the notebook computer.
Computer use in education

There are several influencing variables to consider when examining the status of educational computing. First, there is a great deal of public and political support for computers. The government, academia, educational politicians, and parents share the view that educational technology—especially involving the computer—has a major positive impact on the educational system (National Task Force on Educational Technology, 1986; Shanker, 1990; Sheingold & Hadley, 1990; United States Office of Technology Assessment [OTA], 1988). This influence has caused computer literacy to be valued as a kind of "cultural capital" in today's society, much as higher education has been valued earlier during the twentieth century. A recent survey of New York elementary teachers indicated that 75 percent of them found computers helpful as a teaching aid. Nearly two-thirds (63 percent) believed using computers for teaching will make them more successful as teachers (Braun, 1996).

Second, the use of technology in education continues to increase. Research in this area indicates that the availability of computer technology in education including multimedia, CD-ROMs, Videodisks, and Internet access has grown markedly over the last three decades. In the period from 1983 to 1987, the average pupil to computer ratio in public elementary schools improved from 112.4 to 36.8 pupils per computer (OTA, 1988). More recently, in the 1990s the increase has sharpened. In a article in 1996, DeLoughry reported that from a recent survey Kenneth Green (1996) found that between 1994 and 1995 the
percentage of college classes held in computer-equipped classrooms went up from 15.8 to 24 percent, while the use of electronic mail in classes rose from 8 to 20 percent.

Third, the accumulation of hardware and software is only part of the adoption process. During the last two decades, concern over the appropriate use of the technology has mounted. Researchers such as Henry Becker attempted to determine the use. The results of surveys done by Becker (1991) reported the following concerning the implementation of computers into schools across the United States. In 1983, about three-quarters of all the time spent by secondary school students on school computers was spent learning programming and computer literacy activities. From 1985 to 1989 computer programming decreased from 42 percent to 20 percent for high schools students, and more than 50 percent of the time was still spent on computer education. The rest of the time was spent on teaching word processing, database program use and basic keyboarding skills.

The titles of the following articles attest to the sentiment that many teachers and school districts were dissatisfied with computers and they were disappointed that breakthroughs in educational technology did not revamp education: "Computer 'revolution' [is] on hold..." (O'Neill, 1990), and "The revolution that fizzled" (Bjerklie & Hollis, 1991). Some writers, such as Clark, (1994), suggested there was little research evidence for the unique effectiveness of computer technology. He contended that any necessary teaching method can
usually be designed in more than one media. Although there are varying degrees of acceptance and disagreement with Clark's point of view, other researchers agree that media are tools for students and teachers to use and that learning is founded in the activities and processes that encourage thinking and reasoning, not in the media that delivers information (Jonassen, 1994; Kozma, 1994). Still others indicated that the research that exists indicates many teachers are not using technology in effective ways. Becker (1993) found only 5 percent of the teachers he sampled in 1989 to be exemplary computer-using teachers and that figure fell to 3 percent when teachers who did not use computers at all were included.

Computers have also not delivered according to the expectations of faculty at the university level. The advent of computers in universities more than thirty years ago brought with them a belief that this technology would change teaching and learning in American higher education. This vision helped to spur an enormous investment in information technology by colleges and universities. Geoghegan (1994) commented:

> Given the size of our investment in instructional technology since 1980, and more than 15 years of accumulated experience in instructional computing, it seems reasonable to ask why we have gotten no farther than we have toward the "revolution" in teaching and learning so confidently predicted over the years. (p. 2)

According to Green and Eastman (1994) and Shanks (1993), despite massive expenditures, information technology is not being integrated into the teaching and learning process nearly as much as people have predicted. Willut
(1994) reported that current estimates suggest that information technology may be integrated into no more that five percent of the university courses taught. Although there are many isolated pockets of successful technology implementations, a survey by Green (1996) found only a very small proportion of the faculty are actively using computer technology in their teaching.

Need for the Study

The first phase of this study was designed to identify the characteristics of faculty members that predict or correlate with their degree of adoption of an innovation. Although computers have become more available in university settings, teachers have not integrated them into their teaching. Much of the research that has been done concerns this discrepancy between the potential use of technology and the actual use of technology by teachers. Rogers (1995) reported that the implementation of many of the innovations in organizations have failed, causing a great deal of practical interest in better understating how to effectively introduce computer-related technologies.

However, the reason for these discrepancies has not been satisfied by research. If it were possible to predict the faculty's use of the notebook computers, then the use level could be encouraged through cultural changes in the campus.

The more recent studies concerning adoption have focused on environmental and internal factors rather than acquisition of hardware and
software. Some research, such as a Rand corporation study for the U.S. Department of Health, Education and Welfare (Berman & McLaughlin, 1978), focused on the environmental factors affecting human change, while other studies sought to establish relationships between personological factors and computer technology use through related subjects such as educational administrators (Jorde-Bloom & Ford, 1988).

Still others looked at the importance of internal variables. Maurer & Simonson (1993-94) considered computer anxiety and its relationship to achievement in computer use. Ajzen & Fishbein, (1980) suggested that one's intentions to perform a behavior are determined by one's subjective norms and one's attitude toward the behavior. Subjective norms is an interesting internal variable since it embodies an individual's interpretation of influential people who can be considered external forces.

Sheingold and Hadley (1990; 1993) surveyed teachers who had integrated computers into their teaching in order to identify characteristics, personological and environmental, which might have been related to teachers' use of computers. Becker (1994) developed a set of standards for judging what would constitute an exemplary computer using teacher and identified the variables that made them different from other teachers. The two variables which Becker's reported best differentiated the two groups were (1) the amount of time the teachers spent using computers at school, and (2) the amount of training they'd had in using computers. Despite this research, the relationship between
combined personological variables and the use of computer technology by teachers has not been identified. Questions concerning why some teachers choose to spend time with computers and time in training and others do not remain unanswered.

According to Hunt, Joseph and Cook (1977), innovativeness is a person's predisposition toward the acceptance of innovative behavior. This definition differs from Rogers and Shoemaker (1971) who defined innovativeness as the degree to which an individual is early in adopting innovations relative to others in social systems. Since the integration of computer use into teaching has not been achieved to any great extent on university campuses, it would still be considered a new behavior (Rogers, 1983). Therefore, in this study the use of the notebook computers in teaching would be considered the adoption of innovation and the Hunt, Joseph and Cook definition has been applied.

The second phase of this study was to determine if there are changes that took place on the university campuses because of the use of notebook computers in teaching and learning. Rogers (1995) stated that during the redefining/restructuring stage of organizational adoption the innovation is re-invented to accommodate the organization's needs and structure more closely, and when the organization's structure is modified to fit with the innovation. Schroeder, Van de Ven, Scudder, and Polley (1986) determined that organizational units not involved in the development or re-invention of an innovation tend to view it as an external mandate. In this situation the
receptiveness, learning and adoption speed are diminished. Consequently, it is important that at two of the three universities' faculty and staff were directly involved in the decision to acquire the notebook computers as well as the decision to facilitate their use in teaching through networking classrooms and dorms, and acquiring notebooks for all students. Technology innovations have often been assumed to be an object and an external force that affects organizational structure.

A more recent and realistic view of a technology innovation in an organization according to Orlikowski (1992) is to see it as the human interaction in which its meaning is gradually worked out through discussion. This discussion allows for the re-invention to take place so the organization's participants can define the new idea so it becomes theirs and fits the organization. The software including the interactive capabilities of e-mail and World Wide Web available on the notebook computer encouraged this type of interaction. It was this view which guided the research focus in this study. The questionnaire was developed to investigate the changes in the concerns and attitudes of the faculty as well as the changes in the instruction delivered by the faculty.

Statement of the Problem

Notebook computers are one of the newest innovations available to educators; the first laptop was made commercially available by Toshiba in 1986.
DeLoughry, (1996) noted recently that laptop computers have made it easier for faculty members to use technology in the classroom without having to push a bulky computer cart across the campus. A yearly survey by Green indicated that between 1994 and 95 the greatest gains in the use of information technology as an instructional resource were in the use of e-mail and presentation software. However, his 1996 survey indicated these gains had slowed and leveled off. As discussed previously in this chapter, there is a great deal of research concerning computers in education and some research exists regarding student access to portable computing (Gardner, 1993 & Loader 1993). However, the personological characteristics, which in a given setting which can predict the adoption of computer technology in the educational realm, have not been delineated. This study might contribute to an understanding of the adoption, or lack of adoption, of computer technology use in university settings.

After the organizational decision to acquire notebook computers was made by the universities, this study recorded environmental and teaching changes as well as faculty concerns that occurred over a one-year period. Since notebook computer technology is a new innovation in the educational environment, it is important to understand what changes may occur and what environmental factors affect the use of the innovation within the organization. As more educational institutions make adoption decisions concerning notebook computers, specific information concerning the changes the technology might cause is important. The findings may also offer insight to administrators and
technology directors concerning the successful introduction of computer-related innovations into university settings.

**Purpose of the Study**

The first purpose of this research was to determine the best predictors of notebook computer adoption by the faculty in an organizational adoption. The second purpose of the study was to determine the changes in teaching and learning, attributed to the universal availability of notebook computers, which occurred over a one-year period.

**Research Questions**

The following questions were used to guide the study:

1. To what extent if any do the selected variables: age, rank, innovativeness and subjective norms predict a faculty member's adoption of the notebook computer?

2. How does universal notebook computer accessibility affect a faculty member's level of computer use?

3. Are there more or different uses of computer technology in the classroom on campuses because notebook computers are available to all faculty?

4. Are there changes in the instructor's teaching methods because of the universal availability of notebook computers?

5. Does the faculty's access to the notebook computers change the types or level of concerns expressed by the faculty?
6. Does the faculty's computer anxiety change after faculty have had access to the notebooks for a period of time?

Research significance

The objectives of this research were to determine: (1) which factors best predict the adoption of the notebook computer by the faculty; (2) how faculty notebook computer use changes over time; and (3) how teaching and learning change after faculty and students have universal access to notebook computers.

Furthermore, this study contributes to existing research and the body of knowledge concerning prediction of adoption and use of computer technology by university faculty. The following were expected outcomes:

1. There will be a significant rise in the number of faculty who score in the Utilization and Integration levels of the Level of Use Assessment.

2. The Concerns Based Adoption Model - Stages of Concerns about an Innovations Questionnaire will show significantly more faculty peak in stages four, five and six after the notebook computers have been used for a period of time.

3. There will be significantly less computer anxiety among faculty who have universal access to notebook computers over a one-year period. The amount of change will be dependent upon the length of time the computers are available and the amount of prior use.
4. Subjective norms, innovativeness, academic rank and age, are expected to be significant predictors in the adoption of the notebook computer.

This study also followed changes in course syllabi concerning the use of technology by faculty and students. The information collected from focus groups on two of the campuses was used to understand the underlying conditions and problems encountered because of the organization's adoption of notebook computers. Morgan (1998) indicated that focus groups should be used for this purpose "when the research topic involves understanding the success or failure of a particular program in specific setting, focus groups may well be the most effective tool for uncovering the reason behind the outcome" (p. 52).

Generalizability

Because distribution of notebook computers to faculty was an organizational adoption decision, random selection of the participants was impossible; however, random selection of individuals for focus group participation and course syllabus selection was possible. It is hoped that the results of the study can be generalized to other university faculty in small teaching-oriented institutions where notebooks computers are distributed to all faculty.

Definition of Terms

Several terms were defined for use in the study:

*Adoption:* the decision to make full use of an innovation.
**Diffusion:** the process by which an innovation is communicated through certain channels over time among the members of a social system.

**Innovation:** an idea, practice or object that is perceived as new by the individual or other unit of adoption (Rogers, 1995).

**Innovativeness:** a person’s willingness to change or adopt novelty relative to a social system (Rogers, 1995).

**Innovator:** a person who has a tendency towards the willingness to change or adopt novelty relative to a social system.

**Integration:** a state of use of computer technology where its implementation is critical to the functioning of the instruction as a result of the established teaching tasks being delegated to computer technology. Its sudden absence would disrupt and impede the scheduled flow of instruction.

**Notebook computer:** a portable microcomputer weighing 4-6 pounds. It is a programmable, electronic device for storing, retrieving and processing data with a central processing unit that is manufactured on a silicon chip, a microprocessor, thus enabling it to be small and relatively inexpensive.

**Motivation:** that which drives a person to respond to some stimulus.

**Nonuse:** a condition where computer technology is not used at all in teaching.

**Organization:** a stable system of individuals who work together to achieve common goals through a hierarchy of ranks and division of labor (Rogers & Agarwala-Rogers, 1976)
Portability: the ability of the faculty member to take the notebook computer to sites where it is needed by the individual; including home, classroom, conferences and presentations.

Use: the state of use of computer technology in instruction. The distinguishing attribute is the critical nature of their implementation to the functioning of instruction. This occurs as a result of the sharing of teaching tasks by the teacher and the technology.

Utilization: the state of use where teachers and computer technology share some teaching tasks but the roll of the computer has not been established. Its sudden absence would now disrupt the scheduled flow of instruction.

Summary

This chapter provided a brief overview of the theory of diffusion of innovations as it applies to this study. General information was given about notebook computers as an innovation and educational computing. A description of the organizational adoption of notebook computers by three small universities, Valley City State University and Mayville State University and Jamestown College was provided. The purpose of the study, to identify characteristics which may predict the faculty's adoption of the computers and also to identify the kinds of changes which occurred because of the accessibility of notebook computers, was clarified.
CHAPTER 2. LITERATURE REVIEW

Introduction

The purpose of this chapter was to examine the research literature as it relates to: (1) Rogers' Diffusion of Innovations theory; (2) Concerns Based Adoption; (3) Adoption Prediction; and (4) Computer Use.

Diffusion of Innovation

In the field of education, notebook computers are a relatively new technology innovation. As with all new innovations introduced into a social system, an adoption/diffusion cycle may occur. The potential users first become aware of the innovation, and each individual then judges its relative value and makes a decision based on that judgment. Each individual then chooses to implement or reject the innovation and seeks conformation concerning their decision (Rogers, 1995). This process may potentially lead to one of three cycles: adoption/diffusion, adoption/non-diffusion or non-adoption/non-diffusion of the innovation.

One factor which can influence the cycle of adoption significantly is the type of adoption decision, in this case, organizational adoption. The innovation-decision process in organizations differs from the process by individuals in that it is much more complex, it involves a larger number of individuals and the process involves change in both the innovation and the organization if
adoption/diffusion is to occur (Rogers 1995). Early studies on organizational adoption such as Czepiel (1975) or Mytinger (1968) focused on the innovativeness of the organization using the models and methods of investigating innovativeness earlier developed for individuals. These studies found rather low relationships between the measured qualities of the organization and its innovativeness.

The publication of Innovations and organizations (Zaltman, Ducan, & Holbek, 1973), the authors changed adoption research in organizations. Rather than measuring innovative characteristics of the organization, this work focused on the innovation process at the level of the organization and attempted to understand the implementation, or use, of the innovation. Later during the 1980s and 1990s, Van de Ven and Rogers (1988) reported a renewed interest in organizational adoption research due to the employment of new communication and computer technologies by organizations. One large and well-funded research effort on this topic, the Minnesota Innovation Research Program, was begun at the University of Minnesota in 1983. The research by this group, lead by Professor Andrew H. Van de Ven, resulted in fourteen in-depth case studies of technological innovations in a variety of fields. One conclusion reached in this research was that innovation decisions are not initiated on the spur of the moment, nor by a single incident, nor by a single individual, but are caused by a shock to the organization reached when the organization must face its needs or problems (Schroeder, Van de Ven, Scudder, & Polley, 1989).
The organizations (the three universities) in the current study each made the decision to adopt notebook computers for their faculty prior the faculty beginning to use the notebook computers. Therefore, this study focused, as suggested by Zaltman, Duncan, and Holbek (1973), on the innovation process within the organization and attempted to understand the changes which occurred in all of the organizations and in the use of innovation because of the adoption.

A second factor which can significantly influence the adoption/diffusion of an innovation is the rate of adoption, especially if an innovation is organizational. Rogers (1995) found that from 49 to 87 percent of the variance in rate of adoption is explained by five attributes: (1) relative advantage - the degree to which an innovation is perceived as better than the innovation proceeding it; (2) compatibility - the degree to which an innovation is perceived as meeting the needs of potential adopters; (3) complexity - the degree to which an innovation is perceived as difficult to understand and use; (4) trialability - the degree to which and innovation may be experimented on a limited basis; and (5) observability - the degree to which the results of an innovation are visible to others. These attributes were also characterized as important to organizational innovation by Zaltman, Duncan, and Holbek (1973).

In case studies conducted by the Minnesota Innovation Research Program on organizational adoption concluded innovation receptiveness, learning and adoption speed are facilitated when the adopters are provided with opportunities
to re-invent the innovations to fit the needs of the organization (Schroeder, Van de Ven, Scudder, & Polley, 1986). However, a study of several innovations in three organizations by Tyre and Orlikowski (1994) found that only a brief window of opportunity existed in an organization during which an innovation can be modified. Without this reinvention or modification, the innovation becomes imbedded into the organizational structure but is less likely to meet the needs intended. If the rate of adoption is slowed because certain attributes, the window of opportunity for reinvention may be lost. As reported by Tyre and Orlikowski (1994), if modification of the innovation does not occur, adoption/diffusion is less apt to occur.

Although each of the universities in this study supplied notebook computers to their faculty during the one-year study, each of the institutions were different concerning the length of time their faculty had access to and training in the use of the notebook computers. Each university was expected to reflect different rates of change and use over the one-year period. Perhaps the window of opportunity for modification and reinvention matched up with the adoption period better at one of the institution than at the others. Of the five attributes which affect the rate of adoption, according to Rogers (1995), four were determined to have contributed to the rate of adoption are in this study:

1. Relative advantage - If faculty in a university had more experience in the use of computers they might consider the notebooks to be more of an advantage to teaching. If universities provide classrooms which have
multimedia and network connections the faculty may consider the
notebooks more of an advantage.

2. Compatibility - If more individuals in the university felt they had
contributed to the decision to adopt the notebook computers, they were
more likely to believe that the notebook would fit their needs. Brandner
and Keal (1964) found compatibility to be important in business
organizations.

3. Trialability - The longer faculty had access to computers in general and
notebooks, specifically, the more likely they would be to use the
innovation.

4. Observability - The more the notebooks were used in the classroom, the
greater the awareness of their use by other faculty. When student are
issued notebooks computers, their observability in the classroom also
increases. Roger and Shoemaker (1971) reported that the ease with which
the results of the innovation can be reported is a major force in the
diffusion process.

Rogers (1995) stated that the model of the innovation process in
organizations usually consists of a sequence of five stages, each characterized by
a particular range of events, actions, and decisions made at that point. Rogers
(1995) visualized the stages as shown in Figure 1.
Rogers (1995) described the innovation process in an organization as consisting of two broad activities: (1) *initiation* - defined as all of the information gathering, conceptualizing; and planning for the adoption of an innovation, leading up to the decision to adopt, and (2) *implementation* - all of the events actions and decisions involved in putting an innovation into use. The adoption decision itself divides initiation; composed of the agenda-setting and matching stages, from implementation; composed of the three stages of redefining/ restructuring, clarifying and routinizing (see Figure 1.1).
• Agenda-setting stage - determines the problems which face the organization and may create a need for an innovation.

• Matching stage - is a reality test in which the organization attempts to determine if the innovation can feasibly be used to solve the problem experienced by the organization.

• The Redefining/Restructuring stage - includes the modification of the innovation to fit the institution's particular needs, while at the same time the structures of the institutions are altered to make use of the notebook computers. These changes occur only after the implementation decision has been made (Zaltman, Duncan, & Holbek, 1973)

• The Clarifying stage - defines more clearly the relationship between the innovation and organization's needs.

• The Routinizing stage - is where the innovation becomes an ongoing element in the organization and it loses its separate identity.

During the matching stage two major types of innovation decisions in organizations exist: (1) authority decisions, and (2) collective decisions. Zaltman, Duncan, and Holbek (1973) described the difference as the degree to which members of the unit participate in the decision. Authority decisions are made by an individual or by a small group while collective decisions are made by all or a majority of the adoption unit's members.

In this study, two of the campuses (VCSU and MaSU) established educational computing goals through their technology planning committees.
Their committees also dealt with the general technology problems and discussed the options for meeting their goals. The problem faced by the committees was the result of comparing the educational computing goals of the organization with the established realities and budgets of the institutions. The resulting solution was the decision to adopt the notebook computers for faculty and students. Dialogues were also held with students and faculty prior to the adoption decision. Marrow, Bowers and Seashore (1967) found that increased participation in the collective decision process, while taking a longer period, is likely to lead to more commitment by participants to working through some of the difficulties experienced during implementation.

In the third institution (JC) the agenda setting and matching stages were completed through administrative decisions and student computers were not included in the solution. Jamestown College applied authority decisions during the first two stages. Rogers and Shoemaker (1971) emphasized that, “Changes brought about by the authoritative approach are more likely to be discontinued than those brought about by the participative approach” (p. 314). Many researchers make the assumption that when members become involved in decision making, they will be more likely to implement the changes these decisions involve and thus potentially reduce resistance to change (Coch & French, 1948; Marrow, Bowers, & Seashore, 1967; Watson, 1971).

Notebook computers were considered to be an appropriate innovation to accomplish the goals of all three institutions. This study attempted to determine
if, to what extent, and under what conditions the universities advanced through
the redefining/restructuring, clarifying and routinizing stages of the innovation
adoption process.

Concerns Based Adoption Model (CBAM)

The Concerns-Based Adoption Model (CBAM) was developed over a thirty-
year period by Hall, Wallace, and Dorsett (1973) from the Research and
Development Center for Teacher Education at the University of Texas at Austin.
This model comprises three diagnostic dimensions: (1) the individual’s concerns
as he or she is involved in the change process; (2) the levels of use of an
innovation; and (3) the Innovation Configuration which describes the operational
forms of an innovation. The first diagnostic dimension, Stages of Concerns (SoC),
focuses on the concerns of individuals involved in change (Hall, 1979). Research
has shown that users or potential users of an innovation have seven kinds of
concerns (Hall, George, & Rutherford, 1986). The concerns were organized into a
model of Stages of Concern. There is developmental movement through these
stages. Certain types of concern will be more intense, then less intense, before
arousal of other types will occur, thus the name “stages”. While the seven Stages
of Concern are distinctive, they are not mutually exclusive. An individual will
likely have some degree of concern in every stage but the intensity of concern
varies as the implementation of change progresses (Hord, Rutherford, Huling-
A 35 statement questionnaire was used to indicated the individual's type and level of concern about an innovation:

1. Awareness, level 0 - indicates little concern about or involvement with the innovation.

2. Information, level 1 - indicates the individual has a general awareness of the innovation and interest in learning more detail about it. While the person is unworried about himself/herself in relation to the innovation, he/she is interested in the innovation in a selfless manner.

3. Personal, level 2 - the individual is uncertain about the demands of the innovation, this includes his/her relation to the reward structure of the organization, or personal commitment. Financial or status implications of the program for self or colleagues may be reflected.

4. Management, level 3 - indicates individual's attention is focused on the processes and tasks of using the innovation and best use of information and resources. Issues which arise at this level are related to efficiency, organizing, managing, scheduling, and time demands.

5. Consequences, level 4 - indicates the individual is focusing on the impact of the innovation on students in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and changes needed to increase student outcomes.
6. Collaboration, level 5 - indicates the individual is focusing on coordination and cooperation with others regarding the use of the innovation.

7. Refocusing, level 6 - indicates the focus of the individual is on exploration of more universal benefits from the innovation. This may include the possibility of major changes or replacement with a more powerful alternative.

According to Newlove and Hall (1976), depending on the individual's closeness to and involvement with an innovation, the individual's concerns will be different in type as well as in intensity. Concerns vary depending on the amount of knowledge about and experience with the innovation. The SoCQ is not expected to record lower levels of concern, but it records a change in the type of concerns expressed by the respondents.

The Stages of Concerns Questionnaire (SoCQ) was examined and chosen by the researcher because it focuses on the concerns of individuals involved in change. It was included in this study's questionnaire to identify the concerns of the faculty about the notebook computers. The types and level of concerns at the beginning of this study were compared to those at the conclusion of the study. The differences in the stages of concern between the institutions at the beginning and conclusion of the study were expected to be distinctive for each institution. The differences in the concerns are also likely to reflect the level of adoption reached at each institution.
Other research which used the C-BAM for much the same purpose include Wiley (1992) who surveyed 231 teachers on their concern about computers and then applied the results to staff development, Todd (1992) who reported faculty concerns in integrating computer technologies into teacher education at the university level, and Frame (1991) who studied the effect two workshops would have on participants' concerns and level of instructional computer use. In the latter study, Frame found that the workshops changed the concerns of the participants and increased their computer use.

Adoption Prediction

Adoption prediction in the present study was based on innovativeness, subjective norms, age and academic rank.

Innovativeness

The definition of innovativeness according to Hurt, Joseph, and Cook (1977) focuses on the measurement of an individual's willingness to innovate. They defined innovativeness as one's "willingness to change." Innovativeness may relate to individuals or to organizations. This study is involved with organizations, however, the innovativeness of the individuals within the organizations were examined as predictors of adoption of the innovation rather than the innovativeness of the organization. The most recent studies on the innovation process in organizations focus on the implementation or putting the an innovation to use (Van de Ven, Scudder, & Polley, 1986).
In their development of the Innovativeness Scale (IS), Hurt et al. (1977) focused on the measurement of an individual’s willingness to innovate. They defined innovativeness as one’s “willingness to change.” This definition varies somewhat from that of Rogers and Shoemaker (1971), stated at the beginning of this section. However, the former definition was used because the present study examined a faculty’s predisposition toward innovativeness, not their rate of adoption. Because this study attempted to determine if innovativeness as well as several other factors predicted adoption, the IS was appropriate for this study.

Other studies which utilized the Hunt’s Innovativeness Scale include; Marcinkiewicz (1994/95) who found IS contributed significantly to elementary school teachers’ computer use in teaching, Crawford (1995) who found that library media specialists are more innovative than the general population, and Witteman (1976) who hypothesized that high levels of innovativeness would be related to the levels of opinion leadership. Whitteman’s results indicated a significant linear correlation of .50 between the response to the IS and the measure of opinion leadership (N = 936).

Goldsmith (1986) considered the validity of four innovativeness scales. He found that, although all four scales measure related constructs, the Innovativeness Scale seemed the best measure of the willingness to try new things. A version of IS was chosen as the predictor variable in the present study. The IS was used to indicate if faculty at the three institutions had a
predisposition toward innovativeness, thus predicting whether they would use notebook computers for their instruction.

Subjective norms

A questionnaire to measure the variable of subjective norms was developed by Marcinkiewicz and Regstad (1996). It was developed referring to the procedures described by Fishbein and Ajzen (1980). Four significant-other entities were identified to ascertain who or what might have influenced the individual's intent to use computers for teaching. The significant-other entities which were identified by Marcinkiewicz and Regstad (1996) were the teachers' principal, colleagues, pupils, and professional body. One set of four items was developed for each significant-other entity.

The internal variable, subjective norms, was found to have significance in studies by Marcinkiewicz and Regstad (1996) and Marcinkiewicz and Wittman (1994/95). Marcinkiewicz and Regstad (1996) reported: "...it appears that subjective norms is most predictive of computer use. Even though self-competence, perceived relevance and innovativeness were identified as predictors in three of the studies, when subjective norms was added none of the other variables were listed during the analysis" (p. 8). The fact that subjective norms emerged as a dominant predictor supports the theory that personal motivation contributes to computer use.
In the present study the subjective norms scale was applied because the nature of subjective norms includes the dimension of the relationship of an individual's personal motivation to his or her environment. However, further research was needed to contribute to understanding of this relationship. This study was expected to support and contribute to existing research.

These norms concern whether or not the perception of what relevant others thought effected an individual's behavior (Fishbein & Ajzen, 1975). Subjective norms are used as an interaction to estimate one's willingness to comply. The theory of reasoned action proposes that one's intentions to perform a behavior are determined by one's subjective norms and one's attitude toward the behavior of relevant others (Ajzen & Fishbein, 1980). This variable provides perspicacity into the internal response or valuing germane to the external pressure. "Are faculty motivated by motivators within the university?"

The focus on internal variables in the present study drew support from several sources. First the data in Sheingold and Hadley's survey (1990) revealed that teachers who did integrate computers into teaching were distinguished by their motivation, often working on their own time to learn about or to plan for the using the computer. Second, in research reported on the adoption of notebook computers at Crookston State University, Cook (1995) reported: "The faculty members who were most adept in using the new technology were held in the highest esteem by students. The student opinion of the instructor increased in proportion to the use of the computers in the classroom" (p. 101).
In another section of the same study (Cook, 1995), the lack of adoption of the notebooks by some faculty was blamed on a lack of support by the administration. Cook reported, “Faculty members expected to receive positive reinforcement during the adoption period of the notebook program. Several comments made by faculty related to the lack of emotional and professional support, which was perceived as a negative outcome of the notebook program” (p. 131). Third, according to Rogers (1995) an organization's hierarchy, reward system and regulations can encourage, or discourage, the adoption of a new idea.

For the purposes of the present study, the significant-others' names in the questionnaire were changed to administration, faculty members, students and professional body. It was a fact that at each of the institutions in the study an external variable, the notebook computers, was introduced to all faculty. The internal variables measured by subjective norms were expected to predict adoption of the notebook computers.

Age and academic rank

The relationship of age to the adoption of computers is unclear. Respondents to Sheingold and Hadley's (1990) survey of outstanding teacher-users of computers encompassed a largely mature group, over half of whom were between 40 and 49, with three-quarters teaching for 13 years or more. These 600 computer-users were selected teachers who had integrated computers especially into their teaching.
In research on innovation (Rogers & Shoemaker, 1971), the effect of age showed mixed results. Rogers (1983) reported that those who are mature favor change. Hayes (1985) estimated that expertise in a subject develops over about ten years of serious effort. Other studies such as Marcinkiewicz (1991) found age not to be a significant predictor of computer use by elementary teachers.

In a university community there may be a closer relationship between adoption and academic rank, however, age and academic rank are most likely highly correlated. In a study done by McCord (1984) at Drexel University the findings were as follows:

The data showed that faculty attitudes toward the decision were dependent upon interaction between rank and computer-competence. Faculty with the rank of Full Professor, regardless of their own computer-competence, tended to have a favorable attitude toward the decision. If they viewed the decision favorably and were not already computer-competent, these members of the faculty participated in some form of training. Faculty with a rank of Assistant Professor also tended to view the technological conversion favorably; their participation in training, however, appeared not to be influenced by their attitudes toward the decision. In the middle rank, that of Associate Professor, faculty who were computer-competent were more pleased than those above or below them in rank; on the other hand, assistant Professors who were not computer-competent were less pleased that those above or below them in rank. (p. 11)

Age and academic rank were expected to have a relationship to the level of computer use in the present study.
Computer Use

In research related to the general use of computers in education, Sheingold and Hadley (1990) surveyed teachers who were experienced and accomplished at integrating computers into their teaching. They examined frequency of use, type of software used, and perceived effects of use. Their findings indicated the three factors that contributed to these teachers' success were motivation, support and collegiality from their schools, and access to sufficient quantities of technology. Becker (1994) and Hadley (1993) characterized the environment commonalities and patterns of exemplary computer-using teachers with much the same results as Sheingold and Hadley's 1990 study. All of these studies had findings which speak not only to the availability of the technology but to the effects of culture on the use of technology.

In other research even more closely related to higher education, Green and Eastman (1994), and Green (1996) surveyed computer use in higher education. The surveys reflected computing on 660 two- and four-year college and university campuses across the United States. The results of the survey indicated the largest growth in instructional technology use by faculty between 1994 and 1996 was e-mail and preparation of presentation handouts. Green (1996) found that, “Given the rising demand for and expectation about technology, it is not surprising that this year's survey identifies the closely linked issues of instructional integration and user support as the key technology
issues confronting American colleges and universities" (p. 20). Green's survey also indicated that less than half (43.4%) of American colleges and universities have a strategic plan identifying institutional goals, objectives, or implementation priorities for information technology, while, only about a quarter of them (28.1%) have a financial plan for replacing hardware or upgrading software.

Given the finding by Green (1996), higher education is facing difficulties if they are to accommodate the factors listed as important to the successful integration of computers into teaching. While university professors maybe motivated to use instructional technology (IT) in their teaching, the Green survey indicates that support and adequate funding for IT is not available. Ehrmann (1995) stated, "...the current technology infrastructure as most institutions is so taxed and under-funded that campuses are stretched supporting just the 'early adopters' - the first wave of students and faculty drawn to desktop computing and IT resources" (p 20). Ehrmann also believed that the successful integration of IT is almost always associated with significant structural change and this is the very kind of change that is routinely resisted by educational institutions.

One strategy for implementing IT into the higher education classroom is to require that students at the institution have access to computers. In the fall of 1995, DeLoughry (1995) indicated that 21 four-year institutions required undergraduates to have access to computers. At Drexel University, which has
had this requirement for twelve years, access today means student ownership or simply having access to computers in university supported computer laboratories. Drexel was one of the first institutions to require student access to computers and, initially in 1982, the requirement was that all 1983 freshmen would be required to own microcomputers. Individuals at Drexel explained that requiring purchase was very difficult to document.

In the fall of 1996, of those 21 universities, only three were found who distributed notebook computers to all full-time students and faculty. They were Valley City State University (VCSU) in Valley City, North Dakota, the University of Minnesota Crookston (UMC) in Crookston, Minnesota, and Waldorf College in Forest City, Iowa. The universal accessibility of faculty and students to IT at these institutions set them apart in the types of changes that may be occurring on their campuses. In a study conducted by Cook (1995) on the UMC campus, universal access to notebook computers played an important role in computer-assisted instruction.

In order to determine faculty computer use, the instructor's decision to use computing was considered to be an indicator of the adoption of the innovation (Hall, 1981; Rogers, 1962,1983,1995; Rogers & Shoemaker, 1971). To appropriately assess the use of computers, the term "use" needed to be defined as precisely as possible. In the current study, the variable "level of computer use" referred to the integrated employment of computers into the faculty's teaching. Because notebook computers were used in this study, computing is no
longer limited to the physical classroom or the time frame of the class.

integration may take place inside or outside the classroom 24 hours per day.

Rieber and Welliver (1989), and Welliver (1990) defined a model of Instructional Transformation that describes the process of adoption of an innovation. This human behavior has been studied generally and was reported by Rogers (1983), and Rogers and Shoemaker (1971). More specific to the current study, a framework for examining the adoption of innovations among educators is described in Hall, Loucks, Rutherford, and Newlove (1975). This framework was called Levels of Innovation Use. It was explained by Hall, Loucks, Rutherford and Newlove (1975):

Based on our experiences in the field as practitioners and adoption agents and on our past research efforts, we have found that “change” or innovation adoption is not accomplished in fact just because a decision maker has announced it. Instead, the various members of the user system, such as teachers and professors, demonstrate a wide variation in the type and degree of their use of an innovation. (p. 52)

The Level of Innovation Use framework consisted of eight levels through which adopters move from “non-use” to “managing” and, finally, “integrating” use of the innovation.

The Instructional Transformation model (Hooper & Rieber, 1995; Rieber & Welliver, 1989; Welliver, 1990) was specifically developed to look at the educational innovation, the computer. According to this model, the teacher advances through five stages of involvement with computers. First, an instructor familiarizes him/herself with computers, or familiarization; then, he or she
progresses to using computers in teaching, or *utilization*. A higher level of use is perceived when the instructor's use has become critical to his or her teaching, or *integration*. At this level, the instructor consciously and inextricably delegate some of their duties to the computer and are aware of the changes to their role as a result. The attribute of "criticality of the computers" develops as a result of the delegation of some of the teacher's duties to the computer. The fourth stage is *reorientation* which is a fine-tuning to make better use of the computer as a tool. The final stage is *evolution*, which is the continued integration of the computer into the teacher's methods in more convoluted practices. The key to this level is that an instructor remains sensitive to, is prepared for and is able to adapt to change.

In the present study the faculty's Level of Computer Use (LCU) was reported using a three-level scale conceptualized by Marcinkiewicz and Welliver, (1993). It was based on the Instructional Transformation Model described above, however, it used only three categories: Nonuse, or the absence of any computer use for teaching; and Utilization and Integration which represented progressive levels of computer use. The criterion for membership in the two use levels was the dimension of expandability of use, i.e., whether computers were expendable to one's teaching. The LCU has been used in several studies (Marcinkiewicz, 1991; Marcinkiewicz & Grabowski, 1992), and was adopted by the Grosse Pointe (Michigan) Public School System for use in its Staff Computer Skills Survey (Marcinkiewicz & Welliver, 1991).
Critical mass

In a keynote speech at the opening of the Association of Educational Communications and Technology Convention in 1997, Everett Rogers indicated that he believed instructional technology may soon reach "critical mass" in higher education. Rogers (1995) defined critical mass as: "...a point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining" (p. 313).

Rogers (1997) also stated that critical mass is important because once it is achieved, the rate of adoption accelerates. The interactive quality of the new communication media (e-mail and WWW) is suggested by Rogers as the primary reason for computer technology reaching critical mass. With each additional adopter, the utility of an interactive communication technology increases for all adopters including previous ones. According to Rogers, (1995), the difference in the interactive innovations is that there is a built-in "forcing quality" in the adopter-to-decider relationship, which stems from the reciprocal interdependence of interactive innovations, (i.e., one cannot get a fax unless one has a fax machine). Two studies that illustrated the diffusion of interactive innovations and critical mass were: Gerbaxani (1990) on the diffusion of Bitmap and Internet; and Kramer (1993) on the diffusion of the Minitel in France.

Reaching critical mass was expected to be of importance in the present study with respect to the level of adoption of the notebook computers. Since 100% of the faculty in the study were provided with notebooks, the level of
adoption and the reaching critical mass was a measurement of use by the faculty, not simply of possession. If, as suggested by Rogers, interactively was important for an innovation to reach the adoption level of critical mass, then the amount and length of time the interactively available with the notebook computers is important.

According to Williams, Rice, and Rogers (1988), interactivity is the degree to which participants in a communication process could exchange roles in, and the have control over, their shared dialogue. Having control means the extent to which an individual can choose the timing, content, and sequence of a communication act, search out alternative choices, enter the content into storage for other users, and perhaps create new communication capabilities.

However, the amount of interactively available varied at each of the institutions at the time of the study. Valley City State University, where all students and faculty had notebooks at least six months prior to responding to the second questionnaire, had the most interactivity available to participants. Students and faculty could access e-mail and the Internet (World Wide Web) on a 24-hour basis. This access was also available in 20% of the campus classrooms. At both Mayville State University and Jamestown College only the faculty had notebooks. Students did not have notebook and access to computers and the Internet was limited to computer labs. Faculty access to e-mail and the WWW was limited to the offices on campus. The differences in the level of interactively available on the three campuses were expected to have an impact on whether
critical mass was reached and hence whether a higher adoption occurs on the individual campuses.

**Computer anxiety**

Montag's (1984) study described computer attitude as: "...an individual's feeling about the personal and societal use of computers in appropriate ways. Positive attitudes include an anxiety free willingness or desire to use the computer, confidence in one's ability to use the computer and computer responsibility" (p. 58). In the present study an attempt was made to determine if having notebook computers for a period of time would change the negative attitudes (anxieties) participants have concerning the notebooks.

A number of studies have examined the relationship between computer anxiety and personality variables (Hawk, 1989; Loyd & Gressard, 1984; Rosen, Sears. & Weil, 1987). "Significant evidence has been amassed in this body of research to support the hypothesis that computer anxiety is a distinct and measurable construct" (Maurer & Simonson, 1993).

Simonson, Maurer, Montag-Torardi, and Whitaker (1987) defined computer anxiety as: "...the fear or apprehension felt by individuals when they used computers, or when they considered the possibility of computer utilization" (p. 238). A research instrument referred to as the Computer Anxiety Index (CAIN) was developed by Maurer (1983). Research utilizing CAIN (Maurer, 1993/94) found a reduction of computer anxiety from the beginning of a class to
the end, when the class included instruction on computer use. This conclusion was also supported in earlier findings that determined instruction in the use of the computers can be effective in reducing computer anxiety (Hayek & Stephens, 1989; Jones & Wall, 1985; Koohang, 1987). All three campuses in the present study offered faculty and students varying amounts of training in the use of the notebook computers and the software available. The CAIN (Maurer, 1983) was reviewed and chosen as the instrument to appraise the level of anxiety in the pre and post assessment of the university faculty.

Summary

This chapter began with a review the theories applied to the current study, including the diffusion of innovation and the Concerns Based Adoption Model. The theory sections were followed by a discussion of research related to adoption predictors including: innovativeness, subjective norms, age and academic rank. A brief description of the specific tools used to measure variables followed each predictor. The chapter concluded with research concerning the general use of computers in education, the use of computers in higher education, the variable used to measure computer use, and the concept of critical mass. The tools used in the current study to describe computer use in the population studied (Stages of Concerns Questionnaire, Level of Computer Use and Computer Anxiety Index) were delineated briefly.
CHAPTER 3. METHODOLOGY

Introduction

The present study had two phases. The first phase was to determine whether the selected variables either individually or in combination were related to the adoption of the notebook computers by the university faculty. The second phase of this study was to determine if change occurred and if so what types of change was undergone by the institutions due to the adoption of the notebook computers. The research was undertaken in two phases. This chapter discusses in detail the procedures used to fulfill the two phases.

In the first phase of this study the scale, Level of Computer Use assessment, was used to determine the degree of adoption. The variables expected to predict adoption were: (1) faculty member's innovativeness as measured by the Innovativeness Scale; (2) subjective norms as assessed by the Subjective Norms Questionnaire; (3) age; and (4) academic rank.

The second phase of the study was longitudinal. Its purpose was to determine if changes in faculty concerns and teaching and learning occurred over a one-year period. If changes did occur, how did they differ among the three institutions due to the adoption of the notebook computers? The variables that were expected to measure the teaching changes included: (1) faculty members' levels of computer use measured by the scale Level of Computer Use; (2) types of faculty concerns about using computers expressed, as measured by the Stages of
Concerns Questionnaire; (3) computer anxiety, as measured by the Computer Anxiety Index; (4) classroom uses of technology; (5) teaching methods employed; and (6) frequency of software use. The last three variables were measured through individual questions on the Computers in Teaching Technology Questionnaire.

This chapter includes the following sections: (1) Sample; (2) Procedure; (3) Research Questions; (4) Instruments Included in the Questionnaire; and (5) Summary.

Sample

The sample consisted of the faculty from three small colleges/universities in the upper Midwest. All full-time faculty and part-time faculty who taught at least a 50% load (N=151) at the three college/universities (VCSU = 55, MaSU = 45, JC = 51) were included in the initial sample. Faculty received two questionnaires: the first in February of 1996, and the second in February of 1997. Only faculty who returned both questionnaires were used in this study because the responses to the first and second questionnaire were matched. The final sample consisted of N=85.

The sample was divided into three groups. The first group of faculty received notebook computers in February of 1996 (VCSU, N=37). A second group of faculty received computers in August of 1996 (MaSU, N=27). Both institutions made the organizational decision to provide notebook computers for all faculty
and students. The faculty in these two groups were aware that their students would be receiving notebook computers in the fall of the year following the faculty's acquisition of computers. The third group of faculty also received notebook computers in August of 1996 (JC, N=21), however, there was no plan in place for students to receive notebook computers. The organizational adoption of notebook computers by the three institutions provided an opportunity to study interesting variables in a setting in which accessibility to computer technology was not a variable.

Institution context

The three institutions shared more than just their decision to provide notebooks to their faculty. Other characteristics shared by the three institutions at the time of the study (Table 3.1).

Table 3.1. Institutional statistics for 1996-97

<table>
<thead>
<tr>
<th>Factors</th>
<th>VCSU</th>
<th>MaSU</th>
<th>JC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of full-time faculty</td>
<td>54</td>
<td>37</td>
<td>51</td>
</tr>
<tr>
<td>Number of students</td>
<td>1121</td>
<td>756</td>
<td>1105</td>
</tr>
<tr>
<td>Male/Female ratio of full-time faculty</td>
<td>26:20</td>
<td>30:7</td>
<td>35:21</td>
</tr>
<tr>
<td>Percent of students from North Dakota</td>
<td>80</td>
<td>70</td>
<td>63</td>
</tr>
</tbody>
</table>
VCSU and MaSU shared several administrative positions including President, Vice Presidents of Academic Affairs, Vice President of Business Affairs, Comptroller, and Grant writer. VCSU and MaSU were also part of the North Dakota University System. The third institution, JC was a private institution with a religious affiliation.

In the spring of 1997, at the time of the distribution of the second questionnaire, each of the three institutions had completed differing amounts of technological infrastructural changes to accommodate the use of the notebook computers.

**VCSU**

- Network connections were in every faculty and staff office with the exception of the Athletic facility.
- Twenty-one percent of the classrooms were networked (16-98 connections per classroom).
- Forty-three percent of the classrooms had multimedia presentation capabilities, including large screen TVs for projection of computers, video, sound and still cameras.
- There were an average of 20 direct network connections in each dorm and a 50 modem pool available for dorm and off-campus dial-in connections.
- A help desk was staffed to assist with problems.
- Plans were made to network 4 more classrooms and the Athletic facility during the following summer.
MaSU

- The campus was 90 percent networked in its faculty and staff offices.
- Five percent of the classrooms (i.e., computer labs) were networked (i.e., 15-25 connections in each lab).
- Ten percent of the classrooms had multimedia presentation capabilities.
- No dorms were networked, however, 8 modems were available for dorm and off-campus dial-up access.
- Summer 1997 plans were to complete the campus network and add 12 networked multimedia classrooms with 12-70 Internet connections in each.

JC

- The campus network was nearly completed, and about 90 percent of the faculty had direct network connections in their office while the remaining had modem access.
- None of the classrooms or dorms was networked, with the exception of computer labs.
- None of the classrooms had multimedia presentation equipment in place. Off-campus and dorm access was available through 18 modems.
- There were no current plans to add connections or multimedia presentation equipment to classrooms.
Procedure

Initially, the universities that were adopting the notebook computers were identified and their characteristics were identified. The Vice President of Academic Affairs (VPAA) at each of the universities was asked for permission to administer the questionnaire and organize the focus groups. Two of the universities shared one VPAA. Therefore, only two individuals were contacted and they both gave permission. Samples of the questionnaire were sent to both Vice Presidents as well as offers to supply copies to the University President if requested. The university mailboxes were used to distribute the questionnaire. The VPAAAs at the three institutions also gave permission to have their offices serve as the collection point for the returned questionnaires and signed slips.

The questionnaire was entitled "Computer Technology in Teaching (CTIT)" (Appendix A). The full-time faculty on all three campuses received the questionnaire. Part-time faculty who taught at least a 50% load were also sent a questionnaire. This instrument was reviewed and accepted by the Iowa State University Human Subjects Review Committee prior to being distributed (Appendix B). A cover letter of explanation accompanied each questionnaire (Appendix A). The subjects were assured in the cover letter that individual responses would be kept confidential. Anonymity was maintained through specific information recorded on the second page of the questionnaire by the respondent which was recorded. A number was assigned to the first questionnaire as each was returned. The second questionnaire was then
matched to the first using the specified information and the same number was assigned to the second questionnaire. The cover letter also contained directions for the return of the questionnaire. The lower portion of the letter was to be removed by the respondent and returned separately with the respondent's signature. Both the questionnaire and the signed slip were returned to the Vice President of Academic Affairs' office at each university.

The questionnaire consisted of eight sections. Each section was titled with a label and a set of directions. The first three sections requested general information about the respondents. Sections one included twelve multiple choice and fill-in the blank questions concerning background information on the respondent. Section two included five questions about the respondent's teaching responsibilities and style. Section three included twelve questions pertaining to the respondent's computer use. Non-users were asked to skip this portion of the questionnaire.

Sections four through eight were Likert-scale instruments with the exception of section five which was a forced selection. Each was designed to gather information to answer the research questions posed in the study. Section four consisted of the 26-item Computer Anxiety Index (CAIN) [item 25-50]. The following six-point self report scale and response was used: 1 = Strongly agree; 2 = Agree; 3 = Slightly Agree; 4 = Slightly Disagree; 5 = Disagree; 6 = Strongly Disagree. The scoring was designed so that the higher the score the higher the level of computer anxiety. Responses to certain items were reversed so that
scoring was consistent with the directionality of the wording of the item (see Appendix A).

Section five consisted of the Levels of Computer Use (LCU) [items 51-54] assessment, four sets of items each with three choices in each set. The response procedure was forced choice and respondents were directed to select the statement which they most strongly felt was true about them. The scoring on the three choices in the set was 0, 1 or 2. The scores of the four items were totaled. Responses to certain items were reversed so that the scoring was consistent with the directionality of the wording of the item (see appendix A).

The sixth section was the Innovativeness Scale (IS) [items 55-64] was a 10-item instrument using a self-report, 7-point scale. The following scale and response was used: 7 = Strongly agree; 6 = Agree; 5 = Moderately agree; 4 = Undecided; 3 = Moderately disagree; 2 = Disagree; 1 = Strongly disagree. The scoring was designed so that the higher the score the higher the degree of innovativeness.

The seventh section consisted of the 35 item Stages of Concerns (SoC) [items 65-99] questionnaire. The scoring was based on a 0 to 7 scale. The following scale was use: 0 = Irrelevant; 1 and 2 = Not true of me now; 3, 4 and 5 = Somewhat true of me now; 6 and 7 = Very true of me now. Statements on each of seven concerns were dispersed throughout the questionnaire and totaled separately. High numbers indicated high concern and low numbers low concern.
The eighth section included the 16 item Subjective Norms (SN) [items 100-115] questionnaire. It consisted of four sets of four items each. The following five-point self report scale and response was used: 5 = to a large extent; 4 = frequently; 3 = not sure; 2 = seldom; 1 = not at all. The scoring was designed so that the higher the score the higher the individual's motivation to comply.

The second questionnaire was the same as the first except for the explanation and the date on the cover letter. It had the same number of sections and questions.

A random sample of the course syllabi were also collected on the VCSU and MaSU campuses (Appendix C). A fall 1995 syllabus for each of 30 randomly selected of a courses was compared with a syllabus from the same course approximately one year later. The number and type of technology uses by faculty and students were counted on each syllabi. Two questions concerning technology uses by faculty and students was also included in section three of the questionnaire.

Separate focus groups were also held on the VCSU and MaSU campuses. Eight randomly selected full-time faculty were invited to take part in a focus group on each campus after the students had had their computers for a semester. The purpose of the groups was explore in greater depth the changes that were happening to the universities because of the distribution of the notebooks. Individuals who attended were not identified to insure the individuals would speak freely during the focus group sessions. Questions asked
during the one-hour session reflected concerns, problems and changes on the campus due the use of the notebook computers. A list of questions is included in Appendix D. The researcher led the discussion and a transcriber recorded and typed the responses. The analysis and reporting of the data was completed using guidelines described by Krueger (1998).

Data collection waves

All three schools were studied over time; the first questionnaire was distributed to faculty at all three institutions in February of 1996. This was at approximately the same time as the notebook computers were dispensed to the faculty at VCSU. The second questionnaire was distributed one year later in February of 1997. During the interim year MaSU and JC faculty also received computers and the VCSU students received computers. A data collection timetable is shown in Table 3.2.

Table 3.2. Data collection timetable

<table>
<thead>
<tr>
<th>Activity</th>
<th>VCSU</th>
<th>MaSU</th>
<th>JC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Questionnaire</td>
<td>Feb. 96</td>
<td>Feb. 96</td>
<td>Mar. 96</td>
</tr>
<tr>
<td>Postcard reminder</td>
<td>2 weeks later</td>
<td>2 weeks later</td>
<td>2 weeks later</td>
</tr>
<tr>
<td>Follow-up phone call</td>
<td>4 weeks later</td>
<td>4 weeks later</td>
<td>4 weeks later</td>
</tr>
<tr>
<td>2nd Questionnaire</td>
<td>Feb 97</td>
<td>Feb. 97</td>
<td>Mar. 97</td>
</tr>
<tr>
<td>Postcard reminder</td>
<td>2 weeks later</td>
<td>2 weeks later</td>
<td>2 weeks later</td>
</tr>
<tr>
<td>Follow-up phone call</td>
<td>4 weeks later</td>
<td>4 weeks later</td>
<td>4 weeks later</td>
</tr>
<tr>
<td>Focus group</td>
<td>Spring 97</td>
<td>Spring 98</td>
<td>None</td>
</tr>
<tr>
<td>Syllabus collection</td>
<td>Dated spring</td>
<td>Dated fall 1997</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>1996 or earlier</td>
<td>or after</td>
<td></td>
</tr>
</tbody>
</table>


Two weeks after the questionnaires were distributed, a postcard reminder was sent to individuals who had not returned them. Two weeks later individuals who had still not returned the questionnaire were contacted by phone. This same process was followed one year later when the second questionnaire, “Computer Technology in Teaching Part II,” was distributed.

Of the 151 questionnaires sent out in the first round, 102 (68%) questionnaires were returned. Of the 102 second questionnaires sent out in the second round 85 (83%) were returned. Of the 85 individuals who returned both questionnaires, 37 were from VCSU, 27 were from MaSU and 21 were from JC.

There were 300-350 courses taught yearly on the VCSU and MaSU campuses which had the potential for technology use. Thirty courses or approximately 10% were identified through random selection on each campus. Syllabi from were collected for the 1995-96 school year and again for the 1996-97 school year. Exceptions were made for courses which were taught on alternate years. The syllabi were examined for additions and changes in the course requirements and objectives which reflected technology use by faculty or students (Appendix C).

Once the questionnaires were returned, they were entered into a statistical software file. Data collected from the questionnaires were analyzed using the following statistics: frequency counts, a multiple regression, and t-tests and F-tests.
Phase One

Phase one of the design was concerned with variables of the study and levels of use.

Independent variables

The first phase of this study was intended to identify whether certain variables: age, rank, innovativeness and subjective norms would individually or in combination predict a faculty's use of notebook computers in teaching. The Levels of Computer Use (LCU) assessment (Marcinkiewicz & Welliver, 1993) was used to categorize teachers' computer use in both questionnaires. The research question concerning prediction of use was:

Research Question 1: To what extent if any do the selected variables: innovativeness, subjective norms, age, and academic rank, predict a faculty member's adoption of the notebook computer?

Criterion variable

One dependent variable of this study was the level of notebook computer use. The Level of Computer Use Scale characterizes individuals into three levels of use: (1) Nonuse; (2) Utilization; and (3) Integration. Each participant was assigned to one of the three levels based on answers to four questions. The level of use assignment was made to faculty using the responses from the second questionnaire. Utilization and Integration represented progressively higher levels of computer use. The criterion for inclusion in these levels was the dimension of expendability of use, that is, how expendable computers were to the
faculty's teaching. Faculty who indicated the computer was expendable in their instruction and teaching score lower and were placed in the Utilization category.

The predictive variables in this study (innovativeness, subjective norms, age, and academic rank) and the instruments used are outlined in detail in Table 3.3.

Table 3.3. Phase one variables and related instruments

<table>
<thead>
<tr>
<th>Variables</th>
<th>Instrument</th>
<th>CTIT item #</th>
<th>Reliability</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 In innovativeness</td>
<td>Innovativeness scale</td>
<td>#55-64 (10 total)</td>
<td>r = .89</td>
<td>construct, predictive (Ch. 3)</td>
</tr>
<tr>
<td>2 Subjective norms</td>
<td>Subjective norms scale</td>
<td>#100-114 (15 total)</td>
<td>(SN section)</td>
<td>(SN section)</td>
</tr>
<tr>
<td>3 Age</td>
<td>one item</td>
<td>#6</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>4 Academic rank</td>
<td>one item</td>
<td>#4</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Dependent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 levels of computer use by faculty</td>
<td>Assessment of Level of Computer Use (LCU)</td>
<td>#51-54 (4 total)</td>
<td>Coefficient of reproducibility CR=96 (n=170) kappa = .72</td>
<td>content, face criterion</td>
</tr>
</tbody>
</table>

**Phase Two**

The second phase of the design investigated in this study was the extent to which the availability of notebook computers influenced the variables: computer anxiety, types of faculty concerns, level of computer use, teaching methods, number of classroom uses, and frequency of software use changed because of the availability of notebook computers. A comparison was made between the responses to the two questionnaires and also among the three campuses.
The research questions concerning use were:

Research Question 2: How does universal notebook computer accessibility effect the a faculty member's level of computer use?

Research Question 3: Are there more or different uses of computer technology in the classroom on campuses because notebook computers are available to all faculty?

Research Question 4: Are there changes in the instructor's teaching methods because of the universal availability of notebook computers?

Research Question 5: Does the faculty's access to the notebook computers change the types or level of concerns expressed by the faculty?

Research Question 6: Does the faculty's computer anxiety change after faculty have had access to the notebooks for a period of time?

Variables

The dependent variables in the second portion of the study were: (1) level of computer anxiety; (2) level of concerns about the innovation; (3) level of computer use; (4) the number of technology uses in courses by faculty; (5) types of teaching methods employed; (6) frequency of software use by faculty, and (7) the number of required computer related activities in syllabus.

The independent variable in the second phase of the study was the institution at which the faculty member was employed. As noted previously, the three institutions differed because of:

- the way in which the organizational adoption decision was made;
- the length of exposure to the notebooks by the faculty;
- network and infrastructure differences;
- the amount of interactively available on the campus;
• the length of time and amount of student access to notebooks; and
• experience with computer technology prior to adoption.

The researcher was aware that other differences could appear in the responses to the CTIT questionnaire.

Instruments

Five measures were employed in the study: (1) Computer Anxiety Index (CAIN); (2) Level of Computer Use Assessment (LCU); (3) The Innovativeness Scale (IS); (4) Stages of Concerns Questionnaire (SoCQ); and (5) Subjective Norms (SN).

Computer Anxiety Index (CAIN)

The CAIN, a twenty-six item test, was developed by Simonson, Maurer, Montag-Torardi & Whitaker (1987). It was found to have an internal consistency reliability estimate of .94, and a test-retest reliability estimate of .90. It was administered as directed in the Test Administrator’s Manual (Simonson et al., 1992). Responses were scored so that higher scores indicated a higher degree of anxiety. In this study the CAIN was chosen as a tool to indicate if there was a change in the level of computer anxiety after the notebook computers were available to the faculty for a period during the study.
Level of Computer Use Assessment (LCU)

Marcinkiewicz & Welliver (1993) conceived an assessment based on the Instructional Transformation Model, which was used in the study to report faculty's computer use as occurring at three levels: Nonuse, Utilization, and Utilization. The (LCU) assessment consisted of four questions and two cross-matched items, totaling four pairs of items. The levels of utilization and integration were represented by two items in each of the four questions. A third item was added to each of the four questions indicating Nonuse. Marcinkiewicz (1991, p. 39) computed Cohen's kappa to estimate the consistency of classification of the measures (kappa = .72).

Marcinkiewicz (1991) determined the reliability of the LCU assessment with the Coefficient of Reproducibility (CR). It was used as a measure demonstrating that the items of the LCU formed an ordered scale. The CR of the LCU of Marcinkiewicz's study was CR = .96. The LCU was chosen as the criterion variable to indicate the level of computer use by faculty in the first phase of the research design. The scores of the LCU were compared from the two administrations of the CTIT to determine whether adoption increased over the period of the study.

Innovativeness Scale (IS)

The IS was used to determine the innovativeness of the faculty prior to the diffusion of the organizational innovation—the notebook computers. Hurt,
Joseph and Cook's (1977) Innovativeness Scale (IS) was developed to capture a particular aspect of innovation, the "willingness to change."

The reliability for the 20-item form of the instrument was estimated using Nunnally's technique [KR - 20] for making all possible split-half comparisons (Hurt et al., 1977). This analysis resulted in an estimated reliability coefficient of .94. A short form of the IS was used. It consisted of 10 of the original 20 items. Its correlation with the 20-item scale is .92. The short form was also used in other studies (Marcinkiewicz, 1993/94; Marcinkiewicz & Wittman, 1994/95).

Stages of Concerns Questionnaire (SoCQ)

The SoCQ is one three parts of the Concerns-Based Adoption Model. It was developed over the last twenty-five years by the Research and Development Center at the University of Texas at Austin, and is used to identify the seven stages of concern involved in innovation. The SoCQ was used in this study to address the reactions and thoughts among the university faculty about their involvement in the notebook initiative.

The SoCQ is a 35-item assessment that identifies concerns for each stage using quantitative scores. The raw scores from the SoCQs were converted into percentile scores which can be plotted on a graph by individual score or for a group composite score. A profile can be developed that shows the level of each of the seven stages, thereby presenting a useful pattern of concerns. Raw scores were changed into percentiles using the Manual of Use of the SoC Q (Hall,
George, & Rutherford, 1986). The total percentile scores were not used. Because concerns are developmental in nature, individuals tend to score high on one or two stages and low on others. The concerns are totaled individually to determine the peaks of concern for individuals or groups.

To be concerned means to be in a mentally aroused state about something. The intensity of the arousal will depend on the person's past experiences and associations with the subject of the arousal, as well as how close to the person and how immediate the issue was perceived as being (Hall et al., 1986). As a faculty member becomes more experienced and aware of the notebook computers their peaks of concerns are expected to be highest in stages 4-6. By comparing the differences in where the peaks occur in the stages of concern from the first questionnaire to the second, it was possible to determine the faculty's profile of concerns over adoption of the notebook computers.

The coefficients of Internal Reliability for the SoCQ were computed using data from program TESTAT on the VSTAT library (Veldman, 1967). It was a stratified sample of 830 teachers and professors. The coefficients from this study ranged from a low of .64 for the Awareness stage to a high of .83 for the Personal stage, with four of the seven correlations being above .80. A sample of 171 individuals were asked to complete the SoCQ a second time, two weeks after their initial completion of the instrument. The test-retest reliability correlation from the 132 individuals who returned the both questionnaires ranged from a low of .65 for the Awareness stage to a high of .86 for the Informational stage,
with six of the seven coefficients being above .70. A series for validity studies was conducted, all of which provided support that the SoCQ measured the hypothesized Stages of Concern (Hall et al., 1986).

**Subjective Norms (SN)**

The portion of the questionnaire, SN, was developed and used by Marcinkiewicz referring to the procedures described by Ajzen and Fishbein (1980). Its construct validity is based on the theory that we behave according to how much we listen to what we think others tell us to do. Ajzen and Fishbein reported several studies in which there was a correlation between these measures and the actual behavior. These studies indicated a high correlation between intention and behavior, as well as subjective norms and behavior (for many behaviors).

The tool identified four significant-other entities. In the Marcinkiewicz (cited in Ajzen & Fishbein, 1980) studies these entities included the teacher’s principal, colleagues, pupils, and professional colleges. The assumption was that these collective bodies might influence the teacher’s intent to use computers for teaching. In this study the entities included faculty’s administrators, colleagues, students and professional colleges. One set of four items was used for each significant-other, with the first item of each set addressed as normative beliefs. Respondents indicated their belief of the degree to which the significant-other would approve of computer use in teaching. The following three questions in the
set addressed the faculty member's motivation to comply with the desires of the significant-other. The items narrow in focus from compliance in general, to teaching, to computer use in teaching. Responses were scored on a 5-point scale from "to a large extent" (5) to not at all (1). The tool created and employed by Marcinkiewicz is referred to as the Subjective Norms Scale. Table 3.4 gives a breakdown of the variables and related instruments for the phase two design used in this study.

Table 3.4. Phase two variables and related instruments

<table>
<thead>
<tr>
<th>Variables</th>
<th>Instrument</th>
<th>CITT item #</th>
<th>Reliability</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Computer anxiety</td>
<td>Computer Anxiety Index (CAIN)</td>
<td>#25-50</td>
<td>test-retest = .94</td>
<td>concurrent validity to STAI r = 32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(26 total)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Types of concerns</td>
<td>Stages of Concerns Questionnaire (SoCQ)</td>
<td>#65-99</td>
<td>Test-retest Stages range = .65-.84</td>
<td>Factor analysis 72%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(35 total)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Levels of computer use by faculty</td>
<td>assessment of Level of Computer Use (LCU)</td>
<td>#51-54</td>
<td>Coefficient of reproducibility CR = 96 (n=170) kappa = .72</td>
<td>Content, face criterion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4 total)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Teaching methods</td>
<td>Percentage other than lecture</td>
<td>#10</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5. Number of classroom uses</td>
<td># required of students and used by faculty</td>
<td># 20 and 21</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6. Frequency of software use</td>
<td>Range of 1-4 4 = most use</td>
<td>#17</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>(12 parts)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 syllabi from each campus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Independent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University campus</td>
<td>CITT question</td>
<td>#1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Summary

This longitudinal study had two phases. The first phase, to determine the best predictors of adoption of the notebook computers by the faculty, encompassed four independent variables: innovativeness, subjective norms, age, and academic rank. The second phase, to determine if change occurred and what types of changes occurred because of the organizational adoption of the notebook computers, employed eight variables: (1) level of computer anxiety; (2) types of concerns expressed by faculty about the innovation; (3) level of computer use; (4) the number of technology uses by faculty; (5) number of technology uses required of students; (6) percentage of two types of teaching methods employed; (7) frequency of software use by faculty; and (8) differences in the three institutions. The results from these variables were supported through focus groups and syllabus tracking on two of the campuses.

Questionnaires were used in studies because the researcher needed answers to a variety of questions from a large number of people. The “Computer Technology in Teaching (CTIT)” questionnaire used in this study was eleven pages long and included several assessment instruments for specific variables. The questionnaire was given to faculty twice over a one-year period. Subjects for the study included faculty from three small undergraduate institutions. During the year between the two administrations the three institutions in the study adopted notebook computers for their faculty. Responses from the two
questionnaires were matched for each respondent. Only faculty who returned the first questionnaire were sent the second.

The questionnaire and a cover letter were sent to each of 151 faculty on the three campuses. Postcards and follow-up phone calls were used to assure a high return rate. Eighty-five individuals returned both questionnaires. Supplementary materials were gathered on two of the campuses through focus groups and syllabi. The data collected from the "CTIT" questionnaires and syllabi were analyzed using descriptive statistics and a narrative description. The number and type of technology uses were totaled for each set of syllabi. The information from the focus groups was analyzed and reported in a narrative form using the guidelines discussed by Krueger (1998).
CHAPTER 4. RESULTS

Introduction

The first research question of this study addressed whether the five selected variables (innovativeness, subjective norms, age, and academic rank) either individually or in combination were related to the faculty's level of computer use. The second phase of the study attempted to determine whether eight selected variables (level of computer anxiety, types of concerns expressed, levels of computer use, number of technology uses in courses, types of teaching methods employed, frequency of software use, and number of technology uses recorded in syllabi) increased or changed over a one-year period because of the universal availability of notebook computers on the campuses.

The first step in data analysis was to provide a descriptive summary of the sample. Summary tables are used to present the results when appropriate. First, a profile of the respondents is presented. Then a summary on the descriptive statistics including mean, actual range, and possible range are presented. A summary of the distribution of faculty across the levels of computer use is also given.

Correlations among the variables and intercorrelations for all the variables included in the prediction were computed to examine strengths of relationships between variables. The t-score and p-values were calculated. A linear regression was performed to identify which of the variables were
significant predictors of the level of use. Because the institutions varied in the several factors, a second regression was completed with the university as a fixed effect.

Profile of the Respondents

There were eighty-five individuals who responded to both Computer Technology in Teaching (CTIT) questionnaires sent out by the researcher. Faculty demographic information is presented in Table 4.1.

The gender of the respondents is reported by institution. The percentage of female and male full-time instructors at the universities was 65% male and 35% female, and the respondents in the study were 60% male and 40% female. The mean age of the respondents fell in the range of 41-50, with 70% of the responding faculty between the ages of 41 and 60.

The academic rank of the respondents included individuals with the rank of lecturer through full professor. A majority (60%) of the faculty were at the rank of either Assistant or Associate Professor (Table 4.1).

In academic divisions of the respondents, as expected, the largest majors on the campuses also had the largest number of respondents. The largest majors on the three campuses were elementary education at VCSU and MaSU, and Business Administration at Jamestown College.
Table 4.1. Faculty demographic information

<table>
<thead>
<tr>
<th></th>
<th>Institution</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
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<tr>
<td><strong>Gender</strong></td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
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<td></td>
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<td>15</td>
<td>17.6</td>
</tr>
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<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30</td>
<td></td>
<td>2</td>
<td>2.4</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>30-40</td>
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<td>4.7</td>
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<td>5.9</td>
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<td></td>
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<tr>
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<td>10.6</td>
<td>9</td>
<td>10.6</td>
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<tr>
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<td>7.1</td>
<td>10</td>
<td>11.8</td>
</tr>
<tr>
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<td>8.2</td>
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<td>4.7</td>
<td>6</td>
<td>7.1</td>
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<td>3</td>
<td>3.5</td>
<td>5</td>
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<td>2</td>
<td>2.4</td>
<td>5</td>
<td>5.9</td>
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<td>Business</td>
<td></td>
<td>4</td>
<td>4.7</td>
<td>1</td>
<td>4.0</td>
<td>5</td>
<td>5.9</td>
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<td>3.5</td>
<td>2</td>
<td>2.4</td>
<td>5</td>
<td>5.9</td>
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<td>Science</td>
<td></td>
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<td>2.4</td>
<td>2</td>
<td>2.4</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>Fine Arts, Theater</td>
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<td>1.2</td>
<td>2</td>
<td>2.4</td>
<td>3</td>
<td>3.5</td>
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<tr>
<td>Nursing</td>
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<td>5.9</td>
<td></td>
<td></td>
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<tr>
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<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Mean</td>
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<td>2.79</td>
<td>3.79</td>
<td>3.80</td>
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<td>Non-Use</td>
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<td>5.9</td>
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<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>1-2 years</td>
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<td>3.5</td>
<td>1</td>
<td>1.2</td>
<td>2</td>
<td>2.4</td>
</tr>
<tr>
<td>3-4 years</td>
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<td>3</td>
<td>3.5</td>
<td>2</td>
<td>2.4</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>5+ years</td>
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<td>13</td>
<td>15.3</td>
<td>16</td>
<td>18.8</td>
<td>30</td>
<td>35.3</td>
</tr>
<tr>
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<td>3</td>
<td>3.5</td>
<td>2</td>
<td>2.4</td>
<td>2</td>
<td>2.4</td>
</tr>
</tbody>
</table>
The length of experience with computers varied among the faculty in 1996 when the study began (Table 4.1). However, the average years of experience was 3.49, or more than 3-4 years among respondents. Of the 79 faculty who answered the question, "How long have you used a computer," only 5 were non-users, and no one had less than a year's experience, whereas 59 (75.6%) responded they had 5 or more years of experience. Seven faculty did not respond to the question concerning computer experience.

Data Analysis

Descriptive and inferential statistics were computed. The results of the data analysis are reported separately for phase one and phase two.

Phase one

Descriptive statistics

There were 85 faculty who responded to both questionnaires. Responses from the first questionnaire (1996) were used to determine the independent variables; age, academic rank, innovativeness and subjective norms. Responses from the second questionnaire (1997) were used to determine the level of computer use. Of the 85 matched faculty responses, one did not have sufficient responses to determine an innovativeness score and one did not have sufficient responses to determine a subjective norms score. Descriptive statistics are reported in Table 4.1. Eighty-three faculty responded to demographic questions.
on age and academic rank. Specific information on these variables can be found in Table 4.2.

The recorded scores and the number of cases at each score for levels of computer use are shown in Table 4.1. Of the 85 respondents 2 did not report a level of use. A score of 0 is Nonuse, a score of 4 were is Utilization and a score of 8 is Integration. Twelve respondents recorded totals which were not the expected 0, 4, or 8. The largest group of unexpected responses totaled a score of 6. Notes were written in the margin of the questionnaires to explain these responses. The faculty reported they considered questions relating to teaching to be different than questions relating to instruction. Teaching included preparation and management uses, while instruction was use in the classroom. One respondent wrote, "It's a tool used for efficiency to prepare materials for class. Not used in instruction in classroom."

The independent variables: age, academic rank, innovativeness score and subjective norms were drawn from responses to the first questionnaire given in February of 1996. At the time of the first questionnaire none of the institutions

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovativeness</td>
<td>84</td>
<td>30</td>
<td>70</td>
<td>55.08</td>
<td>8.16</td>
</tr>
<tr>
<td>Subjective Norms</td>
<td>84</td>
<td>34</td>
<td>75</td>
<td>52.80</td>
<td>7.45</td>
</tr>
<tr>
<td>Level of Use</td>
<td>83</td>
<td>0</td>
<td>8</td>
<td>5.40</td>
<td>2.33</td>
</tr>
</tbody>
</table>
had distributed notebook computers to their faculty although VCSU was about to do so. The dependent variable, level of computer use, was drawn from the second questionnaire after the faculty had had the notebook computers for six months to one year.

**Correlation**

A bivariate correlation analysis provided insight into relationships among the independent variables. Because the academic rank data was ordinal, a Spearman rho test was used. The results are reported in Table 4.3.

Table 4.3. Correlations among variables in phase one

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Academic rank</th>
<th>Innovativeness score</th>
<th>Subjective norms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic rank</td>
<td>.51*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovativeness score</td>
<td>-.07</td>
<td>-.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjective norms</td>
<td>.03</td>
<td>-.12</td>
<td>.29*</td>
<td></td>
</tr>
</tbody>
</table>

*p<.01

The results of the Spearman rho test indicated two significant relationships at the .01 or better. They were age/rank and innovativeness/subjective norms. The age/rank relationship showed a very strong positive relationship and a logical one in the academic domain, since faculty move up in rank as they spend more years at an institution. A strong positive relationship between innovativeness and subjective norms was also
indicated. Faculty who scored high on the Innovativeness Scale were significantly more likely to score high on the Subjective Norms.

Because two of the variables were also cardinal, a Pearson correlation was also computed on those variables (Innovativeness and Subjective Norms). The results indicated the same significant relationship between Innovativeness and Subjective Norms as reported in the Spearman's rho correlation.

A General Linear Model (GLM) general factor procedure was used to determine if the variables of age, innovativeness, academic rank and subjective norms would be significant predictors of the level of computer use among the faculty. The model, with Level of Computer Use as a dependent variable, resulted in an overall F value of 2.95 and p = .01. The results are reported in Table 4.4.

Two variables, subjective norms (p = .01) and innovativeness (p = .05), were found to be significant at the .05 level. A significant relationship between Level of Computer Use and subjective norms indicated that if faculty perceived they were very influenced by peers, students, professional groups and administration they were likely to have a higher level of computer use. Innovativeness was also found to be a predictor of the level of computer use. Accordingly, faculty who showed a willingness to change were more likely to have a higher level of use. Table 4.4 summarizes the results of the regression analysis for all covariate variables on the dependent variable of Level of Computer Use.
Table 4.4. Results of the General Linear Model (GLM) for phase one

<table>
<thead>
<tr>
<th>Phase one variables</th>
<th>B</th>
<th>Std. Error</th>
<th>t-test</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.89</td>
<td>2.51</td>
<td>-.75</td>
<td>.45</td>
</tr>
<tr>
<td>Innovativeness Score</td>
<td>6.42</td>
<td>.03</td>
<td>2.03</td>
<td>.05</td>
</tr>
<tr>
<td>Age</td>
<td>-.23</td>
<td>.31</td>
<td>-.76</td>
<td>.45</td>
</tr>
<tr>
<td>Subjective Norms</td>
<td>9.23</td>
<td>.04</td>
<td>2.52</td>
<td>.01</td>
</tr>
<tr>
<td>[Lecturer=0]</td>
<td>-1.03</td>
<td>1.00</td>
<td>-1.02</td>
<td>.31</td>
</tr>
<tr>
<td>[Instructor=1]</td>
<td>.36</td>
<td>1.18</td>
<td>.31</td>
<td>.76</td>
</tr>
<tr>
<td>[Assoc. Professor=2]</td>
<td>-5.49</td>
<td>.75</td>
<td>-.07</td>
<td>.94</td>
</tr>
<tr>
<td>[Assist. Professor=3]</td>
<td>-1.03</td>
<td>.74</td>
<td>-1.40</td>
<td>.17</td>
</tr>
<tr>
<td>[Full Professor=4]</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic Ranks (all)²</td>
<td>F=1.08</td>
<td></td>
<td>.37</td>
<td></td>
</tr>
</tbody>
</table>

¹Parameter was set to zero because it was used for contrast.
²Taken from a test of between-subjects effects. It was an F test of the five academic ranks as a whole.

Because of the ordinal quality of the academic rank, the variable was separated into individual ranks. A GLM contrast was used to test for differences among the levels of academic rank. None of the t-test results for the individual ranks reported in Table 4.4 indicated that there was a significant relationship with level of computer use. The joint F test on all ranks reported a value of 1.08 and a (p = .37).

Due to the reality that VCSU faculty received the notebook computers six months prior to MaSU and JC faculty and other factors described in Chapter 3, it was suspected that the institution at which the respondents were employed could be a source of bias for the results. A GLM with a fixed factor for each institution was utilized. Results are found in Table 4.5. This second model
Table 4.5. Results of the GLM with the three institutions as a variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>Std. Error</th>
<th>T</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>5.06</td>
<td>2.68</td>
<td>1.89</td>
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<tr>
<td>[Lecturer=0]</td>
<td>-1.21</td>
<td>.89</td>
<td>-1.36</td>
<td>.18</td>
</tr>
<tr>
<td>[Instructor=1]</td>
<td>-1.15</td>
<td>1.09</td>
<td>-1.05</td>
<td>.30</td>
</tr>
<tr>
<td>[Assoc. Professor=2]</td>
<td>-.40</td>
<td>.67</td>
<td>-.60</td>
<td>.55</td>
</tr>
<tr>
<td>[Assist. Professor=3]</td>
<td>-1.70</td>
<td>.67</td>
<td>-2.54</td>
<td>.01</td>
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<td>[Full Professor=4]</td>
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<tr>
<td>[MaSU=1]</td>
<td>-2.86</td>
<td>.61</td>
<td>-4.71</td>
<td>.00</td>
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<td>.62</td>
<td>-2.73</td>
<td>.01</td>
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<tr>
<td>[VCSU=3]</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovativeness</td>
<td>4.66</td>
<td>.03</td>
<td>1.65</td>
<td>.10</td>
</tr>
<tr>
<td>Age</td>
<td>-.51</td>
<td>.28</td>
<td>-1.83</td>
<td>.07</td>
</tr>
<tr>
<td>Subjective Norms</td>
<td>2.88</td>
<td>.04</td>
<td>.82</td>
<td>.42</td>
</tr>
</tbody>
</table>

1Parameter was set to zero because it was used for contrast.
2Taken from a test of between-subjects effects. It was an F test of the five academic ranks as a whole.

was more significant than the first. It indicated an F of 5.42 and p < .01 and the overall institutional F was 11.12 with a p < .01. When the institution at which the faculty were employed was taken into account, relationships between Subjective Norms/Innovativeness and Level of Computer Use were no longer significant. This indicated that differences in the institutions did have an effect on the relationships. Since the level of computer use was measured by responses to the second questionnaire, the notebooks and other campus factors effected the level of computer use, thus, the fixed factor—university—would be greatly responsible for the significance. This is referred to as collinearity, the undesirable situation where the correlations among the independent variables
are strong. The GLM contrast between the institutions indicated that VCSU was significantly different from the other two institutions. Factors other than length of notebook exposure may also have affected the results.

Research Question 1: To what extent if any do the selected variables: innovativeness, subjective norms, age, and academic rank, predict a faculty member’s adoption of the notebook computer?

The first research question examined whether a set of variables was predictive of faculty's level of use of notebook computers. Based on this research question, the predicted outcome of this study would be that a combination of the selected variables, age, rank, innovativeness scale and subjective norms, could be used jointly or individually to predict the level of use of notebook computers among faculty.

The data indicated that two variables, subjective norms, and innovativeness were predictive of the faculty's levels of computer use. The other two variables, age and academic rank, were not significant predictors of use.

Phase two

The second phase of the study dealt with technology use and teaching changes on the three campuses. The data were recorded from the two CTIT questionnaires which were given one year apart. Responses of faculty from the first questionnaire were matched with the same respondents in the second questionnaire. The eight variables measured by both CTIT questionnaires included: level of computer use, types and level of faculty concerns, computer
anxiety, number of faculty technology uses, number of required student technology uses, frequency of software use and percent lecture and discussion type teaching methods applied.

In addition to the questionnaire, thirty syllabi were reviewed from the VCSU campus and the MaSU campuses. The 30 courses (about 10% of the total were randomly selected from the 300-400 academic courses offered each year at each of the two institutions. The types of expectations or uses were recorded as a faculty or student use and the type of use was also indicated (Appendix C). The simplest form of technology recorded was an E-mail address for contacting the faculty member. These course syllabi were gathered in the fall of 1996 and again in the fall of 1997. Additional information was also collected through focus groups on the VCSU and MaSU campuses (Appendix D).

**Descriptive statistics**

In the second phase of the study, the differences in the amount of change on the campuses over time were measured by eight variables. All three campuses adopted the notebook computers for their faculty during the period of the study. However, each campus's adoption differed in length of faculty access to the notebook computers, student notebook adoption or expectation of adoption, amount of computer use prior to the study, campus infrastructure factors, and the culture of adoption on campus. Therefore, it was assumed that changes that occurred on all the campuses were due to the adoption, and the
difference in the amount of change on the campuses was due to factors other than the adoption.

There were 85 faculty who responded to the variables in phase two of the study. The (N) number of faculty responding for seven of the eight matched variables and the means of those variables are reported in Table 4.6. The eighth variable, faculty concerns over the innovation, was recorded using the Stages of Concerns Questionnaire (SoCQ). The results of this variable are explained later in the chapter.

The mean difference of each of the seven variables was determined by subtracting the mean of the 1997 variable from the mean of the 1996 variable. In the second questionnaire, because an increase was expected in every variable except two; the mean difference was predicted to be negative for most variables. Two variables, Computer Anxiety Index and the CAIN, and the percentage of lecture method used in class were expected to have positive scores.

The means scores of LCU, number of technology uses by faculty and by students, and the frequency of software use by faculty all rose as expected and indicated a negative mean difference (Table 4.6). The CAIN and the percent of lecture method variables were positive as expected. The mean difference of the variable, percent of discussion and group work method used, while expected to be negative, turned out to be slightly positive.
Table 4.6. Descriptive statistics of the entire sample for phase two

<table>
<thead>
<tr>
<th>Measure</th>
<th>Valid</th>
<th>Missing</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Discussion and group methods used 1996\textsuperscript{1}</td>
<td>72</td>
<td>13</td>
<td>40.24</td>
<td>21.67</td>
<td>88</td>
<td>10</td>
<td>98</td>
</tr>
<tr>
<td>% of Discussion and group method used 1997\textsuperscript{1}</td>
<td>72</td>
<td>13</td>
<td>37.76</td>
<td>21.67</td>
<td>85</td>
<td>10</td>
<td>95</td>
</tr>
<tr>
<td>CAIN 1996\textsuperscript{1}</td>
<td>84</td>
<td>1</td>
<td>47.63</td>
<td>17.95</td>
<td>88</td>
<td>24</td>
<td>112</td>
</tr>
<tr>
<td>CAIN 1997\textsuperscript{1}</td>
<td>83</td>
<td>2</td>
<td>48.47</td>
<td>18.50</td>
<td>93</td>
<td>26</td>
<td>119</td>
</tr>
<tr>
<td># of Technology uses by faculty 1996\textsuperscript{1}</td>
<td>83</td>
<td>2</td>
<td>2.51</td>
<td>2.52</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td># of Technology uses by faculty 1997\textsuperscript{1}</td>
<td>75</td>
<td>10</td>
<td>3.91</td>
<td>2.39</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>% of Lecture method used 1996\textsuperscript{2}</td>
<td>74</td>
<td>11</td>
<td>38.19</td>
<td>22.82</td>
<td>83</td>
<td>2</td>
<td>85</td>
</tr>
<tr>
<td>% of Lecture method used 1997\textsuperscript{2}</td>
<td>73</td>
<td>12</td>
<td>40.22</td>
<td>21.22</td>
<td>79</td>
<td>5</td>
<td>84</td>
</tr>
<tr>
<td>Level of computer use 1996\textsuperscript{3}</td>
<td>85</td>
<td>0</td>
<td>4.93</td>
<td>2.63</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Level of computer use 1997\textsuperscript{3}</td>
<td>83</td>
<td>2</td>
<td>5.40</td>
<td>2.33</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td># of Required student technology uses 1996\textsuperscript{4}</td>
<td>81</td>
<td>4</td>
<td>1.75</td>
<td>2.05</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td># of Required student technology uses 1997\textsuperscript{4}</td>
<td>77</td>
<td>8</td>
<td>2.82</td>
<td>2.08</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Frequency of software use by faculty 1996\textsuperscript{5}</td>
<td>82</td>
<td>3</td>
<td>22.71</td>
<td>7.66</td>
<td>36</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td>Frequency of software use by faculty 1997\textsuperscript{5}</td>
<td>78</td>
<td>7</td>
<td>25.13</td>
<td>5.49</td>
<td>25</td>
<td>11</td>
<td>36</td>
</tr>
</tbody>
</table>

\textsuperscript{1} Computer anxiety index.
\textsuperscript{2} Level of computer use.
\textsuperscript{3} Number of different types of technology reportedly used by faculty.
\textsuperscript{4} Number of different types of technology uses required of students by faculty.
\textsuperscript{5} Frequency of software use for 12 types of computer software.
\textsuperscript{6} Percentage of lecture method used in the classroom by faculty.
\textsuperscript{7} Percentage of discussion and group work methods used in the classroom by faculty.
Because of information gathered in the first phase of the study, the researcher anticipated the three institutions would show different amounts of change for each of the variables. Consequently, variables in the three institutions made each institution's adoption different. Tables 4.7, 4.8 and 4.9 display the means of the variables by institution over the one-year period.

Table 4.7. Results by institution of variables: CAIN and percentage of teaching methods for both questionnaires

<table>
<thead>
<tr>
<th>Institution</th>
<th>CAIN 1996</th>
<th>CAIN 1997</th>
<th>Percent of discussion and group methods used 1996</th>
<th>Percent of discussion and group methods used 1997</th>
<th>Percent of lecture method used 1996</th>
<th>Percent of lecture method used 1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaSU</td>
<td>56.03</td>
<td>53.36</td>
<td>46.40</td>
<td>37.68</td>
<td>38.73</td>
<td>42.20</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>21.56</td>
<td>22.07</td>
<td>22.53</td>
<td>20.82</td>
<td>22.74</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>26</td>
<td>26</td>
<td>10.00</td>
<td>10</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>112</td>
<td>119</td>
<td>98</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>26</td>
<td>26</td>
<td>20</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>JC</td>
<td>Mean 47.628</td>
<td>50.49</td>
<td>29.24</td>
<td>27.06</td>
<td>46.65</td>
<td>45.29</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>15.116</td>
<td>17.94</td>
<td>22.62</td>
<td>19.45</td>
<td>23.82</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>26</td>
<td>26</td>
<td>10</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>79</td>
<td>87</td>
<td>80</td>
<td>70</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>21</td>
<td>20</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>VCSU</td>
<td>Mean 41.72</td>
<td>43.95</td>
<td>42.06</td>
<td>43.90</td>
<td>33.74</td>
<td>35.81</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>15.08</td>
<td>15.20</td>
<td>19.24</td>
<td>21.83</td>
<td>21.81</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
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<td>26</td>
<td>10</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>77</td>
<td>97</td>
<td>90</td>
<td>95</td>
<td>85</td>
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<td></td>
<td>N</td>
<td>37</td>
<td>37</td>
<td>35</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>Mean 47.63</td>
<td>48.47</td>
<td>40.24</td>
<td>37.76</td>
<td>38.19</td>
<td>40.21</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>18.20</td>
<td>18.50</td>
<td>21.67</td>
<td>21.87</td>
<td>22.82</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>15</td>
<td>26</td>
<td>10</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>112</td>
<td>119</td>
<td>98</td>
<td>95</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>84</td>
<td>83</td>
<td>72</td>
<td>72</td>
<td>74</td>
</tr>
</tbody>
</table>

1 Computer anxiety index.
2 Percentage of lecture method used in the classroom by faculty.
3 Percentage of discussion and group work methods used in the classroom by faculty.
Table 4.8. Results by institution of variables: number of technology uses and frequency of software use by faculty for both questionnaires

<table>
<thead>
<tr>
<th>Institution</th>
<th>Number of technology use by faculty</th>
<th>Number of technology use by faculty</th>
<th>Frequency of software use by faculty</th>
<th>Frequency of software use by faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaSU</td>
<td>Mean</td>
<td>1.46</td>
<td>2.91</td>
<td>18.74</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>2.49</td>
<td>2.84</td>
<td>7.96</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>.00</td>
<td>0</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>9</td>
<td>8</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>26</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>JC</td>
<td>Mean</td>
<td>2.76</td>
<td>4.22</td>
<td>24.15</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>2.49</td>
<td>2.24</td>
<td>6.23</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>0</td>
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<td></td>
<td>Maximum</td>
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<td>8</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>21</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>VCSU</td>
<td>Mean</td>
<td>3.11</td>
<td>4.37</td>
<td>24.94</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>2.39</td>
<td>2.00</td>
<td>7.12</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<tr>
<td></td>
<td>Maximum</td>
<td>9</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>36</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>2.51</td>
<td>3.91</td>
<td>22.71</td>
</tr>
<tr>
<td></td>
<td>Std. Dev.</td>
<td>2.52</td>
<td>2.39</td>
<td>7.66</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>9</td>
<td>9</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>83</td>
<td>75</td>
<td>82</td>
</tr>
</tbody>
</table>

1 Number of different types of technology uses required of students by faculty.
2 Frequency of software use for 12 types of computer software.

T-tests and F tests

In the second phase of this study, data from seven variables in the first CTIT were compared to data from the same variables in the second CTIT. A General Linear Model (GLM) of repeated measures with a within subject factor of time and a between subject factor of university was applied to each dependent
Table 4.9. Results by institution of variables: level of computer use and number of required student technology uses for both questionnaires

<table>
<thead>
<tr>
<th>Institution</th>
<th>Level of computer use 1996</th>
<th>Level of computer use 1997</th>
<th>Number of required student technology uses 1996</th>
<th>Number of required student technology uses 1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaSU</td>
<td>Mean 3.44</td>
<td>4</td>
<td>1.37</td>
<td>1.87</td>
</tr>
<tr>
<td></td>
<td>Std. Dev. 2.67</td>
<td>2.59</td>
<td>2.06</td>
<td>2.14</td>
</tr>
<tr>
<td></td>
<td>Minimum 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Maximum 8</td>
<td>8</td>
<td>7</td>
<td>8</td>
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<tr>
<td></td>
<td>N 27</td>
<td>26</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>JC</td>
<td>Mean 5.28</td>
<td>5.15</td>
<td>1.74</td>
<td>2.33</td>
</tr>
<tr>
<td></td>
<td>Std. Dev. 2.08</td>
<td>1.69</td>
<td>1.76</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>Minimum 0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Maximum 8</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>N 21</td>
<td>20</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>VCSU</td>
<td>Mean 5.81</td>
<td>6.51</td>
<td>2.06</td>
<td>3.67</td>
</tr>
<tr>
<td></td>
<td>Std. Dev. 2.47</td>
<td>1.85</td>
<td>2.20</td>
<td>1.88</td>
</tr>
<tr>
<td></td>
<td>Minimum 0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Maximum 8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>N 37</td>
<td>37</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>Mean 4.93</td>
<td>5.40</td>
<td>1.75</td>
<td>2.82</td>
</tr>
<tr>
<td></td>
<td>Std. Dev. 2.63</td>
<td>2.33</td>
<td>2.05</td>
<td>2.08</td>
</tr>
<tr>
<td></td>
<td>Minimum 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Maximum 8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>N 85</td>
<td>83</td>
<td>81</td>
<td>77</td>
</tr>
</tbody>
</table>

1 Level of computer use.
2 Number of different types of different technology reportedly used by faculty.

variable. Within the GLM repeated measures, F tests were used to determine if there were difference among the institutions. The F tests were also used to determine if there were differences in variables on the three campuses over time (Table 4.10). T-tests were used to determine if there was change in each institution for each of the variable over time (Table 4.11).
Table 4.10. Differences among campuses overall and over time

<table>
<thead>
<tr>
<th>Variable</th>
<th>Significance (F test)</th>
<th>Among campuses overall</th>
<th>Campuses over time</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIN(^1)</td>
<td>.82</td>
<td>.19</td>
<td></td>
</tr>
<tr>
<td>LCU(^2)</td>
<td>.43</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>Number of technology uses-faculty(^3)</td>
<td>.80</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Number of technology uses-student(^4)</td>
<td>.02</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Frequency of software use by faculty(^5)</td>
<td>.16</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Percent of lecture method(^6)</td>
<td>.61</td>
<td>.93</td>
<td></td>
</tr>
<tr>
<td>Percent of discussion and group work method(^7)</td>
<td>.37</td>
<td>.29</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Computer anxiety index; \(^2\) Level of computer use; \(^3\) Number of different types of technology reportedly used by faculty; \(^4\) Number of different types of technology uses required of students by faculty; \(^5\) Frequency of software use for 12 types of computer software; \(^6\) Percentage of lecture method used in the classroom by faculty; \(^7\) Percentage of discussion and group work methods used in the classroom by faculty.

Table 4.11. Differences in the variables over time on the three campuses

<table>
<thead>
<tr>
<th>Variable</th>
<th>Significance Over Time (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MaSU</td>
</tr>
<tr>
<td>CAIN(^1)</td>
<td>.16</td>
</tr>
<tr>
<td>LCU(^2)</td>
<td>.23</td>
</tr>
<tr>
<td>Number of technology uses-faculty(^3)</td>
<td>.05</td>
</tr>
<tr>
<td>Number of technology uses-student(^4)</td>
<td>.35</td>
</tr>
<tr>
<td>Frequency of software use by faculty(^5)</td>
<td>.00</td>
</tr>
<tr>
<td>Percent of lecture method(^6)</td>
<td>.42</td>
</tr>
<tr>
<td>Percent of discussion and group work method(^7)</td>
<td>.13</td>
</tr>
</tbody>
</table>

\(^1\) Computer anxiety index; \(^2\) Level of computer use; \(^3\) Number of different types of technology reportedly used by faculty; \(^4\) Number of different types of technology uses required of students by faculty; \(^5\) Frequency of software use for 12 types of computer software; \(^6\) Percentage of lecture method used in the classroom by faculty; \(^7\) Percentage of discussion and group work methods used in the classroom by faculty.
Computer Anxiety Index. There was no significant change in Computer Anxiety as shown in tables 4.10 and 4.11. Since nearly all the faculty in this study had prior computer experience, the CAIN scores changed very little over the one year period.

Level of computer use. Level of Computer Use was significant at only one institution over time (VCSU) $t = (14.31, 21.41), p < .01$. As shown in Table 4.11, faculty on the VCSU campus reported significantly higher computer use in 1997 than in 1996.

Number of technology uses by faculty. There was significant effect of time on the campuses as a whole $F = 21.81, p < .01$. As shown in table 4.10 faculty reported using significantly more kinds of computer technology in their classes after receiving the notebook computers. The time comparisons at the individual institutions indicated each campus experienced significant increases in faculty use of technology.

Number of student uses of technology. This variable indicated a significant main effect institution, $F = 4.21, p < .05$. Table 4.10 also shows a significant effect of time; students were required to use more technology in 1996 than 1997. When a time comparison was conducted for each institution, only students on the VCSU campus showed a highly significant increase $p < .01$ while students increase on the JC campus was significant $p = .05$. It seems likely that this effect occurred because students at VCSU received notebook computers and students at the other institutions did not.
Frequency of software use by faculty. This variable changed significantly over time. Faculty indicated they were using eleven types of software significantly more in 1997 than they had in 1996. Individual institutions over time indicated MaSU faculty were the only group which increased significantly $p < .01$. It seems likely this occurred because at the beginning of the study MaSU faculty had significantly less computer experience than the other two groups.

Method of instruction. Faculty were asked to indicate what percentage of time they spent in lecture, discussion and group work. These variables showed almost no change over the one-year period of the study. It is possible the one year was not long enough for faculty to change their teaching method even though they were using the computer technology in their instruction.

Several variables including level of computer use, number of technology uses by faculty, and number of required technology uses for students all indicated a significant increase and frequency of software use by faculty was moderately significant $p = .06$ on the VCSU campus (table 4.11). The larger changes over time on the VCSU campus appeared to be primarily responsible for the significant differences in the responses to the two CTIT questionnaires.

Concerns Based Adoption Model - SoCQ

Interpreting the Stages of Concerns Questionnaire (SoCQ) involved determining the mean of each of the seven concerns and comparing the changes
from 1996-1997 for each of the concerns for each of the campuses. Line charts are available in Appendix E. The following narrative was written using profile interpretations from the *Measuring stages of concern about the innovation* manual (Hall, George, & Rutherford, 1986).

**Interpretation - Questionnaire I.** When the SoCQ was administered the first time in the spring of 1996, prior to the adoption of the notebook computers, the faculty from both VCSU and JC had very similar patterns of concern about computer technology. Both groups indicated they knew a lot about computers and were not threatened by them. They also had minimal to no concerns about managing use of the notebook computer even though there was some concern about the consequences of use for students.

The MaSU faculty indicated significantly different concerns from the other two institutions. Their concerns included:

- they wanted more information about the computers;
- they felt an intense personal concern about computers and the consequences of using them;
- they also had no concerns about the relationship of students to their use; and
- their pattern indicated they were more likely to be negative toward the innovation. (see Appendix E.)

**Interpretation - Questionnaire II.** At the time of the second questionnaire in 1997, the patterns had changed, some considerably. The pattern for JC
remained nearly the same as the previous year. The MaSU responses reflected that they felt much more comfortable with computers and management was no longer a concern. Their pattern was nearly identical to that of VCSU's and JC's from the previous year. MaSU had a multiple peak in 0 (Awareness), 1 (Informational) and 5 (Collaboration). According to Hall, George, & Rutherford (1986) this indicates MaSU's greatest concerns were relative to looking for ideas from others. They reflected more of a desire to learn from what others know and are doing, rather than a concern for collaboration.

In the second CTIT questionnaire, VCSU scores reported that its faculty had substantially different concerns from the first CTIT. According to Hall et al (1986), the faculty's lower scores in Stage 0 (Awareness) indicated an intense involvement with their notebook computers. The moderate peak in Stage 1 (Informational) indicates the faculty are interested in more information about the computers. VCSU's highest peaks were in Stage 4 (Consequences) Stage 5 (Collaboration) with a even higher tailing up Stage 6 (Refocus). Hall et al suggests the following is true of faculty with this type of a pattern.

- determining the relevance of the notebook computers for students;
- working with other in learning about the use of notebook computers; and
- exploring the more universal benefits form the notebooks, including the possibility of major changes or replacement of the uses of the notebooks with something more powerful.
A few VCSU faculty also indicated that they already know all about computers and have plenty of ideas. (see Appendix E.)

Research questions. The research questions concerning computer use were:

Research Question 2: How does universal notebook computer accessibility effect the a faculty member’s level of computer use?

Research Question 3: Are there more or different uses of computer technology in the classroom on campuses because notebook computers are available to all faculty?

Research Question 4: Are there changes in the instructor's teaching methods because of the universal availability of notebook computers?

Research Question 5: Does the faculty's access to the notebook computers change the types or level of concerns expressed by the faculty?

Research Question 6: Does the faculty’s computer anxiety change after faculty have had access to the notebooks for a period of time?

The research questions examined a set of variables which were expected to identify the changes in the teaching and learning on the campuses over a one year period. The questions were also developed with the understanding that there are expected to be differences in the amount of change on the three campuses over time. Based on the research questions, the predicted outcome of this study was that:

- Universal access to notebook computers would increase the level of computer use in teaching.
- Faculty would use more types of computer technology in their teaching and would require more technology use by students in their courses.
• Faculty were expected to use less lecture and more discussion and group work teaching methods in their courses.

• The faculty's and student's access to the notebook computers were expected to change level of concerns expressed by the faculty. It was also expected that responses to the second SoCQ would reflect a rise in stages 5 and 6 of the concerns.

• The level of the faculty's computer anxiety would decrease after a period of time with universal access to notebook computers.

The results of the data analysis indicated that all but one of the expected increases did occur over the institutions as a whole. Some increases were greater on one campus or happened only on one campus. The expected increase in the use of discussion and group work methods did not occur and the decrease in computer anxiety did not happen on the campuses as a whole.

Syllabi data. Syllabi data were collected and interpreted. The syllabi data concerning computer use were from VCSU and MASU

VCSU syllabi. The first set of syllabi were created Spring 1996 or earlier and the second set of syllabi were created in the Fall of 1996 or later. The second set of syllabi were completed after students has received their own notebook computers. Appendix C contains a list of course titles, and departments of the randomly chosen courses.

In the first set of VCSU course syllabi, only 7 syllabi (23%) indicated computer technology use by the students or faculty. There were 8 total uses in
the 30 courses. Only 1 course syllabus had more than one use (2), and 3 of the syllabi had just the instructor's E-mail address as a way of contacting the faculty member. However, in the second set of syllabi, 24 (80%) had at least one indication of technology use. There were 51 total indications in the second set of syllabi. Of the single uses only two were simply an E-mail address. Two syllabi had 5 uses, two had 4 uses, and 13 (43%) had more than one use listed. Fifty-seven percent more syllabi had at least one technology indication one year later and there were 43 more total indications in the courses, or overall an increase of 84% over the one year period (Table 4.12).

MaSU Syllabi. In the early set of MaSU Syllabi there were six (20%) of the syllabi which indicated some type of technology use and one of the syllabi had two. The survey of the second set of MaSU syllabi indicated 11 (37%) syllabi had technology use indicated. Six of the 12 syllabi had a listing of the faculty's E-mail address and only one more than 1 indication (3) (Table 4.12).

Interpretation of syllabi data. The syllabi from the VCSU campus showed a much greater increase in the number of technology indications than the MaSU syllabi. The largest VCSU increase was in student requirements, including use of the WWW. Faculty uses, including web sites and e-mail, also showed a large increase. The largest increase in the MaSU syllabi was in the use of e-mail. The reason for the rather large increase in the VCSU syllabi and a much smaller increase in the MaSU syllabi is believed to be the fact that, without changing the
Table 4.12. Technology uses and requirements found in the syllabi over a one-year period at VCSU and MaSU

<table>
<thead>
<tr>
<th>Institution</th>
<th>Indicators</th>
<th>1996 (N)</th>
<th>1997 (N)</th>
<th>Increase (1996-97)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCSU</td>
<td>Total¹</td>
<td>8</td>
<td>51</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td># used by faculty²</td>
<td>4</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td># required of students³</td>
<td>4</td>
<td>30</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Average # per course⁴</td>
<td>1.27</td>
<td>1.7</td>
<td>1.43</td>
</tr>
<tr>
<td></td>
<td>Largest # by one faculty ⁵</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td># of e-mail uses⁶</td>
<td>3</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td># of faculty web sites⁷</td>
<td>1</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td># requiring web use by students⁸</td>
<td>0</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>MaSU</td>
<td>Total¹</td>
<td>7</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td># used by faculty²</td>
<td>2</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td># required of students³</td>
<td>5</td>
<td>5</td>
<td>0</td>
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<tr>
<td></td>
<td>Average # per course⁴</td>
<td>23</td>
<td>47</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Largest # by one faculty ⁵</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td># of e-mail uses⁶</td>
<td>2</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td># of faculty web sites⁷</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td># requiring web use by students⁸</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

1 Total number of technology initiatives found in 30 randomly selected courses; 2 Number of technology uses by faculty; 3 Number of technology items required of students; 4 Average number of technology indications in the 30 courses; 5 Largest number of technology indications for any one course; 6 Number of indications which were e-mail; 7 Number of faculty which indicated in syllabi they had a institutional web site; 8 Number of faculty who required students to use the web.

Although all had notebook computers, there was only a slight increase in the use of technology by faculty on the MaSU campus.
Focus group data. Focus group data were collected from Mayville State and Valley City State. A list of questions and raw responses can be found in Appendix D.

Mayville State focus group report. The focus group was conducted in January of 1998, approximately one semester after the students at MaSU received notebook computers. Seven faculty members attended the one-hour focus group activity. They represented the divisions/departments of Health and Physical Education, Education, Mathematics, Social Science, and Communication Arts.

The group responses to the notebook computers were mixed. Some of the responses indicated a very low on non-use of computers for teaching and a dissatisfaction with the adoption. Other responses indicated a high level of use and only positive responses to the decision to adopt. The majority of the group perceived both strengths and concerns with the adoption of the notebook computers.

Most individuals agreed that the availability of E-mail led to better communication among students and faculty colleagues and was a positive result of the use of the notebook computers. One participant summed it up this way: "E-Mail is great for assignments and communications."

Two themes were repeated throughout the focus session. First, the participants expressed a concern about time. Mostly, it was reflected negatively in the loss of time in hooking up and using the computers in the classroom, or in
the loss of time due to the network being down. Some were concerned over the poor timing of the training sessions especially for the training of secretarial staff. In addition, participants thought time was lost in class because the notebooks were a distraction, and some indicated that there was a loss of control during class when the notebooks were on-line thus lecture time was less effective. The positive side of the time factor was verbalized by faculty who found that some assignments could be completed outside the classroom, and others who reflected that software became a self-teacher for some concepts.

The second and by far the most pervasive theme during the encounter was the training issue. There was no positive side to this issue. One individual indicated that he thought, “the training was only 3% effective.” Members of the group seemed to feel they were short-changed in both the amount and the type of training that they received. They wanted to be able to integrate notebooks into their teaching but felt they did not have the basic tools necessary to begin the process. They also showed interest in acquiring more specific knowledge about what other teachers were doing in their curricular areas with technology. Frustration over their technological knowledge and the training they received was expressed in the statements and suggestions that follow:

- “Most people were at the bottom level of the training”
- “Limited practice – not applied”
- “Need immediate application”
- “Need mastery of computer skills – hands on experience”
One individual reflected frustration at being a high-end technology user and felt he had wasted time on the low-level training.

Generally, the faculty seemed pleased with the adoption of technology on the campus but frustrated with the process of learning to use it and integrating it into the classroom. The results of the focus group supported the data gathered through the SoCQ. The SoCQ indicated the concerns expressed by the MaSU faculty.

*Valley City State focus group report.* The focus group was conducted in December of 1996 and April of 1997 one semester following the distribution of notebook computers to students on VCSU campus. Eight faculty members attended the two one-hour focus groups. They represented the divisions/departments of Health and Physical Education, Education, Mathematics, Business and Communication Arts.

The responses to the questions were almost totally positive. It would be difficult to identify any type of overall negative reflection. The negatives were usually expressed as complaints about the need for more technology (networked classrooms or better student computers). Some concerns were over the loss of the network or lack of it at one location on the campus. In addition, there was concern that some faculty did not use computers enough in their teaching. However, the complaints were tempered with the assumptions that it would improve. Even when specifically asked about pressure and negative concerns, the faculty responded as follows:
• “Administration have an influence on us – can be a positive influence but is a type of pressure.”

• “Influenced – Yes with no pressure. Students expect us to use computers so the instructor needs to be ready.”

• “To be innovated and stay innovated...”

The one theme that was repeated overwhelmingly throughout the session was student and student centered. In fact, the term “student” was repeated fifty times in the transcripts of the focus group responses. The faculty at VCSU seemed to be very concerned about the needs of their students with reference to technology. Statements such as those that follow were easy to find in the interview transcripts:

• “The instructor and the student are learning together while the instructor is the facilitator.”

• “Students have more pride in their work.”

• “There is much more accessibility to information through the Internet.

• “The instructor and the students are both more comfortable using computers and showing their computer skills.”

There seemed to be a change occurring in the way teaching was happening on the campus. Students were asked to take more responsibility for class assignments and they were asked to participate more in their own learning. The faculty seemed to want to continue and promote this change. The continued change was supported by the results of the SoCQ. In it the faculty expressed
concern about needing more knowledge about the use of technology in the teaching and learning process.

Summary

This chapter began with a profile of the respondents. The demographic profile included: age, gender, academic rank, division/department, and years of computer use. The results of the statistical information were then reported in two phases. In the first phase, a correlation was used to determine the possible predictors of adoption of the notebook computers. The results indicated in this study, that subjective norms and innovativeness were significant predictors of adoption.

In the second phase of the study, variables were measured one year apart and the differences were determined using a GLM of repeated measures. The campus on which the faculty was employed was also a variable in the second phase of the study. The results indicated several changes had taken place on the campuses as a whole and the VCSU campus was significantly different from the other two campus in level of computer use, amount of technology use, and frequency of software use. The Stages of Concerns Questionnaire was also employed as part of the second phase of the study. Its results were reported in a narrative format. The changes in faculty concerns connected with the use of the notebook computers were the greatest on the MaSU and VCSU campuses while JC remained nearly the same over the one-year period. Narration was also used
to report the changes in the randomly sampled syllabi and the results of the focus groups on the Mayville State and Valley City State campuses.
CHAPTER 5. CONCLUSIONS

Introduction

This chapter presents the summary, discussion and recommendations of the study drawn and analysis of the collected data. The problems, the research questions generated, the rationale for the selection of variables, the procedures used to analyze the data, and the findings are reviewed and discussed. The findings are interpreted and recommendations for further studies are suggested. Chapter 5 reviews Chapters 1, 2, and 3 and restates the research questions.

Overview

This study was designed to explore and assess the impact of the universal adoption of notebook computers on three university campuses. Notebook computers were distributed to all full-time faculty and some part-time faculty at three, four-year undergraduate institutions of higher education. The first institution, Valley City State University (VCSU), had 54 full-time faculty and approximately 1,100 students. The faculty received the notebooks in February of 1996. The second institution, Mayville State University (MaSU), had 37 full-time faculty and about 750 students. The faculty received notebooks seven months later, in August of 1996. The third institution, Jamestown College (JC), with 51 full-time faculty and approximately 1,100 students, also distributed notebooks to its faculty in August of 1996. The entire student population at VCSU received
notebooks for the fall semester of 1996. MaSU planned for its students to receive notebooks in the fall of 1997. The third institution, JC, did not plan to distribute notebooks to its students.

The purpose of this study was first to determine if adoption of notebook computers could be predicted, and second to analyze the changes on the three institutions because of the adoption. Differences between and among the three campuses were determined. Eighty-five faculty completed both of the Computer Technology in Teaching Questionnaires (CTITQ) approximately one year apart. This “matched pairs” sample provided data for examining prediction of use, changes in the level of use, faculty concerns, types of use, innovativeness, and computer anxiety. Support for this data was also gathered from course syllabi and focus groups conducted on the VCSU and MaSU campuses.

Discussion and Implications

The discussion of the results and implications are divided into the two phases in which the research was conducted. First the research questions are restated, followed by a brief review of the related literature, the instruments employed to gather data and analysis of those data. Then implications are drawn based on the findings.

Phase one

In order to accomplish the purpose of the first phase of this study the following research question was proposed:
Research Question 1: To what extent if any do the selected variables: innovativeness, subjective norms, age, and academic rank, predict a faculty member’s adoption of the notebook computer?

In the first phase of the study, the adoption of the notebook computers by the faculty was considered. In order to contribute informatively to the research on the adoption of innovation, several variables were carefully selected based on theory. Notebook computers were viewed from a specific perspective; their distribution to faculty was considered an organizational adoption of an innovation. Research has studied innovations and the process through which people come to adopt them.

The organizations (the three universities) in this study each made the decision to adopt notebook computers for their faculty prior to the faculty beginning to use the notebook computers. Therefore this study focused, as suggested by Zaltman, Duncan, and Holbek (1973), on the innovation process within the organization and attempted to understand the changes that occurred to the organizations and the changes in teaching and learning because of the adoption. Organizational adoption was further studied by Rogers (1995).

The dependent variable in the first phase of the study was generated by the Levels of Computer Use (LCU) scale (Marcinkiewicz & Welliver, 1993). It is a simple measure for classifying teachers by three levels of computer use. There were three categories; nonuse was the absence of any use of computers for teaching. Utilization and Integration represented progressive levels of computer use. The criterion for membership in the two levels was the dimension of
expendability of use, that is, how expendable computers were to a faculty's teaching. The LCU Scale is based on the theoretical area of instructional transformation and a model proposed by Rieber and Weliver (1989) which describes the process of adoption of computers by teachers.

The independent variables chosen as probable predictors included: innovativeness, expectation by significant external entities (subjective norms), age, rank. The instruments summarized below were selected because they examine innovativeness and expectation by significant external entities.

- The innovative Scale (IS) (Hurt, Joseph, & Cook, 1977). Subjects rated their agreement with items indication "willingness to change".
- Subjective Norms: A questionnaire developed by Marcinkiewicz and Regstad (1996) using the personal motivation variables referred to in the procedures described by Fishbein and Ajzen (1980). The specific variable measured by subjective norms was an individual's personal motivation as a response to the perceived expectations of the environment. Four significant-other entities which influence the faculty's intent to use the computers for teaching are queried. They include the faculty's administration, colleagues, students and professional body.

Two demographic variables, age and rank, were selected for this research because of the relevance to the research questions. These demographics were considered even though they were not influenced by intervention, remediation or
training of any sort. Nevertheless, they were considered significant in influencing faculty computer use.

In the first phase of the study, four variables were expected to be predictors of the level of use of notebook computers. Data from the first CTIT were used to determine the score of the four variables. Data from the second CTITQ was used to determine the level of use of the faculty.

**Variable 1 - Subjective Norms and Level of Computer Use:** As was the case in other studies (Marcinkiewicz & Regstad, 1996; Marcinkiewicz & Wittman, 1994/95), a positive relationship was expected between scores on the Subjective Norms and the level of computer use by the faculty. In this study the data showed a significantly positive relationship between the results Subjective Norms (an individual’s perception of the environment) and the level of computer use by the faculty at the conclusion of the study. The significance level was (.011). The importance of this relationship for campuses considering adopting notebook computers, is that scores on the Subjective Norms may be useful in promoting the use of the notebooks among the faculty. Using the Subjective Norms scores as a measure, campus culture could be influenced to afford a higher level of use when the universal adoption is undertaken. If the Index scores are higher, a higher level of computer use can be expected on the campus.

**Variable 2 - Innovativeness and Prediction of Level of Computer Use:** It was anticipated that the faculty’s innovativeness would be predictive of the level
of computer use by the faculty. Innovativeness, as defined by Hurt, Joseph, and Cook (1977) and in this study as "the willingness to change", was found to be a significant predictor of level of computer use. An understanding of the relationship between these variables might influence an adopting campus to increase the innovativeness of the faculty. Innovativeness could be influenced by offering faculty experiences which expand their comfort zone and opportunities to experience change in a safe environment free of negative repercussions and criticism certainly change the innovative culture on the campus.

Variables 3 and 4 - Demographic Variables of Age and Academic Rank:
Age was one of the two demographic variables in the study. The mean age of all the respondents fell in the range of 41-50. Seventy percent of the responding faculty were between the ages of 41 and 60. Although VCSU respondents were slightly older, all three sets of respondents averaged were very close to the same age. In this study there was only an insignificant relationship between age and level of computer use (F = .57), however, both Pearson's and Spearman's rho indicated a significant relationship to academic rank (p = .50 and .51, respectively). Little can be done about the demographic variable of age, however, the understanding that an aging faculty may not adopt notebook computer use as readily as a younger group may change the adoption strategies on a given campus.

Academic rank, highly correlated with age, was not related to computer use. It was divided among five groups: (1) lecturer; (2) instructor; (3) assistant
professor; (4) associate professor; and 5) professor. The largest group (32%) were assistant professors. Although JC faculty were slightly higher in rank, the mean academic rank score of each of the groups fell in assistant professor. The five groups were considered separately, with t-tests and a joint F-test conducted on all ranks. None of the individual t-tests showed significance and the joint F reported a value of 1.07. This study suggests that a higher or lower rank did not influence the computer use level of the faculty.

Phase two

The second phase of the study attempted to determine the differences in the following variables among the institutions. The remaining five research questions were concerning use:

Research Question 2: How does universal notebook computer accessibility effect the a faculty member's level of computer use?

Research Question 3: Are there more or different uses of computer technology in the classroom on campuses because notebook computers are available to all faculty?

Research Question 4: Are there changes in the instructor's teaching methods because of the universal availability of notebook computers?

Research Question 5: Does the faculty's access to the notebook computers change the types or level of concerns expressed by the faculty?

Research Question 6: Does the faculty's computer anxiety change after faculty have had access to the notebooks for a period of time?

The second phase of the study dealt with changes in technology use in teaching on the three campuses. The criterion variable was the institution. It
was expected that the differences in the culture of the three campuses, the
expectations of the adoptions and the length of time with the computers would
make a difference in the variables.

The indicators of these changes included:

- **Computer Anxiety**: A number of studies have examined the relationship
  between computer anxiety and personality variables (Hawk 1989; Loyd &
  Gressard, 1984; Rosen et al., 1987). "Significant evidence has been
  amassed in this body of research to support the hypothesis that computer
  anxiety is a distinct and measurable construct." (Maurer & Simonson,
  1993). Simonson et al. (1987) defined computer anxiety as: "the fear or
  apprehension felt by individuals when they used computers, or when they
  considered the possibility of computer utilization" (p. 238). In this study
  an attempt was made to determine if having notebook computers for a
  period of time would change the negative attitudes (anxieties) participants
  had concerning the notebooks. Computer anxiety was measured using the
  Computer Anxiety Index (Simonson et al., 1987).

- **Concerns of the Faculty**: Stages of Concerns (SoC), focuses on the concerns
  of individuals involved in change (Hall, 1979). Research showed users, or
  potential users of an innovation, have seven kinds of concerns (Hall,
  George, & Rutherford, 1986). While the seven Stages of Concern are
  distinctive, they are not mutually exclusive. An individual will likely have
  some degree of concern in every stage, but the intensity of concern varies
as the implementation of change progresses (Hord et al., 1987). A 35-statement questionnaire, the Stages of Concerns Questionnaire (SoCQ), was used to indicate the individual's type and level of concern about an innovation.

- **Level of Computer Use**: The criterion variable in the first phase of the study, Levels of Computer Use (LCU) scale (Marcinkiewicz & Welliver, 1993) was used to determine change in adoption in the second phase.

- **Number of Faculty and Student Uses of Technology**: This variable was determined by two methods. A checklist of computer technology uses by faculty and required technology uses by students was part of the Computers Technology in Teaching (CTIT) questionnaire given to faculty. In addition, the random sample of campus syllabi indicated the changes in the number of technology uses over a one-year period.

- **Frequency of Software Use by Faculty**: A four-point scale indicating amount of use was part of both CTIT questionnaires. Faculty indicated how frequently they used the software available on the notebook computers. Other likely software types were also listed on the scale. Rises in the total score indicated more frequent use by the faculty.

- **Percentage of Lecture Verses Discussion and Group Instructional Methods**: The faculty in the study were asked to estimate the percentage of time they spent using each of several instructional methods including; lecture,
discussion, group work, laboratory and other. Increases in group work and discussion were expected.

The implications of phase two are divided into seven areas.

1. Increases in level of computer use on the campuses. The three campuses as a whole did not increase significantly in level of computer use over the year of the study. However, Valley City State University did have a significant increase in computer use while the other two institutions did not. Several factors may have contributed to the increase on the VCSU campus. The VCSU campus differed from the other two campuses in; their length of exposure to notebooks, their adoption of notebooks for students during the study, their enhanced the infrastructures for computer use in the classrooms and their significantly different campus culture as determined by the subjective norms survey.

Responses by the faculty to the Level of Computer Use (LCU) scale in this study were not always as expected. In previous studies (Marcinkiewicz, 1991; Marcinkiewicz & Grabowski, 1992), the four questions in the scale were expected to total 0, 4 or 8. In this study the faculty indicated through notes in the margin of the CTIT questionnaire that they perceived a difference between the term instruction and the term teaching. They reported that they responded differently to two of the questions because their definition of instruction included class preparation and their definition of teaching included only their time in the
2. Change in computer anxiety over the one-year period. It was expected at the beginning of this study that the faculty's computer anxiety level would decrease over the one-year period of the study. Although there was a decrease in the computer anxiety at each of the institutions, there was not a significant decrease at any of them. The institution with the largest decrease (3.63) was MaSU. Mayville was the campus with the least computer experience (mean = 1-2 years) among the faculty. The other two campuses averaged 3-4 years and had almost identical means (VCSU = 3.80 and JC = 3.79). Since all of the respondents from the VCSU and JC campuses indicated had at least one year of computer experience at the time of the first study, it is very possible that computer anxiety was not a factor in their decision to adoption and use notebook computers.

3. Responses to other variables. In the second phase of the study the campuses were considered as a group and then separately over a one-year period. The matched data indicated significant differences in the campuses as a group over time for the variables: the number of technology uses by faculty in teaching, the number of required student required uses of technology and the frequency of software use by faculty for several variables, including number of different technology uses by faculty and students, and the frequency of software use by faculty. Only one variable, “number of student required uses of
technology", was identified as being significantly different between the campuses. When the campuses were considered separately, the significant increase was found only on the VCSU campus and not on the other two. This could be accounted for by the adoption of student notebooks by VCSU and not on the other two. The data also showed significant changes on VCSU campus in four of the seven variables, while MaSU has two significant changes (number of technology uses by faculty and frequency of software use) and JC had only one (number of technology uses by faculty). Further evidence of the impact of the notebooks on teaching was found in a review of Syllabi. VCSU syllabi showed a much greater increase in the number of technology uses and requirements than did the MaSU syllabi.

The fact that the majority of significant changes in the variables took place on the VCSU campus would seem to imply that there was something different about the campus that increased the amount of change. As discussed in the implications from the first phase of the study, the results of the Subjective Norms suggests that there may be a cultural difference on the VCSU campus.

In addition, the fact that students on the VCSU campus received computers during the one-year period of the study could be identified as a influential factor. Other explanations for the successful universal adoption of notebooks was more effectual on the VCSU campus include: (1) the faculty had more experience with computers than did faculty on other campuses studied;
and (2) the decision to adopt the notebooks for the students first made by a campus wide committee of faculty, staff and students.

The variable which did not change over the one-year period was the method of instruction. Although the three campus employed lecture and student centered methods such as discussion and group work in differing percentages, the faculty indicated almost no change in their method of instruction over the one year period. It is possible that this type of change will occur over a longer period of time.

4. Impact of critical mass. Rogers (1997) stated that "critical mass" is important because once it is achieved, the rate of adoption accelerates. It was hypothesized that the level of adoption on the three campuses was impacted by whether or not, at time of the study, "critical mass" was reached. According to Rogers' (1995) critical mass is: "...a point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining" (p. 313). The interactive quality of the new communication media (E-mail and WWW) was suggested by Rogers as the primary reason for computer technology reaching critical mass. In the current study, the adoption level on the VCSU campus was significantly higher than on the other two campuses. The interactive communication available on the VCSU campus was considerably greater because the students had notebook computers and because the network infrastructure enabled use from classrooms, dorms and off campus housing. This allowed the computer use to have reached a critical mass on the
VCSU campus at the time of the second administration of the questionnaire. Therefore, a higher level of adoption was recorded on the campus.

5. Differences in faculty concerns among the institutions. The differences in the results of the SoCQ among the institutions may be explained by the differences in the three campuses already discussed above. Other differences include:

- First, at the time of the initial questionnaire in the Spring of 1996, faculty on the VCSU and JC campuses had nearly the identical means length of use (VCSU Mean = 3.80, JC Mean = 3.79). An indication of 3 to 4 years of use. The MaSU faculty data resulted in a Mean of 2.91. This indicated MaSU faculty were significantly less experienced with computers than the other two campuses. Three MaSU faculty of the twenty-three indicated they did not use computers at all in 1996 while no one on the other two campuses indicated non-use. One year later the difference was no longer significant, probably due to the disappearance of the non-users on the MaSU campus.

- Second, in a pairwise comparison of the results of the Subjective Norms Survey, the VCSU campus was significantly different from the other two campuses (Table 5.1). MaSU and JC, however, were not different from each other. This indicates the faculty on the VCSU campus perceived the expectations of students, peers, and administration are more important than did faculty from the other two campuses.
Table 5.1. Pairwise comparisons of institution scores on the Subjective Norms Survey

<table>
<thead>
<tr>
<th>Institution</th>
<th>Institution</th>
<th>Mean Difference</th>
<th>Std. Error</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaSU</td>
<td>JC</td>
<td>-.44</td>
<td>2.0</td>
<td>.83</td>
</tr>
<tr>
<td>MaSU</td>
<td>Valley City</td>
<td>-6.04*</td>
<td>1.7</td>
<td>.00</td>
</tr>
<tr>
<td>Jamestown</td>
<td>Valley City</td>
<td>-5.60*</td>
<td>1.8</td>
<td>.00</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the .05 level.

- Third, during the period of the study only VCSU distributed notebooks to their students. In addition, the infrastructure of the VCSU campus was quite different from the other two campuses. It included a number of classrooms capable of multimedia (computer) projection and Internet connections for students. The MaSU campus had plans for the year following the study, to adopt notebooks for their students and to make many of the same infrastructure changes as VCSU. However, JC reported no multimedia or Internet capable classrooms and had no plans for student adoption. These aspects on the campuses influence the campus cultures. These cultural differences are thought to be responsible for the variances in the concerns expressed in the second questionnaire (see Appendix D).

6. Differences in the faculty concerns over a one-year period. The results of the SoCQ support the findings from other portions of the CTIT questionnaire. The data confirmed that the notebook computers caused very little change in the JC campus. Similarly, although all of the scores of concerns rose, the profile of
the concerns did not change at JC. Both VCSU and MaSU showed distinct changes in their concerns over the one-year period. VCSU's concerns rose in stages 5 (Collaboration - a focus on coordination and cooperation with others regarding the use of the notebooks) and 6 (Refocusing - a focus on exploration of more universal benefits from the notebooks) while dropping in stage 0 (Awareness - little concern about or involvement with the notebooks). The Refocusing stage was the highest peak of the seven stages. According to Hall, George, and Rutherford (1986), a profile which has its highest peaks in Collaboration and Refocusing and shows a drop in the awareness stage, indicates a group which is willing to significantly modify the innovation (notebook computers) to fit its needs. As discussed by Rogers (1995), modification an innovation to fit the organization is an important occurrence if adoption is to take place.

MaSU's concerns profile differed more from the first questionnaire to the second than did the other two campuses (see Appendix D). At the time of the first administration of the SoCQ, MaSU's stage 1 (Informational) score was their peak score. This indicated they had a general awareness about the notebooks and were interested in learning more detail. Their profile also indicated intense personal concern about computers and their consequences while denoting no concerns about the relationship of students to use. They were more likely to be negative toward the innovation. At the time of the second questionnaire, the MaSU profile indicated they knew quite a lot about computers and were not
threatened by them. It also showed minimal to no concerns about managing their use but some concern about the consequences of use for students. Appendix D contains line charts comparing the MaSU profiles.

Concerns do not exist in a vacuum. According to Hord et al. (1987), concerns are influenced by participants’ feelings about an innovation, by their perception of their ability to use it, by the setting in which the change occurs, by the number of other changes in which they are involved and, most of all, by the kind of support and assistance they receive as they attempt to implement change.

7. The focus group research. At two of the institution the focus groups were expected to add depth and texture to the data from the questionnaire. Both groups were held one semester after students had received their computers. The emphasis of the questions was on teaching and learning. It was obvious from the responses that the level of adoption was different on the Mayville campus than on the Valley City campus. While the VCSU faculty seemed very comfortable with the computers and their use in the classroom, the MaSU faculty were very concerned about being able to use the computers, but had not integrated them into their teaching. There was some indication that they were not convinced that it was important.

The analysis of the focus group supported the results from the SoCQ and the Subjective Norms survey. The culture on the VCSU campus was one which supported and encouraged change, and student learning was often the central
reason for the change. The change that occurred on the MaSU campus was
great, but perhaps the culture on the campus not as ready to take advantage of
the notebook adoption as was the VCSU campus.

Recommendations

Several recommendations are offered based on the finding of the study.

Adoption of notebook computers

It is important to take into account several factors when considering the
universal adoption of notebook computer by an organization. Simply having
more technology does not in itself result in teachers integrating it into their
teaching. Indeed, in the schools surveyed, there was more than double the
average number of computers available nationally (Becker, 1989). Yet, there was
only about one teacher per school who had integrated the computer into his or
her teaching. The exceptional availability of computers was not matched by the
exceptional use of computers. There were other factors which influenced
adoption in the Becker study.

The results of the current study were much the same. Computer
availability was not a factor because of organizational adoption of notebook
computers. There were adoption differences among the three campuses and one
campus used the technology significantly more than the other two. What
motivated faculty on one campus to integrate computer technology into their
teaching while faculty on other campuses seem less motivated lies in part in cultural differences on the campuses.

It is important to understand and attempt to cultivate a campus culture which will enhance the adoption. One measure of cultural differences on the campuses in this study was subjective norms. It concerned one's perception of whether relevant others think an individual should engage in specific behavior (Fishbein & Ajzen, 1975). In one sense, it might be interpreted as the basis for peer pressure. This variable provides insight into the internal response or valuing relative to the external pressure. The campus, VCSU, which showed significantly more adoption for several variables scored significantly higher on the subjective norms portion of the CTIT Questionnaire. A second indication of the differences on the three campuses was the change in the pattern of concerns as measured by the Stages of Concerns Questionnaire. JC and VCSU began the study with nearly identical patterns of concern. The results of the second questionnaire indicated JC had varied very little from its pattern of the previous year however VCSU's pattern had risen especially in stages 5 (Collaboration) and 6 (Refocusing) with a drop in stage 1 (Awareness). According to Hall, George and Rutherford (1986), this response indicates the faculty have an intense involvement with their computers and major concerns about cooperative efforts in relation to students and further use of the computers (see Appendix D).

Organization wide buy-in of the adoption is important to the success of the innovation. It was pointed out by Marrow, Bowers, and Seashore (1967) that
increased participation in the collective decision process, while taking a longer period is likely to lead to more commitment by participants to working through some of the difficulties experienced during implementation. Thus, taking the time to include all groups affected by the adoption in the decision has a positive effect on the outcome. Two of the institutions made the decision to adopt the notebooks through a technology committee while the third, JC, had an administrative decision as the catalyst to adopt the computers. This process may have been a reflection of, or a cause for, the differences in campus cultures.

Appropriate infrastructure is important to the use level of the notebook computers. Without networked offices and classrooms, multimedia presentation hardware in a number of instructional areas and off campus and dorm access for students the notebook computer technology has little use other than as a management tool for the faculty. At the time of the study, VCSU was the only one of the three institutions which had such an infrastructure. VCSU showed significant increases of technology use in four of seven variables while the other two institutions had increase in no more than two. The focus group responses and syllabi data also supported these findings.

Of all significant agents in a university culture students would be most likely to readily welcome educational computing and be the least difficult to influence. Students' eagerness for educational computing itself may influence school culture. Morano (1984) showed that students' perception of teachers' effectiveness increased by virtue of teachers' modeling the use of computers and
providing instruction in which computers have been integrated. This same attitude was reflected in the qualitative research by Cook (1994) concerning laptop adoption at the University of Minnesota at Crookston. Therefore, adoption of notebook computers for faculty without also adopting for students may mean a lower level of technology use in the organization. Student adoption was another element which VCSU did not share with the other two institutions. The variable results related to increased student use and the increased technology expectations in the syllabi on the VCSU campus both support this supposition.

The members of the school culture need to demonstrate expectations of educational computing use. This can be done by making equipment available and providing necessary being sensitive to the needs of teachers by providing training to increase their self-competence in computer use and perceived relevance of computers in teaching.

According to Schroeder, Van de Ven, Scudder, and Polley (1986) in their case studies on organizational adoption, innovation receptiveness, learning and adoption speed are facilitated when the adopters are provided with opportunities to re-invent the innovations to fit the needs of the organization. However, a study of several innovations in three organizations by Tyre and Orlikowski (1994) found that only a brief window of opportunity existed in an organization during which an innovation can be modified. Without this reinvention or modification, the innovation becomes imbedded into the organizational structure
but is less likely to meet the needs intended. Tyre and Orlikowski (1994) also reported, if modification of the innovation does not occur, adoption/diffusion is less apt to occur. If adoption of notebook computers on college campuses is to diffuse and change the teaching and learning in that institution, the organization needs to plan for the window of opportunity. Creating a positive culture, soliciting support from all parties, providing appropriate training for faculty, having appropriate infrastructure to support teaching and adopting notebooks for students will optimize adoption during the window in time when notebooks are adopted.

**Future research**

Although a great deal of information was gathered concerning the adoption of notebook on these three campuses, the focus of the study was on small undergraduate campuses and data were gathered only from faculty. To further understand both the prediction and adoption of notebook computers, information on adoption by larger campuses needs to be gathered. Data from other member of the campus including students, staff and administration would be of value in understanding the notebook adoption portraiture.

More research is necessary to determine why notebook adoption is more successful for some organizations than others. Even when computers are widely and readily available, they may not be adopted for integration into teaching by the majority of teachers. The factors which influence adoption when computers
are universally available need to be studied further. Research based on the following would be of value:

- The identification of specific personal factors under the umbrella of motivational factors is a very important one.
- The amount and type of training provided with the adoption needs to be further understood.

How can an administration or faculty change the environment of the organization and cause the adopter to perceive their environment as expecting them to use computers?

With the exception of the insight gained from the focus groups held on the campuses, all the data gathered in the study were quantitative. Qualitative research concerning the specifics of campus culture prior to and during adoption could yield more specific information about the predictive factors that influence the adoption of computer use or lack of it on various campuses. Explicit discussions with faculty about their use of computers in the classroom and the changes that occurred because of the universal availability would further the understanding of the changes in teaching and learning. This same discussion with students might cast further light on the impact computer use has on student learning at all levels.

Two variables that did not show any significant change over the one-year period of the study were changes in the type of instruction used by the faculty member. The data were gathered by asking the percentage of time spent in
several instructional methods. Continued monitoring of these changes over a longer period of time or through different data collection methods would, hopefully, record changes in the instructional methods used on a notebook computer campus. Such changes in instructional method could then be compared to changes in student achievement on the campus.

Research into all of the areas mentioned will increase information concerning adoption, teaching, learning and improved culture for change. Universal adoption of notebook computers is in its infancy on college campuses. The number of universities and colleges adopting this innovation is certain to increase. It is the hope of the researcher that the data gathered and reported in this study will be useful in such adoptions.
APPENDIX A. COMPUTER TECHNOLOGY IN TEACHING (CTIT) QUESTIONNAIRE

Please respond to the following items by answering the questions, filling in the blank or circling the answer that best fits you. When you are done, please return the survey in the enclosed envelope through campus mail. Tear off the bottom of the cover letter and return it separately. It will be used only to determine who has returned and not returned surveys for follow-up purposes.

Section I: Background Information
This section will be used to gather general background information concerning all respondents.

1. University/College at which you work _______________________

2. Gender
   a. male
   b. female

3. Highest degree attained
   a. BA/BS
   b. MA/MS
   c. EdD/PhD
   d. Other _______________________

4. What is your academic rank ________________ (Ass. Professor, Instructor, Lecturer)

5. Approximately what percentage of your professional time is spent at the following?

   6. teaching ___% 
   7. student supervision ___% 
   8. advisement ___% 
   9. administration ___% 
   10. research ___% 
   11. service ___% 
   12. coaching ___% 
   13. other ___% List _______________________

   Total 100 %

6. Age at last birthday
   a. under 30
   b. 30-40
   c. 41-50
   d. 51-60
   e. over 60
Section II: Information Pertaining to Your Teaching Assignments

Questions in this section should be answered with reference to your teaching assignments only.

8. In what division and/or department do you teach? _____________________

9. How many total credit hours did you teach during the 1996-97 school year? (Do not include Summer)

   Number of credit hours _______ semester hours quarter hours (circle one)

10. On average, estimate approximately the percentage of class time spent in each of these teaching methods, across all classes.

    11. lecture ___%  
    12. discussion ___%  
    13. group work ___%  
    14. laboratory ___%  
    15. other ___%  Other ____________________________

   Total 100%

11. Do students write papers or do written projects for your courses? Yes No

12. Do you have students rewrite them after receiving feedback? Yes No

Section III: Information Pertaining to Your Computer Use

If you do not use a computer skip to # 25

13. How long have you used a computer?

    a. less than a year  
    b. 1-2 years  
    c. 3-4 years  
    d. 5 or more

14. Check each that apply to you.

    ___ Have a desktop computer in my work office
    ___ Have a computer available at work which is shared
    ___ Have desktop at home
    ___ Have a notebook (laptop) computer supplied by the institution
    ___ Have a notebook (laptop) computer of my own
    ___ Have a notebook (laptop) available for special needs (trips etc.)
    ___ Other Explain ________________________________

15. What platform do you work on most often? (DOS, Mac, Windows, UNIX etc.) ________
16. If you primarily use a notebook (laptop) computer, how long have you used it?
   a. less than 6 weeks
   b. 6 wks. - 1 yr.
   c. 1 - 2 yrs
   d. Longer than 2 yrs.

17. In column one below, circle the number which best describes your use of that type of software.

18. In the column two below, circle the letter which best describes your needs for training on the software. The software listed are examples but do not limit choices.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Never</td>
<td>A</td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>2</td>
<td>Very Infrequently</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>3</td>
<td>Infrequently</td>
<td>C</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>Quite Frequently</td>
<td>D</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

1 2 3 4 word processing (Microsoft Word, WordPerfect) A B C D
1 2 3 4 communication (e-mail) (Kermit, Eudora) A B C D
1 2 3 4 spreadsheets (Excel, Lotus) A B C D
1 2 3 4 databases (FoxPro, Access) A B C D
1 2 3 4 presentation software (PowerPoint, Persuasion) A B C D
1 2 3 4 multimedia (Hypercard, Director, Morph) A B C D
1 2 3 4 desktop publishing (Pagemaker) A B C D
1 2 3 4 graphic design (Freehand, SuperPaint) A B C D
1 2 3 4 programming (C BASE, PASCAL) A B C D
1 2 3 4 web browsers (Netscape, Mosaic) A B C D
1 2 3 4 course specific software A B C D
1 2 3 4 others List ____________________________

19. List below any specific software applications you are interested in learning about.

20. Check the following activities which you require of your students either in or out of class.
   ___ presentations using software (PowerPoint, Persuasion)
   ___ Videodisks
   ___ CD-ROM based lesson
   ___ World Wide Web
   ___ databases
   ___ spreadsheets
   ___ multimedia presentations
   ___ internet including e-mail
   ___ statistical software (Statview)
   ___ graphing (Mathcad, Maple)
   ___ others List ____________________________________________

21. Check the following computer activities that you have used in class or in preparation for teaching?
   ___ presentations using software (PowerPoint, Persuasion)
   ___ Videodisks
   ___ CD-ROMS
World Wide Web
- databases
- spreadsheets
- multimedia presentations
- internet including e-mail
- statistical software (Statview)
- graphing (Mathcad, Maple)
- others _ List ___________________________

22. Do you use e-mail often?
   a. yes
   b. no

23. How often do you use the following computer activities to communicate with students or your classes?
   a) never  b) once per week or less  c) several times per week  d) daily
   - e-mail
   - listservs
   - others _ List ___________________________

24. Describe one computer-based activity that you have used in your teaching.

Section IV: Attitudes Towards Computer Related Technologies
Read the following statements. To what extent do you agree that each statement is true about you? Agreement is rated along a 6-point scale from SA for strongly agree to SD for strongly disagree.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>SA</th>
<th>SD</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Slightly Agree</td>
<td>Slightly Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>

25. Having a computer available to me would/does improve my productivity.
   SA A SA SD D SD

26. If I had to use a computer for some reason, it would/does probably save me some time and work.
   SA A SA SD D SD

27. If or when I used a computer, I could get a better picture of the facts and figures.
   SA A SA SD D SD

28. Having a computer available would/does improve my general satisfaction.
   SA A SA SD D SD

29. Having to use a computer could/does make my life less enjoyable.
   SA A SA SD D SD

30. Having to use a computer could/does make things easier for me.
   SA A SA SD D SD

31. I feel very negative about computers in general.
   SA A SA SD D SD
32. Having a computer available to me could/does make things more fun for me.

33. If I had a computer at my disposal, I would/have tried to get rid of it.

34. I look forward to a time when computers are more widely used.

35. I doubt if I will ever use computers very much.

36. I avoid using computers whenever I can.

37. I enjoy using computers.

38. I feel that there are too many computers around now.

39. Computers are probably going to be/are an important part of my life.

40. If I were to use a computer, I could/do get a lot of satisfaction from it.

41. If I had to use a computer, it would probably be/it has been more trouble than it is worth.

42. I am usually uncomfortable when I have to use a computer.

43. I sometimes get nervous just thinking about computers.

44. I will probably never learn to use a computer.

45. Computers are too complicated to be of much use to me.

46. If I had to use a computer all the time, I would probably be very unhappy.

47. I sometimes feel intimidated when I have to use a computer.

48. I sometimes feel that computers are smarter than I am.

49. I can think of many ways that I could/do use a computer.
Section V: Level of Computer Use
Select the one statement in each of the groups that is most true for your situation. Circle the letter prior to the statement. If you do not use computers mark “c” for questions 51-54.

50. a. In my instruction, the use of the computer is supplemental.
    b. The computer is critical to the functioning of my instruction.
    c. I do not use computers for teaching at all.

51. a. The use of the computer is not essential in my instruction.
    b. For my teaching, the use of the computer is indispensable.
    c. I do not use computers for teaching at all.

52. a. The computer is critical to the functioning of my instruction.
    b. The use of the computer is not essential in my instruction.
    c. I do not use computers for teaching at all.

53. a. For my teaching, the use of the computer is indispensable.
    b. In my instruction, the use of the computer is supplemental.
    c. I do not use computers for teaching at all.

Section VI: Survey of adeptness at accepting new ideas
Read the following statements. To what degree do you agree that each statement is true about you? Agreement is rated along a 7-point scale from SA for strongly agree to SD for strongly disagree.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>A Agree</th>
<th>Slightly Agree</th>
<th>Slightly Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>54. I am generally cautious about accepting new ideas.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55. I rarely trust new ideas until I can see whether the vast majority of people around me accept them.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56. I am aware that I am usually one of the last people in my group to accept something new.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57. I am reluctant about adopting new ways of doing things until I see them working for people around me.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58. I find it stimulating to be original in my thinking and behavior.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59. I tend to feel that the old way of living and doing things is the best way.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60. I am challenged by ambiguities and unsolved problems.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61. I must see other people using new innovations before I will consider them.</td>
<td>SA A MA U MD D SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>
### Section VII: Concerns Questionnaire

The purpose of this portion of the survey is to determine what people who are using or thinking about using various programs are concerned about at various times during the innovation adoption process. The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various programs to many years of experience in using them. Therefore, a good part of the items on this questionnaire appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items please circle “0” on the scale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>01234567</td>
<td></td>
</tr>
<tr>
<td>0. I am concerned about students' attitudes toward computer technology in our curriculum.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>65. I now know of some other approaches that might work better.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>66. I don't even know what computer technology is.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>67. I am concerned about not having enough time to organize myself each day.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>68. I would like to help other faculty in their use of computer technology.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>69. I have a very limited knowledge about computer technology.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>70. I would like to know the effect of reorganization on my professional status.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>71. I am concerned about conflict between my interests and my responsibilities.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>72. I am concerned about revising my use of computer technology.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>73. I would like to develop working relationships with both our faculty and outside faculty using computer technology.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>74. I am concerned about how computer technology affects students.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>75. I am not concerned about computer technology.</td>
<td>0 1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>
76. I would like to know who will make the decisions in the new system.

77. I would like to discuss the possibility of using computer technology.

78. I would like to know what resources are available if we decide to adopt computer technology.

79. I am concerned about my inability to manage all that computer technology requires.

80. I would like to know how my teaching and administration is supposed to change.

81. I would like to familiarize other departments or persons with the progress of this new approach.

82. I am concerned about evaluating my impact on students.

83. I am concerned about students' attitudes toward computer technology.

84. I am completely occupied with other things.

85. I would like to modify our use of computer technology based on the experiences of our students.

86. Although I don't know about computer technology, I am concerned about things in the area.

87. I would like to excite my students about their part in this approach.

88. I am concerned about time spent working with nonacademic problems related to this innovation.

89. I would like to know what the use of computer technology will require in the immediate future.

90. I would like to coordinate my effort with others to maximize the effects of computer technology.

91. I would like to have more information on time and energy commitments required by computer technology.

92. I would like to know what other faculty are doing in this area.

93. At this time, I am not interested in learning about computer technology.

94. I would like to determine how to supplement, enhance or replace current computer technologies.
95. I would like to use feedback from students to change the program. 0 1 2 3 4 5 6 7
96. I would like to know how my role will change when I am using computer technology. 0 1 2 3 4 5 6 7
97. Coordination of tasks and people is taking too much of my time. 0 1 2 3 4 5 6 7
98. I would like to know how computer technology will make teaching better that it is now. 0 1 2 3 4 5 6 7

Section VIII: Subjective Norms Questionnaire
Read the following items, then select a response that is most true of you from the set of responses. Select the one you actually believe to be most true rather than the one you think you should choose or the one you would like to be true. This is a measure of personal judgment: there are no right or wrong answers. Try to respond to each item independently when making your choice; do not be influenced by your previous choices.

A not at all  B seldom  C not sure  D frequently  E to a large extent

99. My administrators think I should use computers in teaching. A B C D E
100. In general, how often do you do what your administrators think you should do? A B C D E
101. How often do you do what your administrators think you should do concerning your teaching? A B C D E
102. How often do you do what your administrators think you should do in using computers for teaching? A B C D E
103. My colleagues think I should use computers in teaching. A B C D E
104. In general, how often do you do what your colleagues think you should do? A B C D E
105. How often do you do what your colleagues think you should do concerning your teaching? A B C D E
106. How often do you do what your colleagues think you should do in using computers in teaching? A B C D E
107. My students think I should use computers in teaching. A B C D E
108. In general, how often do you do what your students think you should do? A B C D E
109. How often do you do what your students think you should do concerning your teaching?

A B C D E

110. Not at all    seldom    not sure    frequently    to a large extent

110. How often do you do what your students think you should do in using computers for teaching?

A B C D E

111. My profession thinks I should use computers in my teaching.

A B C D E

112. How often do you do what your profession thinks you should do concerning your teaching?

A B C D E

113. 114. How often do you do what your profession thinks you should do in using computers for teaching?

A B C D E

Any additional thoughts or comments may be added here. Use the back of this sheet if necessary. Please check through to be sure you have not missed any pages. Thank you.
April 2, 1996

Dear Faculty Member,

Technology has become the buzz word of the 90s. It is fast becoming the “Cultural Capital” of this generation, much as a college education was considered in previous generations. Higher education is responding to the advance of technology and in many cases advancing it through the building of computer networks, through student access to computers and through curriculum changes. As a faculty member in an institution of higher education, you and your students are likely to be impacted by the ongoing development of technology. As such I am extremely interested in the your opinions of technology and its impact on your teaching.

As a faculty member, your participation is voluntary, but very critical to the success of this study. Since little is known about the changes which may occur on our campuses because of technology, this survey will become baseline information. None of the information gathered will be available on any individual basis, however it will be compiled and the results will contribute to an understanding of how computer technology augments or changes the educational environment in regional colleges and universities. Other portions of the survey will be used to direct the technology training available on the campuses and to record technology concerns among faculty. Again only the compiled results will be reported.

The identification card attached to the first sheet will be detached and a number will be assigned to the card and the questionnaire. It will be used to match a follow up questionnaire to this one. The purpose is to insure the confidentiality of the information.

When finished please tear off the bottom portion of this letter and return it separately using the address label on its back. Return the survey using the return address label on the back. Both should be returned through campus mail to the VPAA’s office. If you have any questions about the study or for any reason you are unable to complete the survey, please contact me at (701) 845-7238 or corwin@badlands.nodak.edu.

Sincerely,

Terry Corwin
Director of Instructional Technology
APPENDIX B. HUMAN SUBJECTS APPROVAL

Last Name of Principal Investigator: 

Checklist for Attachments and Time Schedule

The following are attached (please check):

12. □ Letter or written statement to subjects indicating clearly:
   a) purpose of the research;
   b) the use of any identifier codes (names, etc.) how they will be used and when they will be removed (see item 17);
   c) an estimate of time needed for participation in the research and the place;
   d) if applicable, location of the research activity;
   e) how you will ensure confidentiality;
   f) in a longitudinal study, note when and how you will contact subjects later;
   g) participation is voluntary; non-participation will not affect evaluations of the subject.

13. □ Consent form (if applicable)

14. □ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. □ Data-gathering instruments

16. Anticipated dates for contact with subjects:

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17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

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APPENDIX D. FOCUS GROUP QUESTIONS

Focus Group
Valley City State University
December 18, 1996 and April 12, 1997
(8 individuals total)

Directions
These questions focus on changes in your teaching rather than the student's use of the computer. Please answer these questions with your true feelings, that is the purpose of the random sample. This group reflects a variety of divisions and years of experience. You need only answer the questions you feel you can contribute to.

1. In general has your teaching changed because of the notebooks?

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<tr>
<th>Department</th>
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<td>HPE</td>
<td>More access information orientated, Investigated mobility, Availability to find information on Laptop Great Tool - need to find ways to use it More a part of us now and don't feel as threatened by notebooks Students have access to their own computers and feel more comfortable using PowerPoint so assignments can be made more freely Instructor can expect more from the students (Typewritten, Using Listservs) Using the Web really challenges the students In the Fall it took more time because there was more learning involved In Spring it has been more fun using notebooks as a great learning tool Don't use e-mail much because of lack of access at the Field house</td>
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<td>EDUC</td>
<td>Expose Elementary School, More availability due to loaded web sites, Use E-Mail to contact students Gives more responsibility to the students Great tool for developing portfolios and web pages Develops more social skills Assignments and presentations have changed Students evaluate themselves more by video taping themselves Instructor and student are learning together while the instructor is the facilitator</td>
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<td>Use notebooks a little so far with great anticipation for more usage Use excel for comparisons on relationships and graphing capabilities Use Internet for information and resources</td>
</tr>
<tr>
<td>COMM ARTS</td>
<td>E-Mail (everyone now has an account), Use E-Mail to send assignments and journal entries and make a group and send information by class group, students have notebooks to use all of the time and not only when labs are open (Dorm use etc.)</td>
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BUSI

Great communication with students over E-Mail (makes a difference because students can access out of class)

2. Does the increase in the number of computers, phone lines and modems directly effect your teaching?

HPE

Instructors are frustrated because of lack of connections at the Field house. Doesn't work for e-mail at Field house. Too complicated to hookup to modems.

EDUC

Would use the classrooms more if we had more access to equipped classrooms. Loaded computer software on our own computers

MATH

If we had more hookups, we could do more.

COMM ARTS

Students E-Mail assignments in class then we put the students work on the big monitor which makes teaching quicker.

3. Have you noticed any differences in your classroom because of your use of the notebook?

HPE

Students accept timeline assignments because the students have more access to the information. Can share files and use them as a tool then have the students log off (example: is downloading tests). This inspires to keep the students busier during class time. We need to change our teaching style to keep the students attention. Some students read their e-mail instead of listening to their instructor. Computers have become a part of the student. Student Teachers are encouraged to use PowerPoint. Use Proxima to project on the wall. Students couldn't journalize things during class and listen at the same time. Need more computer connections - difficult to get Online at Field house.

EDUC

Students help each other, therefore there is more communication. They work together on projects. Social interaction. Students are less apprehensive about using technology, second nature. Uses Netware Broadcast Message but all classrooms are not hooked to Internet. Internet can be very distracting.

MATH

Less communication because each interaction problem solving lesson can't be seen on one computer. Students need to work individually on graphing etc. and not together as a group. Students can help each other on mechanical things like the "How To's". Students have the attitude of acceptance - they are expected to learn the software themselves and they know it is their responsibility to learn this.
Instructor competes with the notebooks. Instructor needs to find ways to get the students' attention and control their screen and what the students are doing during class time. (interrupted by Netware Broadcast Messages between students) Less stress about turning in assignments because they can be E-Mailed to the instructor.

Laptop allow the instructor to go through the material faster. Students are not at the same ability level so some loose attention. Need to disable the Netware Broadcast Message. Use Groupwise so record on computer can't turn off or delete accidentally.

4. Has electronic communication made a difference in your contact with students? Is there more or less?

Students share more information to the class through presentations. They want to show their computer skills to their other classmates. Communication is poor because of the lack of hookups at the Field house. Students can e-mail journal assignments to their instructors.

Had to change from WordPerfect to Word. Use more because expanded to Excel. Communicate more on e-mail to student teachers. Use PowerPoint almost never.

Could be great for communication especially with student teachers. However, she hasn't used e-mail like she should.

Yes, e-mail is great for communication. It can also be used for advising students. It works very well if student teachers are hooked up.

5. Do you use the computer more since getting your notebook? In what ways?

Had accessibility with Desktop computer for presentations but Notebook are more convenient.

You can do everything with notebooks. Do more work and is more efficient. Students have more pride in their work. Search out information of Web. Netware messages have slowed down.

For entertainment and education. It is a tool not a toy.

Was at three campuses last year. In my office more this year.

Yes, more for teaching and communication. Word Processing hasn't changed. Spend 70% more time on the computer because of the Web.

More convenient. It is hard to get access on home computer because of my family demands. Play with PowerPoint.

Instructor is in his office more (Unix) Use to have to spend more time in the computer lab to make sure the assignments worked.
6. What factors increase or retard your use of the computers in your teaching?

HPE
Portability with the Notebooks helps increase the usage however, it is hard to teach on the notebooks in non-networked classrooms. 50-minute class periods are not conducive to technology. Can cover more information with notebooks. Work more cooperative education but loose communication and social skills.
Lack of connections and modem hookups. It takes so much time to do everything.

MATH
Instructor's lack of ideas and knowledge of computers retards us. Room arrangements are terrible, tables are too narrow.

EDUC
Same courses at VCSU and NDSU but different expectations. Lack of access to computers at NDSU.
Class periods aren't long enough to set up and take down.

BUSI
Loose lecture time to power up and shut down. Scheduling would be beneficial to stay in same classroom with back to back classes. Jamestown classrooms are off-net and part-time students don't have notebooks therefore, there is lack of uniform access and students feel left out. Need different lesson plans for Jamestown classes.

7. Do you feel your use of the laptop is influenced by what students, peers, or administration expect?

HPE
Networked classrooms should be used for computers (valuable) Always get support from the administration.
Yes, it is influenced by these factors. It has changed from Fall to Spring Semester. More general use the first semester dealing with new hardware. Now use with content. But sometimes PowerPoint doesn't work so we need hard copies. Training was made available to all with NO PRESSURE.

EDUC
Yes, all of the above in a positive way. Students pay technology fee for the computer so they need to use them.
Pressure with surveys about computers. Model usage of computers give them benefits. Pressure from students who are utilizing computers because of the cost.

MATH
Influenced - Yes with no pressure. Students expect to use computers so the instructor needs to be ready.

COMM ARTS
Some use them in one way or another, some don't. Hard to make connections with certain courses. Need to experiment in the department to use computers and classroom information together. Administration have an influence on us – can be positive influence but is a type of pressure.

BUSI
Very little effect. Expectation is that some were all computer and some not. Instructors decision to do some lecturing and/or use the computer. Instructor would like to choose classroom depending on day of the class period – Computer day or not!
8. Has your comfort level with computer technology changed since you received your notebook?

HPE
Yes, much more accessibility to information through Internet. Instructor and student are both more comfortable using computers and showing their computer skills.

9. What are your concerns about changes which may be happening because of the notebooks?

HPE
Information into bigger bounds. How to research and access information. All of VCSU campus is not in same direction in regards to notebooks. Course syllabus can be put on the Network for students information. Not enough memory. Student-centered. Do own Web Search. More input and opportunity to give input.

MATH
Technology-based. Promotes Student learning and we are going in the direction of Student-Centered Learning. Technology is the tool helping us.

EDUC
Be innovated and stay innovated. Web Page (too many black parts – not updated) Can technology keep up with our needs and can money be available?

BUSI
Sending students out to get jobs when companies have DOS and not WINDOWS, businesses to not have computers like our university.
Focus Group
Mayville State University
January 22, 1998
(7 individuals)

These questions focus on changes in your teaching rather than the student's use of the computer. Please answer these questions with your true feelings, that is the purpose of the random sample. This group reflects a variety of divisions and years of experience. You need only answer the questions you feel you can contribute to.

1. In general has your teaching changed because of the notebooks?
2. Have you noticed any differences in your classroom because of your use of the notebook?
3. Has electronic communication made a difference in your contact with students? Is there more or less?

<table>
<thead>
<tr>
<th>Department</th>
<th>Response</th>
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</table>
| HPE        | On behalf of non-computers - no hookups for notebooks  
Doesn't make teaching change  
Use supplementary only - Use traditional teaching  
Defrays student learning. Doesn't substitute computers for teaching - use chalk/overheads  
Takes too much time to hookup  
Lost kids due to distraction and increase in cost  
Uses Technology as a tool  
Don't require students to bring computers to class  
Changes communication - teacher with students more than students with teacher  
Computers change demands on students  
E-Mail for better communication  
Expect better work from students. Tools of the future will give students a big boost |
| EDUC       | Don't use the computer every day. Students bring it once a month to class  
Traditional teaching.  
E-Mail is great for assignments and communications  
Feel more professional  
Need to adjust to system being down or other problems. |
| MATH/EDUC  | Elementary doesn't add a lot by computer  
Use PowerPoint Presentations  
Require E-Mail for communication with students  
Require Reflective Journalizing and computer makes it better.  
In Ed Tech - don't know if students learn more but does enhance communication  
Students will be better equipped when they leave school.  
Makes student life easier – can work at home - print later at school  
Makes student life easier – can work at home - print later at school. |
SOCIAL SCI.

Similarity – computers
Electronic classrooms and everything on Web makes material more accessibility.
More multicultural - Better Communication
At first no one knew what they were doing with E-Mail.
Loose time with computers - need to adjust to interruption and time it takes to hookup.
New to CD ROMs

COMM ARTS

Teacher receives more feedback immediately
Teacher is more accessible to students
Loose class time.
Use PowerPoint Presentation in Speech.
Students do more of the learning.
Students become more actively involved in class.
Great tool.
Loss of Control
Feel like at hands of technology
Feel more comfortable with computer now and how to use technology and implement it.
Advantage is more visual stimulus, more hands on experience, more peer teaching and learning, more openness to help each other, and more preparation at home.
Free to explore new ideas. Fine Tune and always exploring
Use tech to evaluate teachers use of technology.
More electronic and Less paper.
Student become lazy in getting information because of so much on the WEB

MATH:

Use on outside assignments.
Computer software changes the nature of the assignments.
Concentrate on concepts. Software takes care of skills.

6. What factors increase or retard your use of the computers in your teaching?

HPE
Trained by non teachers.
More effective and motivated if taught by a teacher instead of a non teacher.
Where is my mouse and where did he go?
Training is only 3% effective.
Can’t use technology.
Lack of training and lack of knowledge about computers.

EDUC/MATH
Most people were at the bottom level of the training.
Only showed one time. Limited practice - not applied.
Poor training with no equipment in Place.

COMM ARTS

Need to start at ground floor.
Immediate application.
Require training when we need it.
Need mastery of computer skills – hands on experience
Training was poor.
SOCIAL SCI.

Need to figure things on your own.
Too many different training levels at the trainings.
Have to do your own thing

7. Do you feel your use of the laptop is influenced by what students, peers, or administration expect?

8. Has your comfort level with computer technology changed since you received your notebook.

HPE

Some know - some don’t (top end - middle - bottom)
Feeling comfortable using computers.
Good individual help from Peers

EDUC/MATH

Poor timing on trainings. During finals week sent secretaries to do Web Page training.
Instructor style improve teaching

COMM ARTS

Need step by step training on Web Pages
No Time to spend on Web Pages

SOCIAL SCI.

People made choices on what was important to them
Faculty can help other faculty learn

9. What are your concerns about changes which may be happening because of the notebooks?

HPE

You need to see something unique in order to use it.
Need to hit you at the right time, see something useful and use it in technology.
See a need before we use it. Needs to be easy

EDUC/MATH

Better Structure
Scheduling is hard for training – Need to get all faculty involved.
Need to find out what I need to know.
What is happening on our campus.

COMM ARTS

Should be continued training.
Training in topics that the instructor wants
Loss of Control
APPENDIX E. INTERPRETATION OF THE STAGE OF CONCERNS (SoCQ) QUESTIONNAIRE

Charts of Faculty Concerns

Concerns in First Questionnaire
Concerns in Second Questionnaire
Concerns of All Campuses Both Questionnaires
## Results of Phase Two Regression by University

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1 Computer anxiety index.
2 Level of computer use.
3 Number of different types of different technology reportedly used by faculty.
4 Number of different types of technology uses required of students by faculty.
5 Frequency of software use for 12 types of computer software.
6 Percentage of lecture method used in the classroom by faculty.
7 Percentage of discussion and group work methods used in the classroom by faculty.
## Results of Phase Two Regression by University

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<th>% of discussion and group methods used</th>
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¹ Computer anxiety index.
² Level of computer use.
³ Number of different types of different technology reportedly used by faculty.
⁴ Number of different types of technology uses required of students by faculty.
⁵ Frequency of software use for 12 types of computer software.
⁶ Percentage of lecture method used in the classroom by faculty.
⁷ Percentage of discussion and group work methods used in the classroom by faculty.
REFERENCES


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