FACULTY PERCEPTIONS OF TECHNOLOGY INTEGRATION IN THE TEACHER EDUCATION CURRICULUM: A SURVEY OF TWO GHANAIAN UNIVERSITIES

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by

ISSIFU YIDANA

has been approved for

the Department of Educational Studies

and the College of Education by

Sandra V. Turner

Professor of Educational Studies

Renée A. Middleton

Dean, College of Education

Abstract

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FACULTY PERCEPTIONS OF TECHNOLOGY INTEGRATION IN THE TEACHER EDUCATION CURRICULUM: A SURVEY OF TWO GHANAIAN UNIVERSITIES (246 pp.)

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This study was designed to investigate the relationship of teacher education faculty members' attitudes and their perceptions of technology professional development needs with faculty technology use for teaching and learning in two Ghanaian tertiary teacher education institutions. The study was based on Rogers' (1995) Diffusion of Innovations (DoI) theory, the Concerns Based Adoption Model (CBAM) of Hall and Hord (1987), and Ely's (1999) conditions for educational technology innovations as theoretical frameworks.

The study used survey methodology supplemented by interviews. The quantitative data were analyzed using multiple regression. Participants in the study were 132 faculty members of the University of Education, Winneba and the Faculty of Education of the University of Cape Coast, both Ghanaian teacher education institutions. The faculty technology survey consisted of 65 items factored into five factors.

The results showed that: (i) faculty perceptions of the effects of technology use on pedagogy and students' learning, (ii) faculty perceptions of barriers and challenges to the adoption and use of technology for teaching and learning, and (iii) faculty motivation for adoption of instructional technology made unique significant contributions to explaining faculty use of technology for teaching and learning.

According to the interviews and responses to an open-ended question on the survey, this study also found that the contextual conditions that facilitate educational technology innovations were not met in the two participating universities. The majority (55.7%) of participants were at the non-adopter stages of technology adoption, based on the CBAM stages of adoption survey.

The study offered faculty members an opportunity to voice their concerns and views concerning their institutions' technology integration programs. The findings could inform university management about technology decisions to promote the use of instructional technology among faculty members.

A major limitation of this study was the use of non-randomized sample which limits the generalization of the findings to these particular Ghanaian institutions at a particular point in time.

Approved: ____

Sandra V. Turner

Professor of Educational Studies

Dedication

To all my Teachers and to the Blessed Memory of my Parents, Naa Paanga Yidana Dahamani and Aisha Iddris

Acknowledgement

In the name of Allah, most Beneficent, most Graceful, most Merciful, I wish to acknowledge His Grace and Guidance, without which my journey this far in my academic dreams would have been fruitless.

A countless number of personalities have influenced my academic life in various positive ways. While I may not be able to mention all of these great mentors, I wish first of all to express my profound gratitude to Professor Jophus Anamuah-Mensah (Vice Chancellor of the University of Education, Winneba) and Professor Sandra V. Turner (my academic advisor at Ohio University) for their wonderful mentorship and support in getting me into the PhD program and continuously encouraging me to work harder.

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CHAPTER 1

Introduction

Background of the Study

Ghana's national development strategy (Government of Ghana, 1995) emphasizes the use of information and communications technology (ICT) to accelerate the socio-economic development of the country. In furtherance of this national goal, a national commission on ICT was set up in 2002 to develop a national ICT policy. The development of this policy was based on an extensive nation-wide consultation with stakeholders from the public and private sectors, the academic community, as well as civil society, including members of various political parties and groupings.

The report of this commission is what is now known as the Ghana ICT for Accelerated Development Policy (ICT4AD) (Republic of Ghana, 2003). The ICT4AD policy represents the vision of Ghana in the information era. It takes into consideration the targeted goals of key socio-economic development framework documents such as the Vision 2020. The ICT4AD policy statement therefore sets out the road map for the development of Ghana's information society and economy. It provides a basis for facilitating the socio-economic development of the country in the emerging information, knowledge and technological age. Promoting ICTs in education by deploying and exploiting the potential of ICTs in education is one of the 14 identified pillars of the ICT4AD policy.

The education sector is expected to modernize the curricula at all levels to cater for the integration and introduction of computer-technology studies and the use of technology in teaching and learning. However, the pre-tertiary teachers' computer-based technology literacy levels are generally believed to be very low or nonexistent, and most faculty members in all public universities do not use computer-based technologies in their classrooms. The Faculty of Education of the University of Cape Coast (UCC) and the University of Education, Winneba (UEW), as tertiary teacher education institutions, have accepted the challenge to produce technologically literate graduate teachers to meet the national educational goals. The UEW in particular has designed an elaborate Information and Communication Technology plan, spanning over five years (2003-2008) to meet this challenge. The UCC has a similar ICT plan (2002 – 2007). Both universities have made huge investment in technology facilities and infrastructure in the past four years to enrich their teaching and learning environments.

Technology in Education in Ghana

Technology use for teaching and learning is gaining acceptance in education globally; however, a formal integration of ICT in education in Ghana is still on the drawing boards. The national framework on which the deployment of ICTs in the education sector is based is contained in the Information Communications Technology for Accelerated Development document (Republic of Ghana, 2003). According to this document, a recent survey showed that the level of computer literacy and awareness in the country is very low and this has been identified as one of the key factors limiting the development of the ICT industry and the education sector.

The national policy acknowledges the need for ICT training and education in the schools, colleges and universities, and the need to improve the educational system as a whole. As part of the ICT4AD mission, therefore, Ghana seeks to transform the educational system to provide the requisite educational services and environment capable of producing the right types of skills and human resources required for developing and driving Ghana's information and knowledge-based economy and society. The Government is therefore committed to a comprehensive programme of rapid deployment, utilization and exploitation of ICTs within the educational system from primary school upwards (Republic of Ghana, 2003).

The broad national strategy for the use of ICTs to improve the educational system is spelled out in the ICT4AD document as follows:

> To modernize Ghana's educational system using ICTs to improve and expand access to education, training and research resources and facilities, as well as to improve the quality of education and training, and make the educational system responsive to the needs and requirements of the economy and society with specific reference to the development of the information and knowledge-based economy and society (p.15).

The national objectives for deploying ICTs in the education sector as suggested by the ICT4AD include the (i) facilitation of the deployment of ICT in education, (ii) utilization and exploitation of ICTs within the educational system to improve on educational access and delivery and to support teaching and learning from primary school upwards, (iii) modernization of the educational system to improve the quality of education and training at all levels of the educational system and expanding access to education, (iv) training and research resources and facilities, (v) orientation of all levels of the country's educational system to the teaching and learning of science and technology in order to accelerate the acculturation of science and technology in society and produce a critical mass of requisite human resources and a well informed citizenry, and (vi) achievement of universal basic education and improvement of the level of basic and computer literacy in the country.

In order to achieve these objectives the ICT4AD policy adopted the following strategies:

- modernize Ghana's educational system using ICTs to improve and expand access to education, training, and research resources and facilities,
- improve the quality of education and training and make the educational system responsive to the needs and requirements of the economy and society with specific reference to the development of the information and knowledge-based economy and society,
- transform Ghana into an information and knowledge-driven ICT literate nation, introduce computers into all primary, secondary, vocational and technical schools,
- promote electronic distance education and training and virtual learning systems to complement and supplement face-to-face campus based education and training, systems, mainstream ICTs throughout the entire educational system to promote life-long learning,
- transform the educational system to ensure that there is uninterrupted quality education for all Ghanaians from pre-school to age 17 to reduce poverty and create the opportunity for human development, promote ICT awareness and computer

literacy within the public at large, develop and restructure the relevant ICT curricula for all levels of the educational system,

- encourage collaboration between local and international educational institutions to facilitate educational exchange and the promotion of ICT education and training,
- put in place special schemes to enable students, teachers and educational institutions to purchase computers through attractive financial packages,
- develop an educational intranet to provide educational materials and tools at all levels of the educational system, leverage the use of electronic distance learning networks to enhance the delivery of ICT education and training,
- develop re-training and re-skilling ICT programmes for the management staff of Ministry of Education and educational institutions at all levels, and
- develop educational management and information systems to improve the quality of management of educational institutions, promote Internet access to all educational institutions including the schools, and universities and colleges.

Others strategies recommended to achieve the objectives of ICT in education include:

- promote e-learning in the schools and universities,
- facilitate collaboration between the Ministry of Education and various accreditation agencies and examination bodies for ICT education and training, and
- ensure that all universities and colleges take steps to progressively offer their programmes and courses online to broaden access to higher education to a large

section of the population and to maximize the quality and efficiency of learning processes, systems and activities (Republic of Ghana, 2003, pp. 33-35).

The policy as described above is the roadmap for Ghana's ICT utilization in the education sector. It is an ambitious plan requiring technology expertise, infrastructure, and commitment on the part of politicians and educational administrators to implement it to the letter. The policy identified the Ministry of Education, Science and Sports, the universities, polytechnics, colleges and research institutions, and local and foreign educational and training provision organizations as the key implementation agencies, players and stakeholders. Therefore, the universities in Ghana have a leading role to play in the realization of the dreams specified in the national ICT policy, particularly in training and education of an ICT literate workforce for the information-dependent economic environment that the information revolution has ushered us into. In particular, the University of Education, Winneba and the Faculty of Education of University of Cape Coast are charged with the responsibility of producing graduate teachers who will teach in and administer the pre-tertiary institutions of Ghana's educational system. What the policy specified are national intentions that are yet to be implemented. It is therefore correct to say that ICTs are not yet an integral part of Ghana's education system, at least not in the formal realm where they are expected to be used for teaching and learning.

Technology in Higher Education

The deployment of ICT in higher education is still in an incubation/gestation period in Ghana. Technology integration into instruction and across the curriculum is not yet gained widespread acceptability and practice in Ghana. However, almost all the public universities and polytechnics have made heavy investment into Information and Communication Technology (ICT) infrastructural development and facilities in line with the ICT4AD policy over the past three years with the view to enriching the teaching and learning environment.

Universities now see the integration of technology into the curriculum and instruction as an effective response to the demands of the information revolution staring at us in every sphere of our lives. Research (Bauer & Kenton, 2005; Collier, Rivera, & Weinburgh, 2004; Whale, 2006) indicates that when integrated with emerging models of teaching and learning, technology can transform education. To integrate technology effectively, Palak (2004) and Protheroe (2005) advise that educators should note that (i) teachers, not technology, are the key to unlocking student potential, (ii) curriculum design is critical for successful integration, (iii) the nature of the technology design largely determines the impact of integration efforts on student achievement, and (iv) ongoing formative evaluations are necessary for continued improvements in technology integration.

Technology and Teacher Education in Ghana

The educational system in Ghana is currently based on the 6-3-3-4 model, consisting of 6 years of primary education, 3 years of junior high school, 3 years of senior high school, and 4 years of university education. In the first 9 years of schooling, teachers teach whole classes across the school curriculum. The basic qualification of teachers at these levels is the 4-year teacher education certificate obtained from 38 pre-tertiary teacher training colleges spread over the country's ten geographic regions. Subject teaching starts at the senior high school and pre-tertiary teacher training college levels. Teachers at these levels are graduates produced from the University of Education, Winneba and University of Cape Coast, which are the only two tertiary teacher education institutions in Ghana. Therefore, Ghana has two levels of teacher education: 38 four-year pre-tertiary teacher training colleges and two tertiary teacher education institutions.

The introduction of ICTs into the two universities started in 2002 (UCC) and 2003 (UEW). In both cases, the initial emphasis was on improving the administrative and communication systems. With the increasing availability of ICT facilities and equipment on both campuses, however, the emphasis is now focused on faculty and student use of the available technology tools for teaching and learning.

This study seeks to investigate teacher education faculty attitudes towards technology integration into teaching and learning and faculty perceptions of their technology professional development needs that relate to their use of available instructional technology. It is my expectation that the study will highlight some of the achievements and bottlenecks in the deployment of ICTs in the teacher education curricula of the two institutions.

Institutional Strategic Plan and Technology Integration

Integrating ICT in their curricula for the campus-based education system as well as their distance education programs has been given prominence in the strategic development plans of UEW (2003-2008) and UCC (2002-2007).

Both UEW and UCC's strategic plans have the intent to make internal adjustments to use learning technologies and telecommunication to enrich their teaching and learning environments. According to UEW's ICT plan, in particular, the far reaching implications that ICT has on higher education are in the following three areas:

- the transformation of the management and administration of higher education institutions;
- the ways in which computers can be used to assist and improve teaching and learning either in the classroom or in the self-directed learning environment with the view to making the delivery of education efficient and cost-effective;
- the ways in which the availability of computers should change the content of what we teach, and transform the degree to which, and the way in which higher education institutions interact with external organizations and collaborators.

The success of any academic innovation lies on the shoulders of faculty members, since they form the bridge between students on one side and curriculum and learning environment on the other (Guskey, 1986; Palak, 2004). Therefore, faculty beliefs, values and perceptions of technology integration into the curriculum and instruction are factors that could associate with their technology use in instruction.

Purpose of the Study

The purpose of this study is to investigate attitude traits that are dominant among faculty members towards technology integration in teaching and learning, the perceptions of faculty of their technology professional developments needs towards the adoption and use of technology innovations in the two institutions, and how these factors relate to faculty technology use in instruction. The goal is to investigate faculty attitudes and expressed needs and concerns that relate to faculty use of instructional technology.

Research indicates that the three important factors that relate to technology integration across the curriculum are (i) technology-oriented curriculum (Graham, Culatta, & Pratt, 2004; Johnson & Howell, 2005; Rogers, 2000; Topper, 2004), (ii) faculty attitudes, perceptions and values attached to the integration program (Kotrlik & Redmann, 2004; Palak, 2005; Tallman & Fitzgerald, 2005), and (iii) on-going faculty technology professional development needs (Graves & Kelly, 2002; Kidney, 2004; Kotrlik & Redmann, 2004).

Faculty attitudes towards technology integration in teacher education, faculty perceptions of technology professional development issues, faculty use of instructional technology may be inter-related, but the literature does not show clearly how these factors interact. The advantages of computer and web-based teaching and learning, and the use of technology in classroom activities are well-documented (Hernandez-Ramos, 2005; Kelly, 2005; Teng & Allen, 2005), but the impact of technology integration on instructional strategies and learning, and the inherent barriers/challenges associated with this paradigm shift, in the Ghanaian context, need to be addressed and investigated further.

Statement of the Problem

This survey seeks to investigate the dominant faculty attitudes towards technology integration into the teacher education curricula, and faculty perceptions of technology professional development needs, and how these factors relate to faculty use of technology for teaching and learning in the Faculty of Education of the University of Cape Coast (UCC) and the University of Education, Winneba (UEW).

The factors to investigate in this study, based on recent literature (Graham, Culatta, & Pratt, 2004; Graves & Kelly, 2002; Hall & Hord, 1987; Kotrlik & Redmann, 2004; Johnson & Howell, 2005; Kidney, 2004; Palak, 2005; Rogers, 2000; Tallman & Fitzgerald, 2005; Topper, 2004), include

(i) faculty attitudes towards technology integration in teacher education curriculum,

(ii) faculty motivation for adoption of instructional technology,

(iii) faculty perceptions of the effects of faculty instructional technology use on students and pedagogy,

(iv) faculty perceptions of barriers and challenges to adoption of instructional technology,

(v) faculty perceptions of technology professional development needs, and

(vi) faculty use of instructional technology.

Factors (i) to (v) are the independent factors used for the multiple regression analysis and Factor (vi) is the dependent factor.

Based on Rogers' (1995) theory of diffusion of innovations and the Concerns Based Adoption Model of Hall and Hord (1987), this study will also assess the technology adoption levels of faculty and faculty members' concerns with the technology innovation at the two institutions.

Theoretical Framework

Rogers' (1995) Theory of Diffusion of Innovations (DoI) and Hall and Hord's (1987) Concerns Based Adoption Model (CBAM) provided a theoretical framework for the study. Both DoI and CBAM are well tested models for a wide variety of innovations, including the integration of technology in education and change processes.

Diffusion of Innovations

Rogers (1995) defines an *innovation* as “an idea, practice or object that is perceived as new by the individual” (p. 12), and *diffusion* as “the process by which an innovation makes its way through a social system” (p. 5). An innovation is therefore seen as a new content (tangible or intangible) that has to be shared among operators within a social system, and which may be considered as a new thing by the potential adopters. The content could be a new product, a new method of solving a problem, or a new system altogether replacing an old system as in change processes.

The innovation content is based on a purpose, which normally is geared towards improving productivity or performance of a social system. Consequently, the assumption is that the innovation will prove better for the system than what is currently in place. The newness perceived by the potential adopters is worth noting here, because it is basically this perception that provokes the resistance to adoption. “Newness” of an innovation, according to Rogers (1995), may be expressed in terms of knowledge, persuasion, or a decision to adopt. The characteristics of innovations, as perceived by individuals, tend to influence their rate of adoption and are associated with the persuasion stage of the innovation-decision process. According to Rogers, diffusion is regarded as a dynamic (time dependent) process involving channels of communication within a social system.

The Concerns-Based Adoption Model

The introduction of ICTs in teaching and learning at UCC and UEW constitutes a major educational change in these institutions. This change requires faculty to rethink instructional strategies and methodologies, and adopt the new technology tools in their professional work. Thus the Concerns Based Adoption Model is the appropriate framework to assess the concerns of faculty in their adoption of the technology innovation.

The concerns theory assumes that change is a process that follows a three-level developmental sequence regarding the concerns that teachers have when an innovation is adopted (Hall & Hord, 1987). These three levels were factored from seven stages of concerned as explained below.

Hall, Wallace and Dossett (1973) developed the Concerns-Based Adoption Model (CBAM), which emphasized the teacher and the innovation as the main elements. One of the tools of the CBAM is the Stages of Concern (SoC), which indicate when teachers get involved in the implementation of an innovation in a spectrum of seven stages. Hall and Hord (1987) grouped these seven stages of concern into three levels of adoption concerns (self concerns, task concerns and impact concerns) as shown in Table 1. Adopters and non-adopters in the first three stages of awareness, information, and personal concerns belong to Level 1 technology user category. They are the group Rogers (1995) described as non-adopters or late adopters. Level 2 technology users are usually at Stage 3 (management of task concerns) of the adoption cycle. They are the early or late majority adopters and are classified as moderate technology users. Level 3 technology users are high technology users and they are at Stages 4, 5 and 6. They are concerned with impact issues. They are the innovators or early adopters.

Table 1

Relationship between CBAM and DOI

Level	Stage	Relationship with DOI
Level 1 (Self concerns)	Stage 0 (Awareness) Stage 1(Informational), and Stage 2 (Personal).	Low technology users; could be non-adopters or late adopters or laggards
Level 2 (Task concerns)	Stage 3 (Management)	Moderate technology users; could be late majority adopters
Level 3 (Impact concerns)	Stage 4 (Consequence), Stage 5 (Collaboration), and Stage 6 (Refocusing)	High technology users; innovators, early majority adopters

Rogers' (1995) DoI theory was used to analyze the communication channels for technology adoption by participants of this study and in the discussions of my major findings. Hall and Hord's (1987) model was used to investigate faculty technology user levels based on their concerns, while Hall, Wallace and Dossett's (1973) seven-stage model was used to analyze faculty's stages of technology adoption. This study focused on teacher education faculty technology innovativeness and factors that are at play when faculty members begin using new technology for teaching and learning.

Research Questions

Using regression analysis and descriptive statistics, this study seeks to answer the following research questions:

1. To what extent are the following factors:

Factor 1: faculty attitudes towards technology integration in the curriculum,

Factor 2: faculty motivation for adoption of instructional technology,

Factor 3: faculty perceptions of the effects of instructional technology on students and pedagogy,

Factor 4: faculty perceptions of barriers and challenges to adoption of instructional technology, and

Factor 5: faculty perceptions of technology professional development needs

related, individually and in linear combination, to faculty use of technology for teaching and learning (Use)?

2. What are the stages of technology adoption of faculty members about the use of instructional technology, according to the CBAM stages of concerns?

Significance of the Study

The study will offer faculty members an opportunity to voice their concerns and views concerning their institutions' technology integration programs and the implementation of these programs.

Participants may benefit personally by reflecting on their use of instructional technology, and by considering options they may not have previously considered.

The findings could inform university management on the necessary steps that should be taken to promote the use of instructional technology among faculty members.

The findings of this study could also serve as a base-line for future studies on technology integration in Ghanaian universities and teacher education institutions.

Since the study involves faculty members who teach across the curriculum, its findings will benefit a diverse section of teacher educators.

Delimitations and Limitations of the Study

Since the study concerns teacher educators and curriculum, it will cover the only two tertiary teacher education institutions in Ghana. The research participants will be faculty members across the disciplines at UEW and the Faculty of Education of UCC.

Time and cost constraints preclude the extension of this study to the pre-tertiary teacher training colleges. A broader survey would clarify the status of ICT usage in Ghanaian teacher education institutions at both the tertiary and pre-tertiary levels. The results of the study will therefore be strictly applicable to teacher education faculty in these two tertiary institutions.

Change and diffusion of an innovation occur over a period of time. This study looks at faculty adoption and use of technology at a particular point in time time. Therefore, the ongoing process of adoption decision making by faculty will not be covered in the study. Instead, it focuses on attitudes and conditions that are related to faculty use of technology in teaching and learning.

Another major limitation of the study is the consequence of using a non-randomized sample. The population of study was too small for random sampling in view of my focus on only teacher education faculty members at the two sites. Therefore the entire population was taken as a time-sample with the consequence that conclusions based on this sample will be at best tenuous and only applicable to this particular population.

Also, the pilot study used participants outside of my target population. This may have adversely affected the conclusion arrived at in fine-tuning my survey based on the pilot test. Thus, the reliability of my measures could be affected.

Since my major source of data was the self-reported responses of participants, issues of participant bias could affect the quality of my data, too.

Definitions of Terms

Technology refers to computer-based tools such as computers, multimedia and the Internet used for teaching and learning purposes.

Faculty attitudes encompass faculty feelings or perceptions about technology integration in curriculum, faculty motivation for adoption of instructional technology, faculty perceived barriers and challenges to adoption of instructional technology, and faculty perceived effects/benefits of instructional technology on students and pedagogy.

Technology user level is the extent of expertise or competency that a user possesses in his/her interaction with computer-based technology for teaching and learning (Christenson, 1997). In this study, a *low* level user is one who has limited/no experience with computer technologies, has attempted to use computer technologies, still requires help on a regular basis, and is able to perform basic functions in a limited number of computer applications; a *moderate level* user is one who demonstrates a general competency in a number of computer applications for instruction; the *high* level user is one who has acquired the ability to competently use a broad spectrum of computer technologies, and is proficient in using a wide variety of computer technologies for instruction. These levels were consistent with Hall and Hord's (1987) CBAM categorization of faculty levels of concerns in their instructional technology adoption.

Technology integration is defined as the use of computer technology to create or reorganize the learning environment (Mills & Tincher, 2003). Technology infusion, on the other hand, involves technology-based tools such as course management systems (e.g. Blackboard, Moodle, WebCT, etc), spreadsheets, multimedia, and telecommunications used to augment particular instructional events. In the context of this study, however, *technology integration* refers to the blending of computer-based tools with learning and instructional activities that provides a richer teaching and learning environment.

Faculty perception of technology professional development needs refers to faculty perceived technology needs and conditions needed for their technology integration, and their preferred methods of achieving those needs. According to Graves and Kelly (2002), technology professional development focuses on issues that facilitate pedagogical and curricular reform.

Faculty technology use refers to faculty use of computer-based technology for teaching and learning. This includes the use of mainstream application software (e. g., word processing, spreadsheet, and presentation software), curriculum/subject-based software, the web, and multimedia tools.

Information and communication technology refers to the combination of computer-based technologies and telecommunication technology for the purpose of gathering data or information, processing data, sharing and disseminating information from one place to another. For example wireless and satellite communications blend with computer-based networks for data and information transfer over long distances.

In the context of this study, ICT and Information Technology (IT) were used interchangeably.

The Organizational Plan of the Study

The study was organized into five chapters. In Chapter 1, the study background and problem definition as well as its rationale and research questions were presented. The relevant literature review was presented in Chapter 2. The literature review was based on the sub-constructs of the study. I described the research design and methodology in Chapter 3. Data presentation and analysis were done in Chapter 4. Chapter 5 consisted of a summary of findings, discussions, recommendations and suggestions for further investigation into the problem, based on the findings of this study.

CHAPTER 2

Literature Review

This chapter reviews the factors that relate to faculty technology use for teaching and learning from the literature. The literature review focuses on the theoretical framework of the study, faculty attitudes towards technology integration into the teacher education curriculum, faculty perceptions of technology professional development needs, and faculty use of instructional technology.

Theoretical Framework

There are several theoretical frameworks that relevant to faculty technology use for teaching and learning. Although Rogers' (1995) diffusion of innovation model has been meaningfully applied to many kinds of innovations, there are others that are particularly relevant to understanding the change process in educational settings. Two of these models that I used in conjunction with Rogers' Diffusion of Innovation model are the Concerns-Based Adoption Model (CBAM) of Hall and Hord (1987), and Ely's (1999) Conditions that facilitate educational technology innovations.

Rogers' Theory of Diffusion of Innovations

The primary intent of the theory of innovation diffusion is to illustrate how any technological innovation moves from invention to widespread use, or non-use (Dillon & Morris, 1996, as cited in Stefl-Mabry, 1999). The theory's purpose is to provide individuals from any discipline interested in the diffusion of an innovation with a conceptual paradigm or framework for understanding the process of diffusion and social change. Surry (1997) observed that the innovation decision process, individual innovativeness, rate of adoption, and perceived attributes discussed by Rogers (1995) are among the most widely-used theories of diffusion. Rogers' theory and many others based on his works help us to understand the process of adopting technologies. The key questions researchers have asked and sought to answer include (i) Why are some technologies adopted and some not? (ii) Why do some faculty members or schools readily embrace new tools, while others are very slow to change? (iii) What factors are at play as people and organizations begin using new technologies (Wilson, Sherry, Dobrovolny, Batty, & Ryder, 2001)?

Wilson et al. (2001) pointed out that adoption can also be seen as a process of information diffusion, culminating in a rational choice to use (or not use) the new technology. This perspective relies principally upon a view of learning as information acquisition (Mayer, 1996). A prospective user engages in a process of inquiry concerning the technology (Hall & Hord, 1987; Rogers, 1995; Wilson et al.). After learning more about the pros and cons, the user (or group of users) commits to a testing, followed by a full-scale adoption and implementation of the technology.

Technology adoption may also be seen as the assimilation of new cultural tools and practices (Rogers, 1995). This view is consistent with theories that stress learners' participation within communities of practice (Lave & Wenger, 1991, as cited in Wilson et al., 2001). The focus is on socially constructed meanings and the sharing of those meanings through participation in purposive activities. The technology itself, in addition to its physical form and function, is also a social construction whose meaning is shared among community members. How the technology fits into existing social purposes and practices will largely determine its prospects for its appropriation and use by the community (Wilson, et al.).

When new ideas are invented, diffused, and are adopted or rejected, leading to various consequences, social change occurs (Rogers, 1995). According to Rogers, this social change can be planned or spontaneous, intended or unintended; for example, a physics department invents a new network interface and protocol for exchanging leading edge information among physicists (planned change) versus the spontaneous and exponential demand for access to the Internet with the advent of the World Wide Web (spontaneous change).

The Innovation Decision Process

The Innovation Decision Process (IDP) states that diffusion is a process that occurs over time and can be seen as having five distinct stages (Rogers, 1995). The stages in the process are knowledge, persuasion, decision, implementation, and confirmation. The IDP is thus a framework for analyzing the adoption and diffusion of an innovation (Rogers, 1995). The innovation-decision process is essentially an information-seeking and information processing activity in which the individual is motivated to reduce uncertainty about the relative advantages and disadvantages of an innovation (Rogers, 1995).

Knowledge occurs when an individual is exposed to an innovation’s existence and gains some understanding of how it functions. Types of knowledge range from awareness about the innovation, how to use an innovation properly, and principles-knowledge dealing with the functioning principles underlying how the innovation works.

Predispositions such as selective exposure and selective perception may influence an individual's behavior toward communication messages about an innovation and the effects that such messages are likely to have. Hassinger (1959), cited in Rogers (1995), argues that even if individuals are exposed to innovation messages, such exposure will have little effect unless the innovation is perceived as relevant to the individual's needs and consistent with the individual's attitudes and beliefs.

Persuasion occurs when an individual forms a favorable or unfavorable attitude toward or opinion of the innovation based upon perceived characteristics of the innovation, such as relative advantage, complexity, and so on. Persuasion is also influenced by information sought from near-peers whose subjective opinion of the innovation is most convincing (Rogers, 1995). When someone who is like us shares a positive evaluation of the innovation, we are more motivated to adopt it. Social networks therefore provide an effective avenue for diffusion of innovations.

Decision occurs when an individual engages in activities that lead to a choice to adopt or reject the innovation.

Adoption is a decision to make use of an innovation as the best course of action available. Active rejection means considering and trying the innovation out on a limited basis, and deciding not to adopt. Passive rejection, also called non-adoption, consists of never really considering the use of the innovation.

Implementation occurs when an individual puts the innovation into use. Until this stage, the process has been a mental exercise. Implementation involves an overt behavior change as the new idea is actually put into practice. This stage may continue for a lengthy period of time until the innovation finally loses its distinctive and noticeable quality as a new idea. Re-invention, the degree to which an innovation is changed or modified by the user, can also occur in this stage.

Confirmation occurs when an individual seeks reinforcement of an innovation-decision already made, or reverses a previous decision to adopt or reject the innovation if exposed to conflicting messages about the innovation. Each stage in the innovation-decision process is a potential rejection point. One can gain awareness of an innovation in the knowledge stage, and then simply forget about it. Rejection can occur even after a prior decision to adopt, which is called discontinuance.

The underlying point about the innovation decision process is that the decision is made through a cost-benefit analysis with uncertainty playing bad referee between the adopter and the innovation. People will not hesitate to adopt an innovation if its overall effect will enhance their utility and productivity. That is the relative advantage issue, as Rogers (1995) explains below.

The Attributes of an Innovation that Influence its Rate of Adoption

Rogers (1995) gives five characteristics or attributes of innovations. These are relative advantage, compatibility, complexity, trialability, and observability. He defined these characteristics as follows:

Relative advantage describes the degree to which an innovation is perceived as better than that which it supersedes. Potential adopters must be convinced that the innovation will serve their needs better than what is currently in place. The more they are convinced of this potential in the innovation, the greater their dispositions to accept it or even adopt it.

Compatibility is the degree to which an innovation is consistent with the existing values, past experience, and needs of the potential adopter. Familiarity with the innovation, based on what potential adopters are used to, enhances their acceptance and consequent adoption of the innovation. The innovator must convince them about the relevance and purpose of the change or innovation.

Complexity is the degree to which an innovation is perceived as difficult to understand and use. Our natural inclinations as humans are always to avoid pain or difficulties, whether psychological or physical. We tend to embrace changes that bring us comfort and make our work or solution process easier. Therefore, the rate of adoption is higher when potential adopters perceive the innovation to be easy to work with or use. This condition is typically associated with industrial machinery or software use. The more user-friendly the innovation content is, the greater its acceptance and possible adoption.

Trialability is whether an innovation may be experimented with on a limited basis. Potential adopters need the opportunity to test the innovation before using it or discontinuing using it.

Observability is the degree to which the results of an innovation are visible to others. Potential adopters tend to embrace an innovation when the effects of implementing the innovation are meaningful and measurable.

Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations (Rogers, 1995).

Other researchers have suggested a similar set of conditions. For example, Table 2, which I adopted from Wilson, Sherry, Dobrovolny, Batty, and Ryder (2001)**,** describes Ely's eight conditions that facilitate the implementation of educational technology innovations (Ely, 1999). These conditions provide useful guidance to those responsible for technology adoption within an educational setting.

The table shows each condition along with a short description and related conditions. For example on availability of time, Ely explained that implementers need time to acquire knowledge and skills, plan for use, adapt, integrate and reflect on what they are doing. He explained further that organizational leadership's role in providing time or paying for time used, and the willingness of individuals to contribute some of their own personal time to the process link the time condition to participation, commitment, leadership and rewards and incentives. This study employed supplementary interviews based on these conditions.

Table 2

Ely's (1999) Conditions that Facilitate Educational Technology Innovations

Condition	*Description*	*linked condition*
Dissatisfaction with the status quo	Feeling a need to change.	Leadership
Existence of Knowledge and skills	Access to the knowledge and skills required by the user.	Resources, rewards and incentives, leadership, and commitment
Availability of Resources	Things needed to make innovation work (e.g. funding, hardware, software, technology support, infrastructure)	Commitment, leadership, and rewards and incentives
Availability of Time	Prioritized allocation of time to make the innovation work.	Participation, commitment, leadership, and rewards and incentives
Rewards or incentives exist	Internal and external motivators preceding and following adoption.	Participation, resources, time, and dissatisfaction with status quo
Participation	Shared decision-making; full communication; good representation of interests.	Time, expertise, rewards and incentives

Table 2: continued

Condition	*Description*	*linked condition*
Commitment	Firm and visible evidence of continuing endorsement and support.	Leadership, time, resources, and rewards and incentives
Leadership	Competent and supportive leaders of project and larger organization	Participation, commitment, time, resources, and rewards and incentives

Communication Channels

Rogers' (1995) defined a communication channel as a means by which messages get from one individual to another. The conditions under which a source will or will not transmit information about an innovation to the receiver and the effect of such a transfer are determined by the nature of the relationship. Rogers (1995) talks about three types of communication channels: (i) mass media, (ii) interpersonal communication, and (iii) interactive communication through the Internet.

Rogers (1995) points out that the mass media have direct, immediate, and powerful effects on the mass audience. Mass media such as radio, television, and newspapers target larger audiences and are the most efficient means of informing an audience of potential adopters about the existence of an innovation. Interpersonal communication channels are, however, more effective in persuading an individual to accept a new idea, particularly if the interpersonal channel links two or more individuals who are similar in socioeconomic status or education (Rogers, 1995).

Rogers (1995) argues that most individuals depend mainly upon a subjective evaluation of an innovation that is conveyed to them from other individuals like themselves who have already adopted the innovation. He contends that this dependence on experience of near peers implies that the heart of the diffusion process consists of the modeling and imitation by potential adopters of their network partners who have previously adopted the innovation. The diffusion theory argues that, since opinion leaders directly affect the tipping of an innovation, a powerful way for change agents to affect the diffusion of an innovation is to affect the attitudes of opinion leaders. The interpersonal communication channel is the more effective mechanism for diffusion of an innovation in this regard.

According to Rogers (1995), the mass media's most powerful effect on diffusion is that it spreads knowledge of innovations to a large audience rapidly. It can even lead to changes in weakly held attitudes. But strong interpersonal ties are usually more effective in the formation and change of strongly held attitudes. Research (Orr, 2003) has shown that firm attitudes are developed through communication exchanges about the innovation with peers and opinion leaders. These channels are more trusted and have greater effectiveness in dealing with resistance or apathy on the part of the receiver.

Rogers (1995) explained that the types of opinion leaders that change agents should target depend on the nature of the social system. Social systems can be characterized as heterophilous or homophilous. Heterophilous social systems tend to encourage *change from* system norms. In them, there is more interaction between people from different backgrounds, indicating a greater interest in being exposed to new ideas. These systems have opinion leadership that is more innovative because these systems are desirous of innovation.

Homophilous social systems *tend toward* system norms. Most interaction within them is between people from similar backgrounds. People and ideas that differ from the norm are seen as strange and undesirable. These systems have opinion leadership that is not very innovative.

For heterophilous systems, change agents can concentrate on targeting the most elite and innovative opinion leaders and the innovation will trickle-down to non-elites. If an elite opinion leader is convinced to adopt an innovation, the rest will exhibit excitement and readiness to learn and adopt it. The domino effect will commence with enthusiasm rather than resistance (Rogers, 1995).

For homophilous systems, however, encouraging the diffusion of an innovation is a far more difficult task. Change agents must target a wider group of opinion leaders, including some of the less elite, because innovations are less likely to trickle-down. Opinion leaders who adopt innovations in homophilous systems are more likely to be regarded as suspicious and/or dismissed from their opinion leadership. Often, opinion leaders in homophilous systems avoid adopting innovations in hopes of protecting their opinion leadership. Generally, in homophilous systems, opinion leaders do not control attitudes as much as pre-existing norms do.

Change agents must, if possible, communicate to opinion leaders a convincing argument in favor of the innovation that accentuates the compatibility of the innovation with system norms (Rogers, 2005). The opinion leaders will then be able to use this argument, which will hopefully resonate with the masses, to support their own adoption decision.

The third channel of communication that Rogers (1995) identified is the interactive communication via the Internet. The World Wide Web and online communications through the internet offer a good avenue to communicate new ideas. The Internet offers an effective medium for social networking among faculty members within and outside their institutions. Change agents could therefore use this medium to communicate ideas and information about an innovation.

The CBAM

Hall and Hord's (1987) Concerns-Based Adoption Model (CBAM) is useful in explaining the level of teachers' commitment in adopting technology innovations. This model is based on an early one by Hall, Wallace and Dossett (1973), which describes seven stages of concern that teachers experience as they adopt a new practice. These levels are explained as:

(i) Awareness. Teachers have little concern or involvement with the innovation.

(ii) *Informational*. Teachers have a general interest in the innovation and would like to know more about it.

(iii) *Personal*. Teachers want to learn about the personal ramifications of the innovation. They question how the innovation will affect them.

(iv) *Management*. Teachers learn the processes and tasks of the innovation. They focus on information and resources.

(v) *Consequence*. Teachers focus on the innovation's impact on students.

(vi) *Collaboration*. Teachers cooperate with other teachers in implementing the innovation.

(vii) *Refocusing*. Teachers consider the benefits of the innovation and think of additional alternatives that might work even better.

The first four levels are “non-adopter” stages, while the last three are “adopter” stages. The CBAM model is relevant for this study because it explores the concerns of faculty with the technology innovation. It also complements quite well Rogers’ five-stage model for diffusion of innovations, which has been tested with several projects and situations, including technology integration in education. The CBAM also addresses the two main shortcomings of Rogers’ (19995) DoI theory: pro-innovator’s biases, and global social system characterization rather than individual concerns.

If the concerns at the non-adopter stages of awareness, informational, personal, and management get appropriately addressed, users begin to express higher concerns at the three adopter stages of consequence, collaboration, and refocusing. If faculty members do not have their concerns first reduced at the non-adopter stages, they will not move on to the adopter stages (Vaughan, 2002). Other research findings support the Stages of Concern as a framework for assessing adoption of innovations and professional development (Adams & Martray, 1981; Damarte & Manhood, 1981; Hall et al.,1973); Marso & Pigge, 1994; as cited in Vaughan, 2002).

The survey of stages of technology adoption, based on the CBAM, is a single-item self-assessment survey on faculty levels of technology adoption for teaching and learning. Research (Christensen, 1997; Christensen & Knezek, 1999) shows that it is a quick useful way to determine the average stage of faculty members' technology adoption, which has implications for the design of their technology professional development programs. It may also serve as a basis for an ongoing assessment of the institutions' technology integration programs. Finally, it gives faculty an opportunity to assess their progress in the use of technology for teaching and learning.

Faculty Attitudes towards Integration of Technology

Thurstone (1928), as cited in Mueller (1986), defined attitude as the sum total of a person's inclination and feelings, prejudices and bias, preconceived notions, ideas, fears, threats, and convictions about any specified topic. Mueller affirmed this definition and added that attitude is (i) affect for or against, (ii) evaluation of, (iii) like or dislike of, or (iv) positiveness or negativeness towards a psychological object. Beliefs (long lasting items of faith, products of cognition or attitude) and attitudes (feelings or perceptions, products of affect or behavior) influence each other in a two-way direction. According to Rogers (1995), predispositions such as selective exposure and selective perception may influence an individual's behavior toward communication messages about an innovation and the effects that such messages are likely to have. He argued that even if individuals are exposed to innovation messages, such exposure will have little effect unless the innovation is perceived as relevant to the individual's needs and as compatible with the individual's attitudes and beliefs about the innovation.

A study by Becker (2000) based on data from the 1998 national survey of K-12 teachers' teaching, learning, and computing revealed that teachers who have a reasonable amount of technical skill and who use computers to address their own professional needs use computers in broader and more sophisticated ways with students than teachers who have limited technical skills and no personal investment in using computers themselves. Ely's (1999) eight conditions that facilitate implementation of innovations confirmed this finding. For instance, if I believe that integrating technology into my teaching would result in greater student learning, I am more likely to use technology than one who holds a contrary belief. On the other hand, if I frequently use technology even for personal purposes, I am more likely to develop interest and believe in technology as a tool for teaching and learning, according to Becker. According to Hall and Loucks (1978), change must be understood in terms of what happens to individuals. Understanding how individual teachers may respond to changing their behaviors and practices is critical for implementation of technology innovation. Change by individuals entails growth, both in terms of how they feel about the change and their skill in applying any innovations (Hall & Loucks, 1978).

In Hall and Hord's (1987) study and recent research (Graham, Culatta, & Pratt, 2004; Graves & Kelly, 2002; Kotrlik & Redmann, 2004; Johnson & Howell, 2005; Kidney, 2004; Palak, 2005; Rogers, 2000; Tallman & Fitzgerald, 2005; Topper, 2004), the components of faculty attitude towards technology integration are identified as (i) faculty attitudes towards technology integration in the teacher education curriculum, (ii) faculty motivation for adoption of instructional technology (IT), (iii) faculty perceived barriers and challenges to adoption of IT, and (iv) faculty perceived effects of IT on students and pedagogy.

Teachers' beliefs and values towards technology integration and use were the subject of investigation by Palak (2004). He studied how K-12 teachers' beliefs and factors other than teachers' beliefs relate to teachers' instructional technology practices. His classification of teachers' beliefs in this respect is worth noting. He identified teachers' beliefs as teacher-centered beliefs, student-centered beliefs, or attitudes toward technology integration. He regarded teacher confidence and comfort, technical support, general school support, and ratio of computers-to-students in the classroom as factors other than teachers' beliefs. His research question was how teachers' beliefs and factors other than teachers' beliefs related to the types of technologies and instructional strategies teachers used when integrating technology.

Palak's results point to the following: instructional technology practices of teachers in substantial ways relate to (i) their beliefs about teaching and technology and (ii) the contextual conditions in their teaching environments. He reported that teachers' beliefs are the primary agents for their instructional technology decisions specifically for their selections of technologies for student use, and that the types of technologies teachers have their students use are directly related to the ways teachers approach teaching and technology.

Kelsey and D'souza (2004) found that faculty perceived technology, when used as a medium for distance learning, as a barrier to effective instruction. They, however, found that faculty members were satisfied with the nature of interactions between them and their students, using a mixed mode of online and face-to-face. Their study also found that faculty had individual preferences and faced some barriers to interaction, and that these perceived barriers, when not addressed appropriately, easily give rise to apathy and lukewarm faculty attitude towards technology-based innovation.

Some (Palak, 2004) believe that the active involvement of faculty in implementing technology innovations for teaching and learning is very important. Schauer, Rockwell, and Fritz (2005) in their qualitative study concluded that faculty commitment and skill development, technology integration and support, financial issues, student engagement and support, quality control for courses and documentation of outcomes, developing policies and governances for course and delivery processes, and compliance with regulations and legal matters are critical issues that administrators of higher education should address in order to address technology use by faculty.

Bauer and Kenton (2005) reported that research in the past decade has shown that computer technology is an effective means for widening educational opportunities, but most teachers at the K-12 level neither use technology as an instructional delivery system nor integrate technology in their curriculum. Participants in their study identified their schools as being proficient with technology, the teachers were highly educated and skilled with technology, were innovative and adept at overcoming obstacles, but that they did not integrate technology on a consistent basis as both a teaching and learning tool. The authors reported that teachers need extra planning time for technology-based lessons and that there exist the possibilities of other factors inherent in teachers' attitudes and perceptions of technology integration that need further investigation.

Swain (2006) identified teachers' attitude measures as interest in technology use, comfort with technology integration in teaching and learning, accommodation of the demands imposed by technology integration in the curriculum, e-mail use for instructional purposes, concern with technology's impact on their students' learning, technology utility, perceptions of technology in teaching and learning, assimilation of innovative strategies in their professional practices, and significance of technology in the curriculum.

Kotrlik and Redmann (2005) in their study of K-12 teachers' use of technology in the classroom observed that (i) teachers feel some anxiety when it comes to technology integration, (ii) teachers perceive they are effective regardless of whether they have integrated technology, or they are encountering barriers, (iii) as teachers perceive an increase in barriers, their integration of technology decreases, (iv) as the availability of student e-mail and the number of computers with Internet connection in the classroom and/or lab increases, their integration of technology increases, and (v) teachers' perceived technology anxiety and their self-perceptions of their teaching effectiveness do not explain the extent of technology integration. These findings suggest that teachers' attitudes towards technology integration are vital factors for the success of educational innovations.

Eifler, Dinsmore, and Potthoff (2004) observed that there is a gap between institutional change and faculty attitudes towards such innovations as technology integration into the curriculum. In the view of Eifler et al., there is a disconnection between policy formulation and implementation because of the nonparticipation of faculty in decision making. This observation is supported by Finley and Hartman (2004), who discuss issues of vision, skills and knowledge, and departmental culture as barriers to the integration of technology into teacher education courses. Theirs was a qualitative case study regarding potential barriers to the integration of technology into teacher-preparatory courses, as perceived by teacher-educators at one university. The theme of interest to the researchers was views of change agents, framed by their visions for appropriate technology usage, their skills and knowledge, and their perceptions of departmental culture. The researchers based their inquiry on the technology standards provided by the International Society for Technology in Education (ISTE). They focused their attention on six broad areas identified by ISTE as critical to using technology in education, namely (i) technology operations and concepts, (ii) planning and designing learning environments, (iii) teaching, learning and the curriculum, (iv) assessment and evaluation, (v) productivity and professional practice, and (vi) social, ethical, legal, and human issues.

Another important observation about Finley and Hartman's (2004) work is that they used the diffusion model of Rogers (1995) as a theoretical basis for their study in assessing institutional change. Overall, the findings of this elaborate study showed that faculty would experiment with technology integration if (i) they feel it is consistent with their teaching style, (ii) they feel they are knowledgeable and competently skilled, (iii) they are supported and rewarded for doing so, and (iv) they can see how it is pedagogically useful.

Faculty Perceptions of Technology Professional Development Needs

The importance of professional development to support technology integration in teaching and learning has gained attention in recent years as a means of enriching the learning environment and improving the quality of education. The Office of Technology Assessment (1995), the U.S. Department of Education (1994), and several other agencies have identified the professional development of teachers and the use of technology as two major factors of school reform that are necessary to provide students with the best educational opportunities during the new millennium. Professional development is critical to systemic educational reform and school improvement that is designed to enhance the teaching learning process (Fullan & Hargreaves, 1996; McKinnon & Nolan, 1989).

There are others (Lambert, 1988; Wade, 1989) who argue that professional development has been only moderately effective in bringing about changes in schools. Norris (1993) and Little (1993), however, report that the reason behind the limited impact of professional development is that concerns of teachers have not been taken into consideration when planning professional development programs. Little (1993) argues that there is a serious disconnection between school reform and teachers' professional development. In most cases, professional development programs are designed, organized, and delivered based on the skills and knowledge that policymakers and external facilitators assume teachers need, rather than allowing teachers to identify their needs and concerns and designing programs to address those needs.

Importance of Faculty Needs and Concerns

To make faculty's technology professional development programs relevant and useful, institutions should take into consideration faculty needs and concerns in designing such programs. Faculty members need to know how their roles and strategies would be affected when they adopt and use instructional technology. They also expect their needs and concerns to be addressed by technology professional developers and institutional leadership.

Borko and Putnam (1995) argued that professional development should involve teachers in the identification of what they need to learn and in the development of the learning opportunity and /or the process to be used to achieve the desired goals. Guskey (1995) and Hargreaves (1995) argued that when teachers are denied input in their own professional development, they are likely to become cynical and removed from innovation efforts. The adopter of an innovation needs to be convinced about the relevance and purpose of the change or innovation. According to Rogers (1995), the degree to which an innovation is consistent with the existing values, past experience, and needs of the potential adopter is an important motivator for adoption and use of the innovation.

Faculty motivation to go the extra mile in the acquisition of technology integration skills and techniques is largely determined by their perceptions of their technology needs, attitudes, perceptions, beliefs, and values that they place on technology integration. The purpose of professional development is to bring about positive changes in the beliefs, attitudes, and classroom practices of teachers (Guskey, 1986).

As Kidney (2004) pointed out, as higher education continues the rush to embrace technology-delivered learning opportunities, one imperative is to find ways to prepare faculty for what life will be like on the other side of the transformation. Kidney emphasized the point that independent of how great a teacher, scholar or researcher may be, he or she needs to have accurate expectations of how roles change, a modicum of technological mastery, and a set of instructional strategies appropriate for the new domain. This calls for a rethinking of curriculum and pedagogy issues. The curriculum-technology integration alignment is very important in this context.

Curriculum and Technology Alignment

According to Sun, Heath, Byrom, Phlegar, and Dimock (2000), professional development planning requires a focus on the teacher's top priority, which is helping students to learn more effectively. Sun et al. (2000) observed that technology integration can become a catalyst for changing instructional strategies. Effective use of technology that enhances teachers' instructional practices goes through a three-step process: first the learning, then the teaching, and then the technology. Teacher education faculty should emphasize technology integration into the curriculum so as to equip pre-service teachers with the technology integration skills and knowledge needed for their future professional work.

Topper (2004) reported that inservice teachers enter graduate programs with the same limited set of technology skills and knowledge that preservice teachers leave undergraduate programs with. This suggests some form of deficiency in tertiary teacher education curriculum, which faculty should address. According to Topper, the problem lies squarely on two factors: the lack of alignment of the curriculum with technology and faculty members' lack of technology skills. In this information technology era, therefore, technology use in instruction requires some amount of technology expertise and skills on the part of faculty members.

This means that the technology professional development program should be based on sound curriculum and pedagogy, as espoused by the National Council for Accreditation of Teacher Education (NCATE, 1997):

> Increasingly central to the role of the new professional teacher is the ability to employ technology to improve student learning and to employ technology in many facets of professional work. This will require new understandings, new approaches, new roles, new forms of professional growth, and new attitudes. (Topper, 2004, p.303)

What NCATE is asking tertiary teacher education programs to do is to ensure that their graduates are technology literate in order to effectively use technology in K-12 schools.

This call is relevant to the UCC and UEW's situation for three reasons: (i) preservice teachers enter the undergraduate teacher education program with severely limited computer literacy, (ii) inservice teachers at the Basic and Secondary School levels lack the necessary technology skills and knowledge, and (iii) there is an ongoing effort to introduce technology studies and integrate technology into the pre-tertiary curricula even as the teachers are not prepared to implement this innovation.

Zhang and Deng (2004) examined students' perceptions of their learning achievements, their instructors' teaching methods, and satisfaction with the instructional technology obtained in a multimedia classroom versus in a traditional classroom at a major mid-south state university. Their study concluded that students in multimedia classrooms had more positive perception of instructors' teaching methods than those in traditional classrooms. This result indicates that faculty's use of technology for instruction could enhance their instructional quality and motivate their students.

Implementation Mode and Methodology

Another factor that is important to faculty technology professional development programs is the mode and methodology of implementation. Educational technology research should focus on the best practices customized for specific faculty needs. Since the levels of individual expertise and technology use differ significantly among faculty members, the choice of mode of inservice training on the use of technology in instruction should be based on the preferences, expertise level and particular needs of faculty members (Kelsey & D'souza, 2004; Schnell, 2003).

In most cases, professional development activities for implementing new innovations usually take the form of a couple of sporadic workshops, and participants are asked to go back to their respective classrooms and successfully implement the programs (Vaughan, 2002). He observed that teachers become reluctant to implement because of the lack of adequate training and interest.

Leh's (2005) study of faculty use of technology reported that using (a) large group workshops, (b) small group meetings, (c) individual mentoring, and (d) just-in-time training had a positive impact on faculty members' ability to use technology in instruction. Finley and Hartman (2004) reported that one diffusion approach has been to encourage Faculty of Education and Arts and Science faculty, through discussions, marketing, technological assistance, and professional development opportunities, to address the ISTE standards in their teacher-preparatory courses. The question, however, is how do we ascertain that faculty members are indeed changing their teaching?

Collier, Rivera, and Weinburgh (2004) confirmed the effectiveness of integrating deliberately scaffolded hands-on experiences and increased modeling of technology to enhance future teachers' ability to select and use appropriate technologies in the instructional setting. Their study suggested that the more appropriate way to ensure effective technology integration was to prepare pre-service teachers adequately to meet current technology standards.

Support for Professional Development

As observed by Schnell (2003), support for the use of instructional technology in classrooms requires services tailored to the diverse needs of faculty. Schnell further asserted that even when a full range of support resources is available, applying them effectively means that services should be well defined and coordinated across the support units that provide them. Irani and Telg (2002) observed that training programs in most institutions were voluntary, consisting of a combination of formal, informal, and self-paced programs and short classes or programs offered at various times over many weeks. Their study reported that, among other things, increasing production staff, improving training facilities, and providing faculty with more assistance and incentives could motivate faculty to use technology in their instruction and professional activities.

Faculty members therefore need to be appropriately equipped not merely with technology expertise but more importantly with the skills and techniques for effectively integrating technology into their curricula and instruction. This calls for an ongoing faculty technology professional development program as pointed out by Eifler, Dinsmore, and Potthoff (2004). Their study indicated that professional development programs promote participants' knowledge, skills, and dispositions toward technology, diversity, and school change.

Faculty Self-efficacy

Change in instructional technologies also partly depends on faculty’s self-efficacy, a belief in their own ability to integrate technology in their instruction in order to achieve a perceived goal or task (Watson, 2006). The goal could be a desire to improve students’ achievement, which, to me, is the ultimate purpose of technology integration in education. The long term impact of technology seminars, workshops, and inservice professional training on faculty attitudes and perceptions towards using computers and the Internet in their classrooms was the focus of Watson’s (2006) study of K-12 teachers. The research was conducted on the West Virginia K-12 RuralNet Project, an NSF funded program to train inservice teachers on integrating the Internet into science and mathematics curriculum. The findings indicated that (i) teachers’ improved level of self-efficacy after a series of summer workshops remained high even after their involvement in the program, (ii) combining intense summer workshops with additional online courses showed a significant increase in some aspects of self-efficacy over just having a professional development workshop, and (iii) certain external factors do affect teacher efficacy over the long term. The external factors mentioned above included one day workshops, seminars, school meetings, and planning sessions. The study concluded that teacher training has a long-term effect on teacher self-efficacy towards using the Internet in the classroom.

Evaluation as Part of Technology Professional Development

Faculty technology professional development programs also focus on evaluation of the adoption of technology in teaching and learning. The question is: How does a faculty member or innovator determine whether the use and integration of technology is having the desired effects? How does one "know" when using technology has "worked," and when it has not? Hall, George and Rutherford (1979) reported that one way of determining the degree of comfort teachers have with an innovation is to monitor their concerns about the innovation. Their findings indicate that the Stages of Concern about the Innovation (SCoI) has provided great insights into monitoring the implementation of innovations in educational settings. The monitoring of expressed concerns provides opportunities for feedback to facilitators and educators providing professional development. Professional development providers need such feedback in order to meet the real needs of participants, in this case faculty members. Monitoring also assists administrators with the implementation of the innovation, because useful feedback from the faculty will help streamline deficiencies in the system.

Leh (2005) observed that though most research findings in technology integration in learning and teaching pertain to K-12 teachers, they are also applicable to faculty in higher education. Both categories of teachers require ongoing technology professional development to keep abreast with the dynamic changes in technology itself.

Faculty Technology Use

Cuban (1986) has argued that computers, as a medium of instruction and as a tool for student learning, are largely incompatible with the requirement of teaching. Cuban's reason in arriving at this conclusion is that teachers are already over-burdened enough without the requirement for them to incorporate student computer use as a regular part of their instructional practice. Furthermore, he claimed that computers are hard to master, hard to use, and often breakdown. Thus these conditions constitute disincentives for teachers to make realistic investment of effort into having students use them frequently. Cuban made these observations in the second half of the 1980's where technology as we know it today was non-existent. Some aspects of his stated position against the use instructional technology may no longer hold.

Becker (2000), basing his argument on data from the 1998 national survey of teachers, teaching, learning, and computing (TLC), agrees with Cuban's position that teachers' overload conditions may still limit widespread classroom use of computers. Over 4,000 K-12 teachers in more than 1,100 schools across the U.S. participated in the TLC survey, which sought to gain insight into teachers' educational philosophies and characteristic teaching practices, teachers' use of computers in teaching, and various aspects of school's environment. A 20-page survey designed to investigate questions raised by Cuban's (1996) critique was administered.

Becker (2000) argued that under the right conditions, computers are obviously becoming a valuable and well-functioning instructional tool. Becker mentioned teachers' comfort and skills in using computers, allocation of some time in the school schedule for students to use computers as part of class assignment, availability of sufficient technology facilities and equipment, convenient access to these facilities, and teachers' personal philosophies that support student-centered, constructivist pedagogy as some of the conditions that enhance classroom use of computers.

According to Becker (2000), the TLC data show that only a small minority of secondary school academic classes use computers significantly for (i) students acquiring information, (ii) analyzing ideas, and (iii) demonstrating and communicating content understanding in science, social studies, mathematics, and other academic work. He pointed out that scheduling problems, pressure of curriculum coverage, and convenient access to computers accounted for this situation.

Kelly (2005) in his dissertation abstract reported that despite the availability of instructional technology on college campuses, faculty members tend to under-use technology for instruction. His study examined the relationships among faculty, their perceptions of organizational support, professional development practices, and the use of technology for instruction and communication. The present level of technology use was compared to the desired level of technology use for instruction and communication, the perceived level of organizational support and the professional development activities of the faculty. Kelly's findings suggest that the majority of the faculty members were receptive to the use of technology in instruction and communication. The findings also revealed that the faculty desired more technology for instruction, a higher degree of organizational support for technology and more professional development related to technology. The study recommended the establishment of a faculty technology development committee and a faculty college program improvement committee. The study also recommended a permanent faculty-driven assessment and improvement process for increasing the use of technology.

A recent study by Hernandez-Ramos (2005) of K-12 schools in Santa Clara County, California in the heart of Silicon Valley, revealed that exposure to technology in teaching preparation programs, knowledge of software applications, and constructivist beliefs were found to be positively related to more frequent use of technology by teachers, both for themselves and their students. This finding was corroborated in an earlier study by Iding, Crosby and Speitel (2002), who reported that, overwhelmingly, teachers and preservice teachers who report using computers for their own personal use are at least moderately proficient with computers, have varying levels of access to computers in schools and individual classrooms, and are interested in learning more about technology for educational purposes. Their study also found that the majority is unaware of any educational software that could be helpful in their teaching, and does not use technology in many teaching-related tasks, including for student portfolios, as tutorials, for demonstrations and simulations, or for remediation.

Teachers and faculty need motivation to integrate instructional technologies into their curricula and instruction. One way of providing such motivation is to require technology skills and use in teaching as part of faculty evaluation (Whale, 2006). A study involving K-12 teachers by Whale showed that few teachers are evaluated on their ability to use technology in the classroom despite conclusive evidence that its effective use has a positive impact on student achievement and that large amounts of resources are dedicated to placing technology in schools. Whale's study implies that if faculty members feel the use of technology in their instruction is part of faculty evaluation for tenure, they would take technology more seriously.

Wozney, Venkatesh, and Abrami (2006), however, observed that we are experiencing exponential growth in the use of computer technology for learning in K-12 schools, and that there is sufficient optimism in the potential of technology that governments have dedicated substantial research funds to identifying and promoting ways to deliver or enhance instruction with the use of technology. Their study found that (i) expectancy of success and perceived value were the most important issues in differentiating levels of computer use among teachers, (ii) personal use of computers outside of teaching activities was the most significant predictor of teacher use of technology in the classroom, and (iii) teacher's use of computer technologies was predominantly for "informative" (World Wide Web and CD-ROM) and "expressive" (word processing) purposes.

Teng and Allen (2005) examined the use of Blackboard as a web-based learning environment to enhance preservice teachers' confidence in the integration of technology into their future instruction as inservice teachers. The findings of this study revealed that exposing participants to Blackboard and the electronic exchange of ideas improved their self-reported computer skills and their confidence in using and integrating technology in their future teaching. In this connection reluctant faculty members, when adequately and appropriately exposed to the power and potency of technology integration as instructional enhancers, are likely to adopt a more positive attitude towards technology innovations for teaching and learning. Vitale (2005) confirmed this observation in his dissertation abstract. His research on K-12 teachers and schools focused on factors cited by successful integrators of instructional technology that were instrumental in their professional growth and transformation as technology integrators. His study strongly argued for the use of instructional design principles to build more effective professional development opportunities in their schools.

Current research (Bauer & Kenton, 2005; Collier, Rivera, & Weinburgh, 2004; Whale, 2006) indicates that when integrated with emerging models of teaching and learning, technology can transform education. Universities all over the world now see computer-based technology as a tool for enriching the curriculum and enhancing teaching and learning. Faculty members play an important role as implementers of institutional technology innovation (Judson, 2006), and their use of technology for teaching and learning would justify the huge investment that their institutions make in technology infrastructure and equipment.

Summary

Across K-12 and higher education, researchers (Bauer & Kenton, 2005; Kelly, 2005; Iding, Crosby, & Speitel, 2002) have noted that there is less integration of technologies into the classroom and more personal use of technology for professional activities such as class management, grade processing, and keeping of students' assessment records The ultimate impact of the heavy investments that universities make on technology infrastructure and facilities will remain illusive if faculty members are not well equipped in terms of knowledge and skills to integrate technology into their instruction and student learning environment. Faculty attitudes and beliefs towards technology and teaching have to be factored into the overall strategy for technology integration because faculty's beliefs and attitudes are the primary agents when they make decisions about technology (Palak, 2004). It is important to consider the concerns of faculty when planning professional development activities since successful implementation will depend on the attitudes and technology needs of the teachers involved in the process (Hope, 1995; Hall & Hord, 1987; Norris, 1993; Todd, 1993; Rutherford, Hall, & George, 1982).

School leaders must also recognize the differentiated activities that promote professional learning within the school culture and challenge the notion that professional development is "basal" in nature and that "one-size-fits every participant" does not work. Informal social networks, as explained by Rogers' (1995) channels of communication, are also critical in the growth of teachers who would eventually become successful integrators of instructional technology. The situation in higher education also requires management to take faculty technology professional development in a much more purposeful direction, reform curricula to reflect the need for and enhance technology integration, and address the perceptions, attitudes and beliefs of faculty in planning, designing, and implementing technology innovations.

CHAPTER 3

Methodology

Using survey methodology and multiple linear regression, this study seeks to investigate the predictive relationship of faculty attitudes towards technology integration in teaching and learning and faculty perceptions of technology professional development needs with faculty technology use for teaching and learning among tertiary-level teacher educators in Ghana.

A review of the literature provided a variety of issues concerning technology integration in instruction, faculty attitudes towards technology integration, faculty use of instructional technology, and technology professional development needs of faculty members, but no one source has adequately covered all the issues proposed in this study, particularly how the identified factors interact in the Ghanaian context.

This chapter covers the following topics: research questions, participants, research design and variables, sampling, instrumentation, pilot study, data collection, response rate, data analysis, and supplementary interviews.

Research Questions

This study was designed to answer the following research questions:

(1) To what extent are the following factors:

Factor 1: faculty attitudes towards technology integration in curriculum,

Factor 2: faculty motivation for adoption of instructional technology,

Factor 3: faculty perceptions of the effects of instructional technology on students and pedagogy, Factor 4: faculty perceptions of barriers and challenges to adoption of instructional technology, and

Factor 5: faculty perceptions of technology professional development needs

related, individually and in linear combination, to faculty use of technology for teaching and learning (Use)?

(2) What are the stages of technology adoption of faculty members about the use of instructional technology, according to the CBAM stages of concerns?

Participants and Setting

The population for this study was faculty members from the University of Education, Winneba (UEW) and from the Faculty of Education of the University of Cape Coast (UCC). These are the only two Ghanaian universities mandated to produce graduate teachers for Ghana's pre-tertiary institutions. The graduates of both institutions are employed by the Ghana Education Service (GES) to teach in the polytechnics, the initial teacher training colleges, senior high schools, junior high schools, and other non-tertiary institutions.

The UEW, the larger of the two sites in terms of teacher education, was established in 1992 to train teachers in all disciplines across the pre-tertiary curriculum. UCC was established in 1961 as a tertiary teacher education institution, but now only its Faculty of Education is involved in teacher education. The study is limited to these two research sites because the topic deals with technology integration issues in tertiary teacher education in Ghana.

The ICT Plans of UEW (2003-2008) and UCC (2002-2007) seek to improve the technology infrastructure through the setting up of computer networks, access to the internets via shared bandwidth and local area networks, optic fiber backbone, satellite and radio communication linkages across their regional campuses. UEW, for instance, is almost through with the fiber optic backbone connectivity in all of its campuses. Most academic departments have also set up their LANs in both sites, which are being integrated into the university's wide area network.

The universities have also been organizing sporadic in-service training, workshops and seminars to enhance the capacities of faculty members in the use ICT for instruction and research work. To facilitate students' computing activities, the two universities have set up computer centers with access to the internet in all their campuses. The new ICT Centers at both UEW and UCC are modern computing facilities, fully networked with wireless (radio) connectivity to the internet. It is expected that the innovative practices being introduced into the universities' teaching and learning environments would enhance the quality of instructional delivery, improve learning outcomes of students and increase cost-effectiveness and efficiency in general administrative practices.

Faculty members from these two universities have similar characteristics in terms of age distribution, computer experience, and their access to ICT facilities and equipment. At UEW 13.7 % of faculty members are above 60, 41.6% belong to the age range 51-60, 35.7% in 41-50, 8.9% in 31-40, and none below 30 years. Both sites train teachers in pedagogy, educational foundations, and curriculum issues as well as content in related academic disciplines, both at the undergraduate and masters' degree levels.

Females are disproportionately under-represented in both institutions. UEW, for instance, has 15% female faculty members while UCC's Faculty of Education has 24% female faculty.

In terms of academic rank, 69% of UEW faculty are within the lecturer, assistant lecturer or tutor category, 23% are senior lecturers, and 8% are professors or associate professors.

The academic disciplines are grouped into six faculties: agriculture education, applied arts education, general culture and social science education, language education, science education, and specialized professional studies in education. Some senior faculty members are affiliated with the research institutes, and they were included in the survey because they also teach in the academic departments.

Research Design and Variables

The study used survey methodology and multiple regression procedures, supplemented by interviews. The dependent factor was Faculty Technology Use for Teaching and Learning (Use). Based on the pilot test, this study used five factors as independent factors, namely:

Factor 1: Faculty Attitudes towards Technology Integration into Teacher Education Curriculum

Research findings (Christensen & Knezek, 1997; Gilmore, 1998; Jacobsen, 1998; Palak, 2004) have indicated that faculty perceptions and attitudes towards technology integration into the curriculum influence their levels of adoption and use of technology for teaching and learning. Twelve Likert scale items covering views, beliefs, feelings and perceptions of faculty about technology integration into the teacher education curriculum were set for this factor. These items were adopted and modified from Christensen (1998) and Christensen and Knezek (1997).

Factor 2: Faculty Motivation for Adoption of Instructional Technology

Faculty members typically have numerous and varied activities which compete for their limited time and effort. It is natural therefore to expect that faculty may have some compelling reasons for integrating and using technology for instruction. The motivation could be intrinsic or extrinsic. Thirteen items, based on Jacobsen's (1998) and Christensen's (1998) work, were set on this factor.

Factor 3: Faculty Perceptions of the Effects of Faculty Use of Instructional Technology on Students and Pedagogy

Hadley and Sheingold (1993) indicated that significant changes accompany teachers' adoption and use of technology in instruction. Some of the effects of using instructional technology are reflected in students' learning and pedagogy as well as faculty instructional strategies. Based on the works of Jacobsen (1998), Christensen and Knezek (1997), and Christensen (1998), 15 items were set for this factor.

Factor 4: Faculty Perceptions of Barriers and Challenges to Adoption of Technology for Teaching and Learning

There may be challenges and barriers towards our efforts to use technology for teaching and learning. These barriers could be lack of technology resources, expertise, and support or anxiety. Ten items based on Jacobsen's (1998) work were adopted and modified for this factor.

Factor 5: Faculty Perceptions of their Technology Professional Development Needs

The literature (Fullan & Hargreaves, 1996; McKinnon & Nolan, 1989) shows that faculty technology professional development enhances faculty adoption and use of technology for teaching and learning. Research findings also show that taking faculty needs and concerns into consideration when designing professional development programs enhances the relevance and usefulness of such programs (Palak, 2004).

Since the inception of the information communications technology programs at UEW and UCC, efforts have been made to equip faculty members with the requisite technology skills and knowledge to enable them to integrate technology into their teaching and learning. Fifteen items based on Soloway and Norris's (1999) survey were adopted and modified to suit my target population.

Use: Faculty Technology Use for Teaching and Learning

Faculty members were asked to rate their use of computer-based technology for personal communication and document preparation, research work, classroom management and student assessment purposes, and for teaching and learning purposes. Four survey items (Items 1- 4) on these broad technology use areas. A second set of six items (Items 5 - 10) was set on specific application software use. A third section included 10 Likert scale items (Items 11 – 20) which asked faculty to indicate their level of agreement on the extent they would use specific technologies, if they were available.

These last set of items were adopted and modified from a survey used by Soloway and Norris (1999).

The dependent factor, therefore, was faculty use of technology (USE). The independent factors included attitude factors (Factor 1 – Factor 4) towards technology integration and faculty perception of technology professional development needs (Factor 5). Age was used as moderating factor.

Female faculty members were under-represented of in both participating institutions (49 females as against 242 males in UEW, and 24 females as against 76 males in UCC's Faculty of Education), I did not use gender as a factor in the regression analysis. Gender was considered as a moderating factor, but a one-way MANOVA found that gender differences were not significant among faculty members in their attitudes towards technology use for teaching and learning.

Sampling

According to Stevens (1996), 15 participants per independent factor is a reasonable sample size for large effect size of .80 (i.e. a minimum of 75 participants is required for five independent factors). Others, however, suggest that 20 participants per independent variable is a better choice of sample size (Abrams, 1999), requiring a minimum of 100 participants in this study. In this study, 132 faculty members responded to the survey.

These participants were regarded as a time sample for the study. In this case, the issue of generalizability could be extended to the future where the population is expected to change as new faculty members are hired and others resign or retire.

According to Garson (2006), random sampling is not required for regression analysis. However, he contends that if regression is used with enumeration data for an entire population, then significance tests are not relevant. When used with non-random sample data, significance tests would be relevant but unfortunately cannot be reliable and thus are not appropriate. Garson concludes that nonetheless, social scientists commonly use significance tests with non-random data due to their utility as an arbitrary decision criterion. To mitigate the problem of non-randomness, I supplemented the quantitative findings with semi-structured interview results.

Sample Representativeness

The sample used in this study was compared to UEW's (2006) faculty data, as shown in Table 3, to demonstrate its representativeness of the general population of the institution. Sample size was 132 and population size 291 for UEW only. The table showed that the sample is reasonably representative of the population in terms of age, gender and faculty rank distributions. However, in terms of faculty age members in the 31-40 and under 30 ranges were over represented. Therefore, despite the low response rate, the sample used in this study is reasonably representative of the population under study.

Table 3

Sample Representativeness

Demography	Sample(%)	Population(%)	Ratio(Sample/Population)
Gender			
Male	89	83	1.07
Female	11	17	0.65
Total	100	100	
Rank			
Up to lecturer	77	69	1.12
Senior lecturer	18	23	0.78
Ass.Prof/Professor	5	8	0.63
Total	100	100	
Age Range			
≤ 30**	6	0	
31-40	23	8.9	2.58
41-50	37	35.7	1.01
51-60	29	41.6	0.70
≥ 61	5	13.7	0.36
Total	100	100	

**The sample included younger ICT instructors and tutors, who are not normally included in the annual reports.

Instrumentation

A four-part survey (Appendix A) was designed to gather data relevant to faculty adoption and use of technology for teaching and learning in tertiary teacher education.

For Part A, 20 items were set for faculty technology use for teaching and learning (USE). For Part B, 65 items were set on (i) Factor 1: Faculty attitudes towards technology integration in the teacher education Curriculum (12 items); (ii) Factor 2: Faculty motivation for adoption of instructional technology (13 items), (iii) Factor 3: Perceived effects of faculty use of instructional technology on Students and pedagogy (15 items), (iv) Factor 4: Faculty perceived barriers and challenges to adoption of instructional technology (10 items), and Factor 5: Faculty perceived technology professional development needs (15 items). These items were adopted and modified from various sources (Christen, 1998; Christen & Knezek, 1997; Jacobsen, 1998; Soloway & Norris, 1999; Chapman, 2003), which are duly credited in the survey.

Part C was one item seeking faculty stages of technology adoption based on the CBAM. This was adopted from Griffin and Christensen's (1999) CBAM survey.

Part D consisted of three subsections on communication channels: (i) faculty media and methods for acquiring new computer skills and knowledge for teaching and learning, (ii) sources of help for faculty using computers for instruction, and (iii) faculty sources of information for keeping abreast of changes in the area of computers in instruction. The twenty-six items were based on the three main channels proposed by Rogers (1995), namely mass media, interpersonal, and Internet communication channels.

The survey used a Likert scale with five options (Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1). Factor scores were obtained by averaging the numeric values of the responses for the related items on the factor. A score near 5 was considered a very high positive attitude, between 3 and 4 a high positive attitude, and a score between 1 and 2 was regarded as the low negative attitude or a strong disagreement. Negatively worded items were recoded before combining with others in a given factor.

In order to minimize participants' satisficing in their responses, items of the attitudes were coded negatively and positively alternately. Items coded negatively were recoded before the data were analyzed. Scores closer to 5 on the average represent positive attitudes, while those closer to 1 represent poor/negative attitude towards technology integration. A mean score for each factor was computed. These were used in the regression analysis.

The survey also requested participants to provide demographic information concerning their levels of technology use for instruction, ages, gender, years in full-time faculty position, and their academic discipline. This information was used to categorize participants for tests of mean differences.

A number of existing surveys were identified in the literature (e.g. Hadley & Sheingold, 1993; Hall, Wallace, & Dossett, 1973). The Faculty Attitudes towards Information Technology (FAIT) was particularly relevant to this study. The FAIT was derived from the seven-criterion structure of the Teacher Attitudes survey developed by Christenson and Knezek (1998). However, it did not exhaustively cover faculty technology professional development needs and specific user trends in faculty adoption of technology for teaching and learning. However, the internal reliabilities for the five factors of FAIT ranged from .90 to .96. The Stages of Concern survey (Hall, Wallace, & Dossett, 1973) was reported to have a high internal reliability with estimates of internal consistency (alpha coefficients) ranging from .64 to .83.

Since none of these surveys addressed all the issues that I sought to investigate, I constructed my own survey based on the literature and interactions with my committee members and other faculty members in the field of instructional technology. In order to assess the content validity of the survey, a factor analysis was conducted. I sought the assistance of committee members to review the items before and after the pilot test was conducted.

In addition to the faculty survey, I conducted a series of short interviews (15 to 25 minutes long) with a eight faculty members to gather their views about the ICT programs in both universities, and to gain insight into the level at which these institutions adopted computer-based technology for teaching and learning. The interview questions were based on Ely's (1990) eight conditions that facilitate the implementation of educational technology innovations. The interviews augmented the quantitative data gathered from the survey. The interview protocol is attached as Appendix B.

Pilot Study

The survey used in this study was based on an initial pilot study conducted during the Winter Quarter of 2005/2006.

A fresh pilot study was conducted on the new survey to establish not only its reliability but also to identify defective items, and get an idea of the expected response rate. I conducted a web-based pilot study of the survey to test its reliability and content validity before administering it to the actual study participants. I targeted 25 Ohio University College of Education graduate students, who were professional educators from Ghana or elsewhere in Africa. These respondents had many of the same characteristics as teacher education faculty members in Ghana. The response rate for the pilot study was 68% (17 participants).

The pilot survey was reviewed by four education faculty members who were actively using technology in their research or teaching tasks. Their feedback helped to improve the quality of the survey in terms of content coverage and content validity of the factors. There was an almost unanimous view that the items were too many.

The reliability scales (Cronbach's Alpha values) for the five factors of Part B of the survey ranged from .76 to .85 (Appendix E), which are similar to the survey of Christenson and Knezek (1998).

Based on the results of factor analysis and item analysis, five factors were identified and coded as Factors 1 to 5. The number of items in Part B was reduced from 75 items to 65 for Factors 1 to 5, while items for the Use factor were increased from 10 to 20 to cater for possible skewed data from the particular set of participants for the study.

Data Collection

I obtained Ohio University IRB authorization for this study. Ethical clearance letters were also obtained from the participating institutions.

In spite of the advantages of web-based surveys, the limited access of my target participants to Internet services made this option not realistic for collecting my data. Therefore, an equivalent paper form of the survey based on the online pilot study version was administered to faculty members involved in the study.

A cover letter of formal invitation to participants was attached to the survey. Participants' involvement in the study was strictly voluntary. I did not offer any incentive for participation, but those who completed the survey were given pens as a token of appreciation. Participants were not required to provide their names or any identifying information as a part of the survey.

Response Rates

The main strategies I adopted to enhance the response rate included (i) appealing for participants' help since the study would be beneficial to faculty in their use of technology for teaching and learning, (ii) seeking the support of the Vice Chancellor, Deans and Heads of Department to encourage faculty to participate in the study because it would serve as a benchmark against which future assessment of the ICT program could be conducted, (iii) letting participants know the deadline for the data collection, (iv) assuring participants' confidentiality of any information they give since the survey was anonymous and only group data would be reported, and (v) promising to make a summary of the study's findings available to participants.

I relied on contact persons in each faculty and campus. The contact persons were urged to use their personal relationships with faculty members to assist in getting faculty members' participation. The department/faculty administrators' offices received and passed on completed copies of the surveys to these contacts, who in turn returned the completed surveys to me. I also visited faculty offices to remind participants, and for those that I could not meet I used telephone calls to remind them.

Data Analysis

For Research Question 1, the multiple regression procedure was used to assess the relationships of the independent factors (Factor 1-Factor 4) and faculty perceptions of technology professional development needs (Factor 5) with the dependent factor, faculty technology use (Use) in teaching and learning.

A frequency table of faculty stages of technology adoption was used to answer Research Question 2. A one-way MANOVA was used to analyze data related to Parts A, D, and Item 4 of Part A of the survey to determine if there were significant differences among low-level, moderate-level and high-level technology users based on faculty attitude factors and communication channels for technology adoption and diffusion.

I used a significance level of .05 for all tests of hypotheses, except when it is necessary to carry out post-hoc analysis. The Statistical Package for Social Sciences (SPSS) was used for all the quantitative data analyses.

Regression Analysis

Multiple correlation is the association between a dependent factor and two or more independent factors (Aron, Aron, & Coups, 2005). The process of predicting the dependent factor based on this association is called multiple regression. In a multiple regression, each factor has its own regression coefficient that gives its relative importance in the relationship outcome.

According to Brace, Kemp, and Snelgar (2006), multiple regression is used under the following situations: (i) for exploring linear relationships between the independent factors and dependent factor – that is, when the relationship follows a straight line, (ii) the dependent factor being predicted should be measured on a continuous scale (such as interval or ratio scale), (iii) the independent factors selected should be measured on a ratio, interval, or ordinal scale. A nominal independent factor is legitimate but only if it is dichotomous, i.e. there are no more that two categories. (iv) multiple regression requires a large number of observations. The number of cases (participants) must substantially exceed the number of independent factors that are being used in the regression.

In this study, the independent factors and dependent factor are continuous. Thus with five independent factors and a sample size of 132 yielding a ratio of cases per factor of 26:1, the use of the regression analysis in this study was appropriate.

Multiple regression assumptions.

Multiple regression analysis is a mathematical maximization method (minimization of squared error deviations). Therefore data points that are significantly different from the rest of the scores could have disastrous impact on the quality of the results. Sample size, multicollinearity, normality, linearity, constant variance, and independence of participants' scores assumptions were checked using various methods as reported in Chapter 4. No violation of these assumptions was a serious concern in this study.

Stevens (1996) reported that the multiple correlation coefficient, R, is optimized when the independent factors correlate highly with the dependent factor, while simultaneously weakly correlate among themselves. The simple correlation coefficient reported in Chapter 4 showed that all the independent factors, except Factor 5, correlated highly with the dependent factor. Also, Factor 1 correlated highly with Factors 2 and 3.

I also checked for data errors, missing values, outliers, and influential points by running basic descriptive statistics, scatter plots, and using regression diagnostics, where Mahalanobis and Cook's distance tests were used to identify outliers and influential point, respectively. Outliers and influential points are sources of distortion of results in linear regression analysis (Stevens, 1999). Outliers and influential points were not a great concern in this dataset as explained in Chapter 4. Missing data were, however, an issue in this study.

Missing data.

A total of 143 participants returned their completed copies of the surveys. Using case summaries, I was able to identify only one wrong data entry in Factor 2 item 2 (3 was entered as 33). This was corrected. From the correlation table it was clear that scores of cases 106 through 110 were identical (dependency) in Factors 3, 4, 5 and Use. Therefore I decided to remove cases 107 through 110. Cases 13, 78, 101, 105, and 130 also were deleted because all the items on several factors were blank, which I considered critical to the research questions. Two other cases were deleted because of clear case of satisficing because their responses to both negatively positively worded items of similar measures were identical. In all, 11 cases were therefore removed from the data, resulting in 132 usable surveys. There were other missing values but they were mainly with the demographic data. The few scattered missing values were replaced by their series means since not more than one really occurred on a given item. So no item was deleted.

Reliability

Post-hoc reliability was conducted to check the internal consistency of factor cores of the final survey used to collect the data. The Cronbach's Alpha for the post-hoc factor scores range from .711 to .810. According to the rating criterion suggested by Robinson et al. (1991), this ranges from extensive to exemplary. The reliability analysis showed that items 8, 11 and 15 of Factor 5 had negative corrected item-total correlations. Items 8 and 11 which were negatively worded were recoded. Item 15 was removed from a rerun of the reliability. Similarly, Item 9 of Factor 2 had a negative item-total correlation, but since it was positively worded, I decided to remove it from the rerun. For similar reasons, Item 6 of the Use factor was recoded and the reliability rerun without item16. Table 3 below shows the Cronbach's Alpha coefficients for the various factors. A reliability analysis for all the factors was also rerun without Factor 5, which had negative total correlation. The factors reliability coefficient increased from .772 to .837.

Table 4

Reliability Coefficients for Factors

Factor	Cronbach's Alpha	N of Items	N of Cases
Factor1	.771	12	127
Factor2	.810	12	124
Factor3	.808	15	129
Factor4	.711	10	129
Factor5	.801	14	127
USE	.864	19	125

Factor Analysis

Post-hoc factor analysis was also conducted to check the content and construct validity of the final survey used for the data collection. The dimensionality of 65 items for Factors 1 – 5 measures was analyzed using maximum likelihood factor analysis. Three criteria were used to determine the number of factors to rotate: the apriority hypothesis that the items factor into five dimensions, the scree plot, and the interpretability of the factor solution. Theoretically, maximum number of factors ($\lambda > 1$) was 18, accounting for 70.5% of total variation in items. However, retention of 18 factors seems unreasonable because of loss of scientific parsimony. Therefore, I used the scree test which yields sharp breaks in size of the λ's. The scree plot indicated that my hypothesis of five dimensions was correct. Consequently, five factors were rotated using a varimax rotation procedure. The rotated solution (Appendix F) yielded five interpretable factors. The five factors accounted for 37.5% of the total variance in the survey items.

Supplementary Interviews

Semi-structured interviews were conducted with a small sample of faculty members (8) to supplement the findings of the survey. The sample included those who used technology as well as non-users, and each research site was represented. With the permission of participants, the interviews were audio-recorded. Participants were interviewed individually by the researcher in their offices or an agreed location on campus. On the average, each interview lasted for 20 minutes.

The interview protocol (Appendix B) was based on the eight conditions that facilitate the implementation of educational technology innovations (Ely, 1999). This part of the data collection tool sought the views of university faculty members on the use of technology for teaching and learning, faculty technology professional development, incentives/motivation for technology users among faculty members, ICT infrastructure and facilities available (networks, computer based technologies/equipment for teaching and learning), curriculum and instructional issues, technical and administrative support, faculty participation in instructional technology-related policy formulation, and perceived barriers of the adoption and use of technology innovations.

Thus, the purpose for conducting the interviews was to obtain clearer and deeper understanding of what was really going on, and how faculty members adopt and use technology in teaching and learning in the participating institutions. The interview data also played the role of validity check of the responses given by the faculty the technology survey (Schuman, 1970). The data from the interviews could also help in redesigning more suitable surveys for future studies in the area of technology integration into the teacher education curricula (Glesne, 2006). The interview data contributed to a greater understanding of the survey findings in this study.

Analysis of Interview and Open-ended Question Data

The themes of the interviews were based on Ely's eight conditions for implementing educational technology innovations. Responses to the open-ended question were grouped in line with the independent factors of the faculty survey (Appendix A, Part B). Interviewee's views and participants' responses to the open-ended question on the faculty survey were then presented along side the major findings on the data from the faculty survey.

Summary

The study involved faculty members of UEW and UCC's Faculty of Education to determine the association of faculty technology use for teaching and learning (as the criterion factor) with faculty attitudes and their perceptions of technology professional development needs (as independent factors). The purpose was to understand the attitudes and concerns of teacher education faculty towards technology integration across the teacher education curriculum. Therefore, the two sites were chosen because they are the only universities in Ghana that are involved in teacher education at the tertiary level.

Data collected from the faculty survey were analyzed using multiple regression. In addition, individual interviews were conducted to supplement the quantitative findings.

CHAPTER 4

Results

The study seeks to use multiple regression analysis to investigate the degree of relationship between faculty attitudes and faculty perceptions of technology professional development needs and concerns with faculty technology use for teaching and learning. The two research questions are:

(1) To what extent are the following factors:

Factor 1: faculty attitudes towards technology integration in curriculum,

Factor 2: faculty motivation for adoption of instructional technology,

Factor 3: faculty perceptions of the effects of instructional technology on students and pedagogy,

Factor 4: faculty perceptions of barriers and challenges to adoption of instructional technology, and

Factor 5: faculty perceptions of technology professional development needs

related, individually and in linear combination, to faculty use of technology for teaching and learning (Use)? Data gathered from parts of the faculty survey and from faculty interviews were used to answer this question.

(2) What are the stages of technology adoption of faculty members about the use of instructional technology, according to the CBAM stages of concerns? Data from the survey items based on the CBAM were used in conjunction with interview responses to answer this question.

The interview was based on Ely's (1999) eight conditions for successful technology integration in education. Eight faculty members (two from each campus location) participated in the interviews. Four of these were non-adopters. All of the interviewees were male. No females were willing to be interviewed.

Qualitative data were also collected from an open-ended question on the faculty survey. Of the 143 respondents, 103 used the open-ended question to express their views, beliefs, concerns and feelings about their university ICT programs, technology integration, and their perceptions of the role of university management. Responses ranged from 1 to 139 words with an average of 50 words.

Participants were also asked to provide demographic information concerning age, gender, faculty, rank, faculty membership status, teaching experiences, technology experience, initial experience using a computer for teaching/learning, time spent on a computer per week, and when they planned to begin using technology for instruction (if not already using it).

This chapter presents the findings of the study under three sections: (i) descriptive information about participants' demographic data, (ii) regression findings related to the research questions, and (iii) other findings.

Demographic Information of Participants

The participants for this study were 132 faculty members of University of Education, Winneba and the Faculty of Education of University of Cape Coast, both tertiary teacher education institutions in Ghana. Of the 132 faculty members, 87.9% (n = 116) were male. The average age of participants was 45. 6 years (standard deviation = 9.

2). Forty-one percent (41%) of the 127 participants who reported their ages were within the age range of 41-50 years (n = 50).

The majority of respondents (68.2%, n = 90) teach at UEW-Winneba's main campus. Respondents from UCC-Faculty of Education constituted 18.2% (n = 24), while those from UEW's regional campuses at Mampong and Kumasi were 6.1 % (n = 8) and 7.6 % (n = 10), respectively. This distribution reflects the relative faculty population sizes of the four sites.

Participants were asked to state the number of years they have been teaching as faculty members on their campuses. Fifty-one percent (n = 68), who formed the majority, have been teaching for 1 to 5 years, while 46% have been teaching for 6 to 15 years, and 1% between 16 and 20 years. There was no faculty member with teaching experience within the 21- 25 years range, but 2% (n = 2) indicated they have been teaching for 26-30 years. Faculty distribution by teaching experience shows that respondents had relatively low teaching experience. This may be because UEW, where a majority of participants teach, is only 15 years old.

Participants were asked to indicate their technology experience. Of the 124 respondents to this item, 75% (n = 95) had been using technology from 0 to 5 years, while 17% did so for 6 to 10 years, 6% for 11 to 15 years, and 2% for 16 to 20 years. These frequencies indicate that the majority of participants are new to technology.

Faculty members were asked to indicate their level of technology use for teaching and learning. As expected, 50% (n = 66) of participants indicated they were in the low users category, 34.8% (n = 46) were in the moderate users category, and 14.4% (n =19) in the high users' category. These figures indicate that most faculty members (85.5%) in this study were in the early stages (low or moderate users) of technology adoption for teaching and learning.

Participants were asked to indicate the level of technology training that they have had in the past five years. The majority (46.2%, n = 61) of them indicated they had just basic computer literacy training (for example, Microsoft Windows operations) or no training at all, 40.9% (n = 54) said they had training on computer applications such Microsoft productivity tools (for example, Word, PowerPoint and spreadsheets), while 12.9 % (n = 17) said they had training in computer-based technology for teaching and learning. This finding implies that, though 72.7% of participants might have had basic computer literacy or training in computer applications, training in technology integration for teaching and learning purposes was on the low side.

The academic disciplines were categorized into eight areas. Participants were requested to indicate the faculty in which they teach. Most respondents belonged to the Faculty of Science Education and the Faculty of Educational Studies (29.5%, n = 39 in each faculty), while 20 (15.2%) respondents belonged to the Faculty of Languages. These numbers were proportional to the actual number of faculty members in each faculty.

One hundred and sixteen (87.9%) participants were full-time faculty members, 7.6% (n = 10) were part-time faculty and 4.5% (n = 6) were retirees on short-term contracts. In terms of faculty ranks, 3.8 % (n = 5) were professors or associate professors, 75% (n = 99) were lecturers or senior lecturers, and 21.2% (n = 28) were either assistant lecturers or tutors.

Participants were asked to indicate when they intended to begin using technology for teaching and learning, if they were not already using it. Nearly half (49%, n = 65) indicated they were already using technology for teaching and learning, 24% (n = 31) said they would start within a year. Thirty-six others (27%) were undecided as to when they would specifically begin using technology for teaching and learning. This last group is a source of concern because it would appear they were still skeptical about the use of computer-based technology for teaching and learning. It could also be that some faculty members strongly feel the conditions for technology implementation for instruction are not yet in place to begin using instruction technology, as some of the responses to the open-ended question suggest. One participant's views summarized this point as follows:

> [My university's] integration of ICT into teaching and learning is a mere hip [i.e., mere words]. It is not making any impact on the ground because the authorities lack the required focus and direction that should go with the purchasing of computers. ICT is a technological phenomenon, and until it is handled as such, there would be no headway. Some people need to be sensitized, others need to be motivated, and a lot more need to be really trained.

This participant is lamenting the lack of administrative support, the lack of technology resources, and the need for faculty to be trained in order to use technology for teaching and learning.

On the average, participants have been teaching as full-time faculty for 6.8 years (range: 1 - 26 years, standard deviation of 4.8), have been using computer-based technology for teaching and learning for 4.5 years (range: 0 – 20 years, standard deviation of 3.6), spent 2.8 hours per day using a computer (range: 0-12 hours, standard deviation 2.3), had a teaching load of 12.2 hours per week (range: 2 - 40 hours, standard deviation of 6.1), and taught classes of size 228 per semester (range: 2 – 804, standard deviation 160.1).

In the next two sections of this chapter, the results based on the analysis of data collected from the faculty survey (Appendix A: Parts A, B, C and D), and the interview protocol (Appendix B) are presented.

The regression analysis used five independent factors (Factors 1 – 5) and one dependent factor (faculty technology use for teaching and learning (Use)) as explained in Chapter 3 under the subtitle: Research Design and Variables.

Descriptive Statistics for Factors

The descriptive statistics for Factors 1 through 5 consisted of the mean scores of items related to each factor. These aggregate scores on factors were used in the multiple regression analysis. Table 5 displays the descriptive statistics for these factors, for Use and age. Based on the literature, age was included in the analysis as a possible factor related to technology for teaching and learning. Factors 1, 2, 3, and 5 and Use average scores range from 3.46 to 3.97, indicating moderately high attitudinal scores. The mean of Factor 4 (2.84) indicates a disagreement with the aggregate scores on barriers and challenges. Since all negatively stated items were recoded, a disagreement with a "no barrier" should be interpreted as an agreement with a "yes barrier". Thus, this score indicated that, on the average, participants agreed these barriers and challenges were impediments to integrating technology on campus. In other words, faculty members perceived barriers and challenges to technology adoption and use for teaching and learning as an important factor.

Table 5

Descriptive Statistics for Factors

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Use
Mean	3.97	3.83	3.84	2.84	3.84	3.46
Standard Dev	.53	.50	.46	.66	.40	.51
Variance	.28	.25	.21	.44	.16	.26

The bivariate correlations among the factors are shown in Table 6. Factors 1, 2, 3, and 4 correlated strongly ($.49 \leq r$ .64) with the dependent factor, Use. Only Factor 5 correlated weakly ($r = .15$) with Use, but since it also correlated weakly with all the other independent factors, it posed no great concern here in terms of multicollinearity.

Stevens (1996) reported that simultaneous higher correlations of the independent factors with the dependent factor and low correlations among the independent factors enhance a higher multiple correlation coefficient ($\underline{R}$) value. However, Factors 1, 2, 3, and 4 correlated strongly ($.45 \leq r \leq .71$) with each other, which could be a concern because of shared variance due to their overlapping effects as explained later under assumptions of regression analysis.

Table 6

Bivariate Correlations of Regression Factors

	Use	Fact1	Fact2	Fact3	Fact4	Fact5
Use	1					
Fact1	.53	1				
Fact2	.64	.71	1			
Fact3	.60	.55	.65	1		
Fact4	.49	.37	.47	.31	1	
Fact5	.15	.29	.21	.28	-.30	1

Assumptions of Multiple Regression Analysis

The main assumptions of regression analysis are sample size, multicollinearity and singularity, outliers, normality, linearity, homoscedasticity, and independence of residuals. Before the multiple regression was run tests of all these assumptions were conducted.

Sample Size

Sample size is central to the generalizability of results. Results based on a small sample size may not generalize with other samples. For multiple regression, Stevens (1996) recommended a ratio of 15 cases per factor for a reliable regression equation. With a sample size of 132 and five factors, this ratio for the study was approximately 26:1. If age was included as a factor, this ratio reduced to 22:1. Tabachnick and Fidell

(2001) also gave a formula for calculating sample size requirements that take into account the number of independent factors that we wish to use. They advise that $N > 50 + 8m$, where m = number of independent factors. With m = 5 in this study, we have $N = 50 + 8 * 5 = 90$. Thus with a sample size of 132, this condition is met. Furthermore, if age was added as a sixth factor, the condition was still met.

Test for Multicollinearity Assumption

Multicollinearity refers to the relationship among the independent factors. According to Tabachnick and Fidell (2001), multicollinearity exists when the factors are highly correlated ($r \geq .9$). Singularity occurs when one factor is actually a combination of other factors. Multiple regression is sensitive to both multicollinearity and singularity.

In multiple regression a high multiple correlation coefficient, R, requires that independent factors correlate highly with the dependent factor while simultaneously have low multicollinearity among themselves (Stephen, 1996). Multicollinearity is important because the violation of this assumption (i) limits size of the multiple correlation coefficient, R, because of shared variance among overlapping factors, (ii) makes the determination of the importance of independent factors difficult, because of the overlaps, and (iii) increases the variance of the regression.

The assumption of multicollinearity was checked using different recommended strategies: from the correlation matrix, from collinearity diagnostics from SPSS output using Tolerance and VIF, and from the scatter plot of standardized residuals and cumulative normal probability plot.

According to Tabachnick and Fidell (2001), it is preferable that the independent factors correlate with the dependent fact by at least r = .30. It is also recommended that bivariate correlations between the independent factors should not exceed .70. From the correlation table (Table 6), it can be seen that all the factors, except Factor 5, correlated strongly with the dependent factor, Use, with r > .30. Also with the exception of the correlation between Factor 1 and Factor 2 (r = .71), the bivariate correlation coefficients among the other factors did not exceed .70. Factors 1 and 2 needed to be investigated further.

Factor 1 consists of mean scores for faculty attitudes towards technology integration into the teacher education curriculum items, while Factor 2 is about faculty motivation for integrating technology for teaching and learning. Since it is expected that higher motivation may engender higher positive attitudes towards technology integration, it is not surprising that there a reasonably high correlation between these two factors.

From the collinearity table, we can also test the multicollinearity assumption using Tolerance and VIF values. Tolerance gives an indication of how much the variability of a specified factor is not explained by the other factors in the model, and it is given by $TOL = 1-R^2$ for each factor, where R is the multiple correlation, which is also called coefficient of determination, and R^2 is an estimate of the effect size. If TOL < .1, it implies the multiple correlation with other factors is high. The corresponding condition for VIF is that VIF scores are required to be less than 10 for the multicollinearity assumption to be valid.

From Table 7, the Tolerance scores for all the factors range from .37 to .69, while the range of VIF values is from 1. 48 to 2.72. These Tolerance and VIF values showed that there were no violations of the multicollinearity assumption, since TOL > .10 and VIF < 10 for all factors.

Table 7

Tolerance and VIF for Regression Factors

Model	Tolerance	VIF
Factor 1	.46	2.18
Factor 2	.37	2.72
Factor 3	.54	1.84
Factor 4	.59	1.70
Factor 5	.68	1.48

Test for Normality, Linearity, Homoscedasticity, and Independence of Residuals

Normality, linearity, homoscedasticity and independence of residuals all refer to various aspects of the distribution of scores and the nature of the underlying relationships between factors (Pallant, 2005). Residuals are differences between the obtained and predicted dependent factor scores (i.e. faculty technology use for teaching and learning (Use) in this study).

The normality assumption is met when the residuals are normally distributed about the predicted factor, Use. The linearity assumption is met when the residuals have a straight-line relationship with the predicted factor, Use, while homoscedasticity is satisfied when the variance of residuals about the predicted factor scores are the same for all the independent factors' scores.

The scatter plot (Figure 1) of the standardized residuals shows that the residuals are roughly rectangularly distributed, with most of the scores concentrated in the center (along the horizontal line $y = 0$). We observe that no obvious pattern of points occurred. This distribution means that the assumptions of linearity and homoscedasticity (homogeneity of variance) are met. This result is confirmed by the normal probability plot of the regression standardized residuals (Figure 2). From the normal probability plot, it is clear that the scores lie in a reasonably straight diagonal line from bottom left to top right. It can also be seen from the histogram (Figure 3) that the distribution of the regression standardized residuals is almost normal (mean = $4.59E^{-16}$, standard deviation = .977). These findings indicate that there are no major deviations from normality.

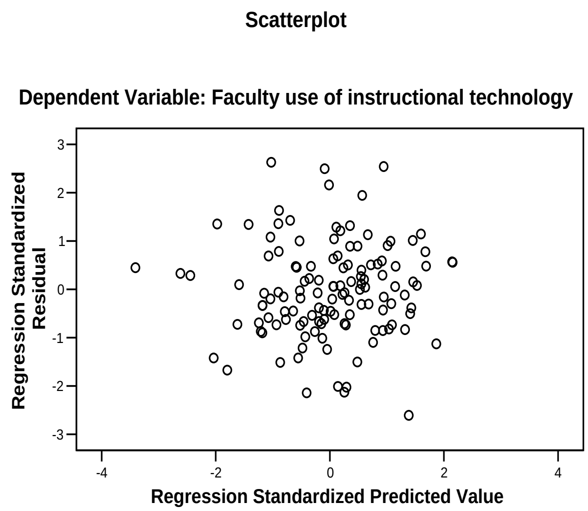


Figure 1: Scatter Plot of Regression Standardized Predicted Values against Regression Standardized Residuals

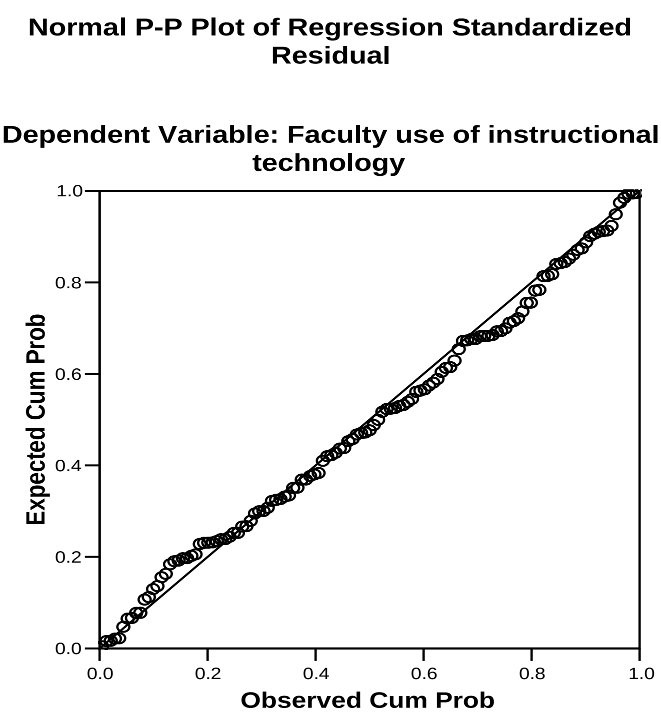


Figure 2: Normal P-P Plot

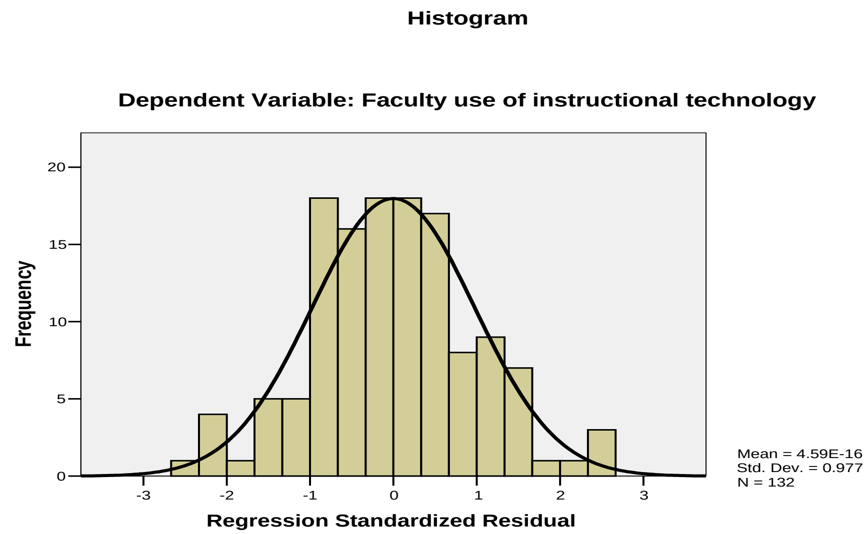


Figure 3: Histogram of Regression Standardized Residuals

Independence of Participants' Scores

Participants were expected to complete the survey independently of one another, but the data screening revealed that six cases were quite identical in almost all responses. It would appear one person completed the entire six copies of the surveys or participants collaborated with each. Five of these cases were removed from the sample to ensure independence of measures on the factors. The test of independence of residuals as stated earlier showed that scores for the remaining 132 cases were independent on the regression Factors 1, 2, …, 5.

Checking Outliers, Extreme and Influential Points

Tabachnick and Fidell (2001) defined outliers as cases that have a standardized residual of more than 3.3 or less than -3.3. From the scatter plot (Figure 1), none of the deviations satisfy either of these conditions. Therefore, there is no serious concern with outliers. The box plot (Figure 4), however, shows that Cases 55 and 111 are outliers associated with Factors 1, 2 and 5. Since these two cases do not occur on any one particular factor, these cases were retained in the study after a confirmation with the Mahalanobis distances test.

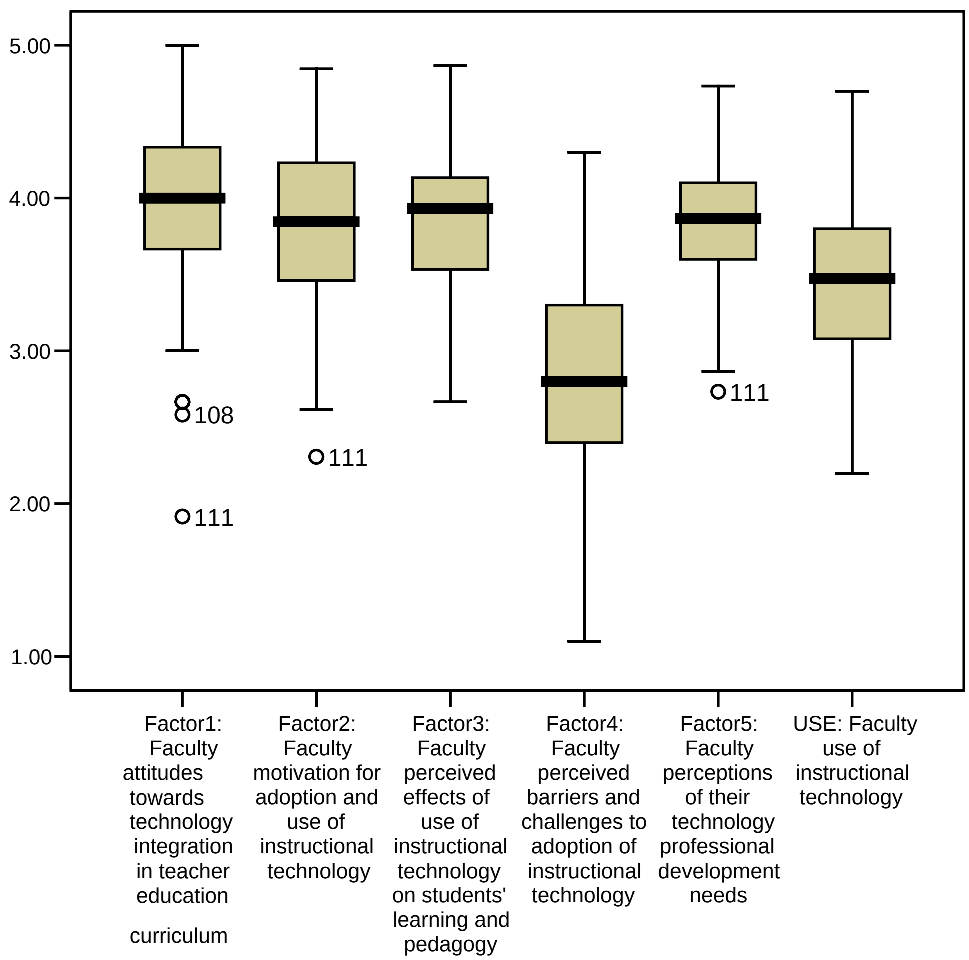


Figure 4: Box Plot

The use of Mahalanobis distances test requires that we use an alpha-level of .001. With five factors, the critical chi-square value was 22.46 (Pallant, 2005, p. 151), using the number of independent factors (5) as the degree of freedom. Cases 55 (observed distance = 26.48) and 79 (observed distance = 24.07) had observed distances greater than the critical value of 22.46. These two cases needed further scrutiny.

Looking back into the data set, it was found that case 55 scored the lowest value (mean = 2.67) for Factor 1, but since this was within the acceptable range [1, 5], the case was retained. On the other hand, the data set revealed that Case 79 scored the highest value on factor 2 (mean = 4.77) and Factor 3 (mean = 4.60), but again because these values were within the acceptable range [1, 5], the case was retained.

There were no cases that had standardized residuals values above 3.0 or below -3.0 as shown by the scatter plot in Figure 1. The residual statistics table (Appendix G) also confirmed that there were no cases with a standardized residual greater than 3.3 or less than -3.3. Thus from these various tests it is clear that outliers are not a concern in this study.

Influential points were checked using Cook's Distances. According to Tabachnick and Fidell (2001), cases with values larger than 1 are a potential problem. From the table of residual statistics (Appendix G), however, it is clear that no case had a Cook's distance greater than 1 (Max = .09). Therefore, influential points are no serious concern in this study.

Thus from the results all of these tests of assumptions, it is safe to conclude that no assumption violations occurred that were a serious concern in this study.

Research Question 1

Hypotheses Testing

A multiple regression was conducted to answer the following research hypotheses:

(a) H_{O1}: R = 0, i.e. linear combination of independent factors does not significantly relate to faculty technology use.

H_{A1}: R ≠ 0, i.e. linear combination of independent factors significantly relates to faculty technology use.

(b) H_{Oi}: $Beta_i$ = 0, i.e. Factor i does not significantly relate to faculty technology use, i = 1, 2, …, 5.

H_{Ai}: $Beta_i$ ≠ 0, i.e. Factor i significantly relates to faculty technology use, i = 1, 2, …, 5.

(c) H_{Of}: R = 0, i.e. there is not any other significant combination of factors better than the full-model.

H_{Af}: R ≠ 0, i.e. there is a significant combination reduced model better than the full model.

Research Question 1 seeks to evaluate the relationship of the independent factors,

Factor 1: faculty attitudes towards technology integration in curriculum,

Factor 2: faculty motivation for adoption of instructional technology,

Factor 3: faculty perceptions of the effects of instructional technology on students and pedagogy, Factor 4: faculty perceptions of barriers and challenges to adoption of instructional technology, and

Factor 5: faculty perceptions of technology professional development needs,

individually and in linear combination, with the dependent factor (Use), using a multiple regression procedure ($\alpha = .05$).

(i) *Test of significance of the combined factors.* A standard regression analysis was conducted to determine the relationship of a linear combination of Factors 1 through 5 with faculty technology use.

The standard regression model summary table (Table 8) and ANOVA table (Table 9) indicated that the test was statistically significant ($F (5, 126) = 27.49$, $p = .000$ ($< .0005$); $\underline{R}^2 = .52$; Adjusted ($\underline{R}^2$) = .50) at $\alpha = .05$. The value of the multiple correlation, R, which indicates how well the independent factors combined relate with the dependent factor (Use), was R = .72. The adjusted $R^2 = .50$ means that all the factors combined accounted for 50% of the variance in the dependent factor, Use.

Table 8

Standard Regression Model Summary

Model	$\underline{R}$	$\underline{R}^2$	Adjusted $\underline{R}^2$	Std. Error	Change Statistics					Durbin-Watson
					R^2 Change	F Change	df1	df2	Sig. F Change	
1	.72	.52	.50	.36	.52	27.49	5	126	.000	1.85

a Predictors: (Constant), Age, Factor3, Factor5, Factor4, Factor1, Factor2

b Dependent Variable: Use: Faculty use of instructional technology

Table 9

ANOVA: Regression Significance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.45	5	3.49	27.49	.000(a)
	Residual	16.00	126	.13		
	Total	33.45	131			

a Predictors: (Constant), Factor 5, Factor 2, Factor 4, Factor 3, Factor 1

b Dependent Variable: Use: Faculty use of instructional technology

Test of significance of individual factors. The significance of the individual regression coefficients, or Beta weights (Table 10), was used to test the hypothesis (H_{Oi}) that each of the factors was not significantly related to faculty technology use for teaching and learning.

For Factor 1, the test was not statistically significant ($t = .559$, Beta = .051; $\underline{p} = .577$). We fail to reject the null hypothesis that Factor 1 does not significantly relate to faculty technology use. In other words, faculty attitudes towards technology integration in the teacher education curriculum were not significantly related to faculty technology use for teaching and learning.

For Factor 2, the test is statistically significant ($t = 2.486$, Beta = .252; $p = .014$) and we reject the null hypothesis that Factor 2 does not significantly relate to faculty technology use. In other words, faculty motivation for adoption and use of technology is significantly related to faculty technology use for teaching and learning.

For Factor 3, the test was statistically significant ($t = 3.523$, Beta = .295; $p = .001$) and we reject the null hypothesis that Factor 3 does not significantly relate to faculty technology use. In other words, faculty perceptions of the effects of technology use on students and pedagogy were significantly related to faculty technology use for teaching and learning.

For Factor 4, the test was statistically significant ($t = 3.641$, Beta = .292; $p = .000$) and we reject the null hypothesis that Factor 4 does not significantly relate to faculty technology use. In other words, faculty perceptions of barriers and challenges to adoption of technology for teaching and learning were significantly related to faculty technology use for teaching and learning.

For Factor 5, the test was not statistically significant ($t = 1.177$, Beta = .088; $p = .241$) and we fail to reject the null hypothesis that Factor 5 does not significantly relate to faculty tech use. In other words, faculty perceptions of their technology professional development needs and concerns did not appear to relate to faculty use of technology for teaching and learning.

Table 10

Regression Coefficients Standard Regression Model

Model		Unstd Coefficients		Std Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	Constant	-.03	.40		-.08	.938	-.81	.75
	Factor 1	.05	.05	.05	.56	.577	-.12	.22
	Factor 2	.25	.10	.25	2.49	.014	.05	.46
	Factor 3	.33	.09	.30	3.52	.001	.14	.51
	Factor 4	.22	.06	.29	3.64	.000	.10	.33
	Factor 5	.11	.10	.09	1.18	.241	-.08	.30

a Dependent Variable: Faculty use of instructional technology

Test of significance of the reduced model. Because neither Factor 1 nor Factor 5 contributed significantly to the regression model, the multiple regression was run again after the exclusion of these two factors. Would Factors 2, 3 and 4 still be able to significantly account for the variance in faculty use of technology for teaching and learning?

To test this hypothesis (H_{Of}), a number of regression procedures were used to select the best possible model. The hierarchical procedure was used because it addresses this hypothesis more appropriately. The factors were entered in the following order: Factor 1 and Factor 5 first, and then Factors 2, 3 and 4. This decision was based on the results of the standard regression, used as preliminary exploratory analysis.

The results (Tables 11 and 12) showed that a linear combination of faculty *motivation* for adoption of instructional technology (IT), faculty perceptions of *barriers and challenges* to adoption of IT, and faculty perceptions of the *effects* of IT on pedagogy and students' learning were significantly ($F (5, 126) = 27.49$, $p = .000$) related to faculty technology use for teaching and learning over and above, faculty attitudes towards technology integration into the teacher education curriculum, and faculty perceptions of their technology professional development needs and concerns ($R^2 = .522$, Adjusted $R^2 = .503$, R^2-Change = .245, F-Change (3, 129) = 21.544, Sig. F-Change = .000 (<.0005)). These three independent factors still accounted for 50% of the variance in faculty technology use for teaching and learning.

Table 11

Reduced Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error	Change Statistics				
					R^2-Change	F Change	df1	df2	Sig. F Change
1	.72	.51	.50	.36	.51	45.07	3	128	.000

a Predictors: (Constant), Factor4, Factor3, and Factor2

b Dependent Variable: Use: Faculty use of instructional technology

Table 12

ANOVA: Regression Significance for Reduced Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.179	3	5.726	45.066	.000(a)
	Residual	16.264	128	.127		
	Total	33.443	131			

a Predictors: (Constant), Factor4, Factor3, and Factor2

b Dependent Variable: Use: Faculty use of instructional technology

Since the second model explains just about the same proportion of variance in faculty technology use for teaching and learning with fewer factors, we reject the null hypothesis that *there does not exist other significant combination models better than the* *full model* and accept the alternate hypothesis that *there exists another significant combination model better than the full model.* In other words, a linear combination of faculty motivation for adoption and use of instructional technology, faculty perceived effects of technology use on pedagogy and students' learning, and faculty perceived barriers and challenges to technology adoption and use gave a better model than the full model. Table 13 shows the regression coefficients for the reduced model with only three factors.

Table 13

Regression Coefficients for Reduced Model

Model 2	Unstd Coeff		Std Coeff			Correlations		
	B	Std Error	Beta	T	Sig.	Zero-order	Partial	Part
Constant	.348	.279	----	1. 245	.215	-------	----	----
Factor2	.308	.088	.307	3.520	.001	.635	.297	.217
Factor3	. 360	.089	.325	4.026	.000	.601	.335	.248
Factor4	.191	.053	.250	3.574	.000	.494	.301	.220

The final regression equation for the unstandardized B-coefficients was:

Predicted Use = .308*Factor2 + .360*Factor3 + .191*Factor4 + .384.

The final regression equation for the reduced model involving significant factors was: $\text{Predicted}Z_{\text{Use}}$ = .307*Factor2 + .325*Factor3 + .250*Factor4.

Relative importance of the factors. To compare the relative importance of the factors, the Beta-weights were used in conjunction with partial coefficients. The Beta weights are useful because each of the different factors has been converted to the same scale (standardized). Table 14 shows the relative Beta weights of the factors in decreasing order.

From the Beta–weights (Table 14), it seemed that *faculty perceptions of the effects of technology use on students' learning and pedagogy* (Factor 3) made the most significant unique contribution to faculty use of technology for teaching and learning (Use). However, looking at the t-statistic values, p-values and CI ranges, it would appear faculty perceptions of *barriers and challenges to adoption of IT* is more statistically significant, as confirmed by the part-squared scores (Table 15).

Faculty perceptions of technology professional development needs (Factor 5) made the least unique significant contribution to faculty use of technology for teaching and learning.

Table 14

Beta Values: Relative Importance of Factors

Factor	Beta	t-statistic	Sig.	CI
Factor 3	.295	3.52	.001	[.14, .51]
Factor 4	.292	3.64	.000	[.10, .34]
Factor 2	.252	2.49	.014	[.05, .46]
Factor 5	.088	1.18	.241	[-.08, .30]
Factor 1	.051	.56	.577	[-.81, .75]

The part correlation table (Table 15) confirms the relative contribution that each of these factors made to the total R^2 (i. e. how much of the variance in faculty use of technology for teaching and learning is uniquely explained by each these factors, and how much R^2 would drop if the factor were not included in the model).

Zero-order correlations are the bivariate correlation coefficients of the individual factors with the dependent factor (Use). The Part-squared values ranked Factor 4, faculty *perceptions of barriers and challenges to adoption of IT,* as the most important factor for faculty technology use for teaching and learning. This factor contributed 5.5% to the value of R^2. The second most important factor is Factor 3, *faculty perceptions of the effects of IT on students and pedagogy* (4.7%), while *faculty motivation for adoption of instructional technology (*2.3 %) *is the third most important factor for faculty technology use for teaching and learning*. Factor 5, faculty *perceptions of their technology* *professional development needs,* and Factor 1, faculty *attitudes towards technology integration into the teacher education curricula,* contributed almost nil to the regression coefficient.

Table 15

Part and Partial Correlations

Factor	Zero-order	Partial	Part	Part-squared
Factor4	.49	.31	.224	.055
Factor3	.60	.30	.217	.047
Factor2	.64	.22	.153	.023
Factor5	.15	.10	.073	.0053
Factor1	.53	.05	.034	.0001

Thus, considering both the Beta coefficients and Part-squared scores for all the factors it was clear that *faculty perceptions of barriers and challenges to adoption of IT*, *faculty perceptions of the effects of IT on pedagogy and students, and* faculty *motivation to adopt and use technology for teaching and learning* are the important factors that related to faculty technology use for teaching and learning in this study.

Faculty attitudes towards technology integration in curriculum and faculty perceptions of technology professional development needs did not appear to significantly relate to faculty technology use for teaching and learning.

Interviews and Open-ended Responses

The supplementary interviews and the responses of participants to the open-ended question on the faculty technology integration survey were analyzed alongside the findings of the regression analysis to shed more light on the major findings. This was done factor by factor as follows:

Faculty attitudes towards technology integration into tertiary teacher education curriculum (Factor 1). The regression analysis showed that faculty attitudes towards technology integration into the teacher education curriculum (Factor 1) did not significantly relate to faculty technology use for teaching and learning.

One of the conditions that might explain Factor 1's insignificant relationship with Use is the level of its relationship with the other independent factors. From the correlation matrix (Table 6), it was found that Factor 1 correlated quite highly with *faculty motivation for adoption of instructional technology* (Factor 2), a significant factor in this study, by as much as $r = .71$. Factor1 also correlated reasonably strongly ($r = .55$) with *faculty perceptions of technology use on students' learning and pedagogy* (Factor 3), the most significant factor in this study. It would appear, therefore, that when all these three factors (Factor 1, Factor 2, and Factor 3) are included in the regression model, there would be a lot of shared variance among them that is statistically removed due to their overlaps. Thus, the importance of Factor 1 may be subsumed in the contributions of the other two significant factors with whom it correlated highly.

This finding may be an indicator that faculty members of these two institutions in Ghana were receptive to integration of technology into their teacher education curricula. The mean score for this factor was 3.97, indicating a high positive attitude score.

Responses from the open-ended question and interviews indicated that faculty members of these institutions believe in the efficacy of technology integration into the teacher education curriculum, as one participant put it:

> I believe that the integration of ICT into the teacher education curriculum is a giant step in the overall development and promotion of ICT to the nation as a whole. Because what better way [exists] in spreading ICT to students than through teachers. It also helps develop interesting ways of learning that catch on well with students and breaks away from the traditional methods of disseminating instruction to students.

Others see technology as a major tool in the teacher education curriculum as the following quotation from a participant showed:

> ICT is a major tool needed to enhance students' learning and a way for searching for information. ICT also encourages lecturers to look for a broad range of information on issues and makes teaching rich. It also maximizes students' participation in lessons.

In this study it would appear faculty members no longer resist technology innovation, but rather the lack of technology resources and expertise appeared to be the problem. One participant put this in the following quotation:

> Integration of ICT into the teacher education curriculum and for teaching and learning as a teacher educator is welcome news. This is because it supports effective teaching and learning and therefore improves performance. However, in our situation, apart from the ICT system being ineffective, there is a problem of inadequate ICT facilities. These problems make ICT usage irregular.

This view was supported by another participant when s/he observed that:

> It [Technology integration] will be a fantastic idea, provided the university can provide the facilities when needed, and in the right quantities, all faculty become enthusiastic and willing to learn and adopt ICT in teaching ; and the university adopts an effective and efficient maintenance culture.

However, one area all interviewees agreed on was the fact that neither their current curricula nor institutional policy requires the use of technology for teaching and learning. In effect technology integration into the curriculum is yet to take place, though some individual faculty members have began using technology in their teaching. When asked whether their current curriculum or university policy requires faculty to use technology for teaching and learning, one of the interviewees responded in the following words:

> I would not say we have integrated technology into our teaching learning yet. What I would say is that faculty members are now generally using ICT for their

> routine work such as word processing and surfing the World Wide Web. A few use PowerPoint presentations in their lesson, but generally I would say we have not as yet integrated technology into the curriculum.

Overall, this study provided evidence that faculty members of the two institutions are ready for the wider adoption and use of technology for teaching and learning, if the conditions on the ground are supportive enough.

Faculty motivation for adoption of instructional technology (Factor 2). Faculty motivation for technology adoption and use for teaching and learning made a significant unique contribution to the explanation of variance in faculty use of technology for teaching and learning (Use). Motivation, therefore, is an important factor to faculty adoption and use of technology for teaching and learning in this study.

Ely's (1999) conditions for successful technology implementation indicate that faculty members' dissatisfaction with the status quo (feeling a need to change), rewards or incentives (internal and external motivators preceding and following technology adoption) and faculty participation in decision-making as important ways of motivating faculty to adopt and use technology for teaching and learning. As observed by some participants, however, the two institutions do not seem to be giving the desired attention to these issues. The commitment on the part of academic administrators in terms of firm and visible evidence of continuing endorsement and support for technology integration seemed to be lacking or at best half-heartedly practised.

On the other hand, some participants cited the beneficial effects of technology on instruction and students' learning as issues that motivate them to adopt and use technology. One area emphasized in the interviews was the belief that information and communications technologies can addresses the challenges of large class sizes and enhance sources of information for preparing instructional materials. These benefits apply to students as well as instructors:

> It [technology integration] will make learning easier and students will be more involved in class activities. Teachers would be less burdened to source information for their students. Besides, students will also get access to remote materials which otherwise would have been difficult to obtain.

In the view of one participant who was a mathematics educator: “Integrating ICT into mathematics education can be an innovative way of breaking the myths of mathematics learning and offer alternative approaches to the instructor. [ICT is] an important development that should be embraced by all teacher educators.”

As one participant put it, “Integrating ICT into teacher education curriculum has positive effects. ICT not only makes T & L interactive but also helps students to learn faster through audio-visual medium of instruction.” Clearly, faculty members are aware of the benefits of technology integration on their teaching. Another participant expressed the view that “ICT is bound to improve the learning skills of students, help them in their research work, and also make learning simple for them. The curriculum will be enriched.” Another participant was blunter on the lack of motivation to integrate technology into the curriculum: “IT is very important but lecturers need workshops and the necessary hardware and software to implement. The situation in UEW is not helpful: No hardware, no good support system, etc.”

Others see the provision of technology equipment such as computers, presentation equipment and subject-based software as motivating factors in their efforts to integrate technology into teaching and learning. These views were summarized by one participant when s/he said, “Lecturers should be given enough computers to help them teach students effectively. Workshops/seminars on ICT should be enhanced.”

This study showed evidence that the majority of faculty members were receptive to the use of technology in instruction and communication for teaching and learning. Participants reported a strong desire for (i) more technology resources for instruction, (ii) innovative academic leadership and technical support, and (iii) more professional development related to technology integration into the teacher education curriculum.

Faculty perceptions of the effects of technology use on pedagogy and students' learning (Factor 3). As can be seen from the Beta values (Table 14) and part-squared values (Table 15), Factor 3 made a significant unique contribution to explaining faculty use of technology for teaching and learning, when the variance explained by all the other factors in the model was controlled. In this case, faculty perceived technology as important to the extent that it has an impact on their pedagogy and students' learning. This finding is in line with Roger's (1995) theory of relative advantage. Rogers argues that even if individuals are exposed to innovation messages, such exposure will have little effect unless the innovation is perceived as relevant to the individual needs and as consistent with the individual's attitudes and beliefs.

From participants' responses to the open-ended question, it is clear that faculty members are aware of the beneficial effects of technology integration on pedagogy and students' learning. For example, one participant observed that:

> The integration encourages students to adopt deep learning approaches to their studies; hence [it] will encourage the students to study for understanding and be able to apply the skills and knowledge so gained to several things that they will encounter in real life, and in their professions.

Another participant put this in another way:

> It is really crucial that ICT be integrated into teacher education curriculum. Teachers' source of information, their strategies and their students are all getting hooked to computers and the Internet. We can't even predict the nature of information source in the very near future.

Some others see the effects of technology integration in the light of long term benefits to teacher trainees:

> Generally, when ICT is integrated into the teacher education curriculum, it would equip the teacher to use IT as a tool to teach and also to prepare his/her materials for students. Secondly, the student would also benefit from it after being exposed to ICT and would use it during his/her curricular work.

A participant, who is one of the few instructional technology users, believes that technology has direct effects on teaching and learning in the following way:

> It [ICT] saves a lot of man-hours in the classroom attending to students on one-to-one basis. This is because ICT engages students at their own leisure time and is

able to correct errors they make for them. Much work is done this way; students love to work more on their own as they witness the output of their efforts without delay.

Another participant observed that "ICT brings the traditional method of teaching much closer to the learner" and that "the learners will be more inclined to look for information themselves." He/she thought technology would enhance both the traditional methods of teaching as well as learners' efforts to find information independent of their instructors.

Other participants see the impact of technology on their teaching load as well as an enhancement of learners' independent learning of some aspects of the curriculum. One of the interviewees put this succinctly in the following words: "When ICT is integrated into the curriculum it will ease the workload of instructors, and students/learners will be able to learn certain aspects of the curriculum on their own and at their own pace."

The results of this study have shown that faculty members are dissatisfied with the status quo and are desirous of change as pointed out in Ely's (1999) conditions for technology integration. However, Wilson, Sherry, Dobrovolny, Batty, and Ryder (2001) observed that how the technology fits into existing social purposes and practices will largely determine its prospects for its appropriation and use by the community. Faculty members would not hesitate to adopt a technology innovation if its overall effect will enhance their teaching and students' learning (Rogers, 1995).

Faculty perceptions of barriers and challenges to the adoption and use of technology for teaching and learning (Factor 4). Factor 4 made a unique significant contribution to explaining faculty use of technology for teaching and learning (Tables 14 and 15). Faculty perceptions of barriers and challenges to their adoption and use of instructional technology were relevant, because, according to Rogers (1995), unless these barriers, challenges, needs and concerns are addressed, the technology integration into teaching and learning would remain an illusive educational goal.

One participant, who had a lot of technology experience elsewhere before moving to his current university, saw the lack of hands-on experience for students and faculty members as one of the barriers to faculty's use of technology for teaching and learning. But s/he is also concerned about the lack of communication between faculty and academic administration with regards to technology integration. His/her views are summarized below:

> We need less formal courses and instead more hands-on experience for students and staff; since the Internet is not dependable it is very frustrating to work with computers at [this university]. In addition, the flow of information is quite reduced: The University's ICT Plan is neither communicated to lecturers nor is their opinion sought. In fact, the priority of ICT seems to be in supplying the administration and not those that are transmitting knowledge. … Support in hardware maintenance is nil and even though the network has improved, Internet access is still very unreliable (about 70% on, 30% off).

These concerns were supported by other respondents as the following quotation showed:

> ICT is important but we should be sure that the necessary infrastructure and materials should be put in place. It is very expensive to run ICT curriculum. So

> proper planning is needed. If possible, we have to solicit help from outside the country. I wonder how all our SSS [Secondary] schools will benefit from ICT education, when even basic needs such as classrooms, electricity, and water are not available to rural schools. We have to plan very well. Remember that we declare our country to be 'Highly Indebted Poor Country' (HIPC).

The lack of academic administrators' support, the lack of time to integrate technology into the curriculum, the lack of expertise, and the lack of technology resources and facilities were the commonest concerns of participants in this study. Quotations from a few more participants would better convey these feelings:

> [My university] should be proactive in its ICT programme because it seems the authorities are not serious at all with the ICT program. Regular and consistent ICT training workshops [should] be organized for faculty members. [This university] should recruit competent and knowledgeable ICT personnel to man the ICT centers. Instructors need high performance capacity computers to work with. …. I think it's a laudable idea for ICT to be integrated into the teacher education curriculum in order to enhance teaching and learning in an educational sector.

Another faculty member said,

> [My university] should improve upon ICT equipment to make ICT programmes more effective; faculty members need to be trained in ICT works; More ICT personnel should be brought into the institution; the network system of the university is very poor and there is the need to look for more effective ones; the idea of using ICT in the teaching/learning process would make ideas easily

> transmittable to learners and I highly recommend its use in our institutions in Ghana.

Access to the Internet was another common concern of participants in this study. Internet is seen as a key component of technology resources for teaching and learning and these participants did not mince words about their frustration with the lack of reliable access to the Internet and other computing equipment:

> It is a good idea, but we don't have the resources and expertise. We need reliable Internet access and technology equipment to work with. The workshops are good but not sufficient in addressing our individual or departmental needs. These workshops would be more relevant if run on departmental basis.

Another participant observed that:

> It is good to integrate technology for teaching and learning, particularly using the Internet. But we neither have the computers and equipment [nor] software for classroom instruction. The ICT centers schedules don't allow continuing students access to the computer facilities.

Another faculty member expressed his/her frustration with the system in the following words:

> I think this talk of ICT integration has been going on for far too long. We should be more serious with the idea than mere lip service. Lecturers still lack the know-how and the resources to implement the program.

One participant was a bit pessimistic about the feasibility of technology integration in the current Ghanaian situation. He suggested that the institutions could implement technology integration gradually:

> Integrating ICT for teaching and learning at this stage of our infrastructural development does not seem feasible. But we can begin somewhere and move on gradually. The government and university administration have to provide lecturers and students free Internet access. We need more training to be able to integrate ICT for teaching and learning.

These observations of the participants in this study reflected the importance of Ely's (1999) eight conditions that facilitate the implementation of educational technology innovations. Ely identified among other issues the lack or availability of *resources* (the availability of hardware, software, technical support, infrastructure and others that are needed to make technology integration work), *time* (prioritized allocation of time to make technology integration work), faculty *participation* (shared decision-making, full communication, and good representation of faculty interests), *commitment* (firm and visible evidence of continuing endorsement and support by institutional leadership) and *expertise* (faculty access to the knowledge and skills required to implement technology innovations for teaching and learning) as important factors that influence technology adoption and use by educators.

Unfortunately, the findings of this study showed that these two universities do not meet these conditions for a successful implementation of their technology innovation programs.

One other important barrier participants openly discussed with me was the time constraints, heavy teaching load and large class sizes. This is one area Cuban's (1986) concerns about the effectiveness of technology integration into teaching and learning may be relevant. Cuban had argued that teachers are already over-burdened enough without the requirement for them to incorporate computer use as a regular part of instructional practice. Becker (2000), basing his argument on data from a 1998 national survey of teachers, teaching, and computing, agreed with Cuban's position. Faculty overloaded working conditions may still limit widespread classroom use of computers as pointed out by one of the interviewees in this study:

> Our department lab has only 30 PCs, the average class size is about 250 students. Many lecturers have to co-teach such large classes. So scheduling the lab sessions becomes a big problem, besides the inadequate number of computers for students' use.

This study showed that faculty members face numerous barriers and challenges in their efforts at integrating technology into their instruction. Some of these barriers are (i) the lack of technology resources, including unreliable access to the Internet, (ii) the lack of faculty's participation in the technology decision-making process, (iii) the lack of expertise and skills for technology integration into the curriculum and for instruction, and (iv) heavy teaching loads and time constraints in the face of large class sizes.

Faculty perceptions of their technology professional development needs and concerns (Factor 5). A bigger surprise in this study was the insignificant relationship of faculty perceptions of their technology professional development needs with faculty technology use for teaching and learning. Factor 5 marginally correlated with all the other independent factors, except Factor 4. It also was the least correlated factor with the dependent factor (Use). That is a concern. It is therefore tempting to conclude that this factor did not interact meaningfully with the rest of the factors investigated in this study. However, this factor's mean score was 3.84 with standard deviation of .40, which indicated a high positive perception of technology professional development.

Thus, even though faculty members of these two Ghanaian universities may value the importance of technology professional development, they may not have the opportunity to implement whatever they have learnt, or in fact they may not have had sufficient technology expertise to integrate technology into their teaching and learning.

A myriad of faculty members' needs and concerns were expressed in their responses to the open-ended question and interviews. Many lamented their lack of training opportunities, their inability to practice what they have been taught because of the lack of follow-up workshops and inadequate focus on their unique needs. Apart from the majority of faculty members' lack of technology expertise and skills, many also observed that the irregular workshops and seminars have not been effective or sufficient to enable them to integrate technology into teaching and learning. They also see technology integration as an important tool for teaching and learning. As one faculty member stated:

> I think it [ICT] is an important tool that will help take teaching and learning to greater heights. [I] will need an expert in ICT to take me throughout stage by stage. The many things that the computer can [do] make me even more confused

to attempt using it as a tool in my teaching. Nonetheless, the benefits are tremendous.

Though this study found that faculty members have a positive perception of their technology professional development needs and concerns, this factor does not significantly contribute to the variance in faculty use of technology for teaching and learning. This finding seems to agree with Lambert (1988) and Wade (1989), who argued that professional development has been only moderately effective in bringing about changes in schools. Furthermore, others (Little, 1993; Norris, 1993) argued that professional development programs do not seem to make significant impact on school changes and reforms because faculty members are not involved in the planning and designing of such programs. On the other hand, Fullan and Hargreaves (1996) and McKinnon and Nolan (1989) reported that faculty technology professional development enhanced faculty adoption and use of technology for teaching and learning. Recent research (Palak, 2004) also indicated that taking faculty needs and concern into consideration when designing professional development enhanced the relevance and usefulness of such programs.

As pointed out by some of the interviewees, it would appear that large-group technology workshops, though they have been helpful in creating a general awareness of technology issues in education, have not had significant impact on faculty use of technology for teaching and learning. This was a common observation from the interviews. Large group workshops like mass media (radio, TV, newspapers, books) may have powerful effect on diffusion as they spreads knowledge of innovations to a larger audience rapidly and may even lead to changes in weakly held attitudes (Rogers, 1995). However, Orr (2003) observed that firm attitudes are developed or changed through communication exchanges about the innovation with peers and innovative opinion leaders. Thus, strong interpersonal ties are usually more effective than the mass media in the formation and change of strongly held attitudes.

Another possible reason why faculty perceptions of their technology professional development needs appeared to have no significant relationship with faculty technology use may be their lack of technical knowledge and skills needed for effective technology integration into their teaching, as pointed out by many of the interviewees. Research (Becker, 2000; Ely, 1999; Hall & Loucks, 1978, Palak, 2004) indicates that teachers who have a reasonable amount of technical skill and who use computers to address their own professional needs use computers in broader and more sophisticated ways with their students than those who have limited technical skills and no personal investment in using computers themselves.

As observed by one of the interviewees:

> Most of us lack the technology know-how and skills to integrate technology into our teaching. The workshops have had marginal effects because most faculty members do not have the opportunity to put into practice what they have learned. Without the follow-up workshops and technology equipment and other resources, faculty members sooner forget whatever they have learned.

Faculty members may also be discouraged from the adoption and use of instructional technology by the lack of their involvement in their institutions' technology innovation plans. When asked how much faculty members were involved in the technology plan for their university, one of the interviewees remarked that:

> That is one area that the university administration has not done well. They go to Accra and hire some technology experts to draw the plan with a few members of the technology management committee. They only inform faculty members after they have finalized everything with the external consultants.

This observation is in line with Little's (1993) that, in most cases, professional development programs are designed, organized, and delivered based on the skills and knowledge of policymakers, and external facilitators assume faculty members' needs, rather that allowing faculty to identify their needs and concerns and designing programs to address those needs.

The insignificant relationship of faculty perceptions of their technology professional development needs and concerns with faculty technology use for teaching and learning in this study may therefore be explained within the context of faculty members(i) lack of technology knowledge and skills, (ii) the lack of participation in technology innovation decision process, and (iii) the lack of opportunity to have hands-on experience with technology in instruction because of limited technology resources. These issues suggest that faculty members need an on-going technology professional development program in order to integrate technology into teaching learning.

Research Question 2

Participants were asked to indicate their stages of adoption and use of technology for teaching and learning based on the CBAM technology adoption survey (Appendix A, Part C). Data from this survey were used to answer this research question.

A total of 131 faculty members completed the stages of adoption survey. The distribution of their adoption stages (Table 16) appears evenly divided among Stage 1 – Stage 5, with a few at Stage 6, the highest stage. As Table 16 indicates, 55.7% of participants are in the awareness, learning, and understanding and application stages (Stages 1, 2 and 3), 34.4% in familiarity and confidence and adoption to other contexts stages (Stages 4 and 5), while 9.9% are in creative application to new contexts stage (Stage 6).

Table 16

Distribution by Stages of Technology Adoption

Level of Adoption	Frequency	Percent	Valid Percent	Cumulative Percent
Stage 1 (Awareness)	24	18.2	18.3	18.3
Stage 2 (Learning process)	22	16.7	16.8	35.1
Stage 3 (Understanding & application of the process)	27	20.5	20.6	55.7
Stage 4 (Familiarity & confidence)	20	15.2	15.3	71.0
Stage 5 (Adoption to other contexts)	25	18.9	19.1	90.1
Stage 6 (Creative application to new contexts)	13	9.8	9.9	100.0
Total	131**	99.2	100.0	

** One participant did not indicate his/her level of adoption

These findings agree quite closely with the findings of the technology user level item, in which 50% (n = 66) of participants indicated they were in the low users category (Level 1), 34.8% (n = 46) were in the moderate users category (Level 2), and 14.4% (n =19) in high technology user category (Level 3), presented earlier in this chapter under demographic information.

Both sets of findings showed that participants in this study are a heterogeneous group of faculty members, whose needs and concerns are bound to differ from one another. The implications of this finding for change agents are that (i) faculty members are aware of technology interventions in education and understand and appreciate technology use in their teaching, and (ii) the group is diverse in their technology needs and concerns.

The results from this survey also suggested that the majority of faculty members have not yet started implementing and confirming technology adoption and use for teaching and learning.

Other Findings

Faculty Age

Based on the literature, the age of faculty members was considered a possible moderating factor in the use of technology for teaching and learning. To test this possibility (Age does not significantly relate to faculty use of technology for teaching and learning), faculty age was added to the multiple regression model. Faculty age entering the model alone was significant (Beta-coefficient -.21, $t = -2.50$, $p = .014$, CI = [-.022, -.003]) in its relationship with faculty technology use for teaching and learning, with older faculty members using technology less, as indicated by the negative value of the Beta score. However, when all the others factors were included in the model, age was found to be only slightly significantly (p = .041) related to faculty technology use for teaching and learning, though the overall model fit was significant. This showed that the independent factors significantly relate to faculty technology use for teaching and learning, over and above faculty age (Adjusted $R^2 = .52$, $p = 000$), with F Change increasing from 6.23 to 26.58, and R^2 Change increasing from .05 to .49.

One reason age may not be an issue in this study is because computer-based technology use for teaching and learning is new in Ghana. It could therefore be that young and old faculty members alike are all now being introduced to technology use in instruction.

Gender

A one-way MANOVA was conducted with Gender as the independent factor and Factors 1 – 5, and Use as the dependent factors. The results indicated that there was no significant difference between male and female faculty members' scores on these dependent factors ($p = .202$ for Wilks' Lambda test statistic for multivariate test of significance). The tests of Between-Subjects Effects were all insignificant for all the dependent factors ($.06 \leq p \leq .63$). Thus, gender differences were not significant among faculty members in their attitudes towards technology use for teaching and learning.

Findings of Supplementary Research Questions

Other issues not specifically covered by the research questions include (i) DOI channels of communication, and (ii) analysis of the survey data by levels of technology use. It may be of interest to know if low-level, moderate-level and high-level technology users differ significantly in their attitudes towards technology adoption and use for teaching and learning as measured by Factors 1 – 5 and faculty technology use, and if there exist significant differences among these groups of technology users in their views about communication channels for technology adoption and use for teaching and learning. This part of the chapter seeks to answer the following supplementary research questions:

(i) Are there differences among High, Moderate and Low users in their attitudes towards technology use for teaching and learning?

(ii) Based on the frequency of high, moderate, and low use of technology, do faculty members rate communication channels for obtaining information about technology differently?

The independent factor was technology user level (1 = low, 2 = moderate, 3 = high). Participants were asked to describe their level of use of computer-based technology for teaching and learning (Appendix A, Part A1, Item 4). Of 131 participants who answered this question, 66 indicated they were low-level users, 46 were moderate-level users and 19 were high-level users. This independent factor was used to answer both research questions.

A one-way MANOVA was performed with attitude Factors 1 – 5, Use and measures of communication channels as dependent factors and level of technology use (1 = Low, 2 = Moderate, 3 = High) as the independent factor.

From the multivariate tests, the overall MANOVA was significant meaning that there exist significant differences among low, moderate and high technology users when we consider Factors 1 – 5, Use and communications channel measures as dependent factors. All four statistics (Pillai's Trace, Wilk's Lambda, Hotelling's Trace, and Roy's Largest Root) proved significant ($p < .0005$) with observed power of 1.0 and effect size (η^2) between .263 and .451 (large effect size) at an alpha level of .05. The tests of between-subjects effects were conducted and found to be significant as shown in Table 17. Only significant results were displayed in the table.

Table 17

Test of Between-Subjects Effects

Factor	df1	df2	F	Sig.	η^2	Power ($\alpha = .05$)
Factor 1	2	128	9.96	.000	.135	.983
Factor 2	2	128	14.50	.000	.185	.999
Factor 3	2	128	7.12	.001	.100	.927
Factor 4	2	128	12.67	.000	.165	.996
Use	2	128	31.03	.000	.327	1.0
SIKACI**	2	128	3.38	.037	.050	.628

** SIKACI stands for Sources of Information about keeping abreast of changes/innovation in areas of computers in instruction.

The faculty survey on Factors 1-5 (Appendix A, Parts A and B) is the source of data for the Research Questions (i) and (ii). The dependent factors (Factors 1 – 5) have been described in Chapter 3.

Thus, for these dependent factors, the null hypotheses that there were no differences among low, moderate and high technology users in their scores were rejected. This means that there are differences among these groups of faculty members in their attitudinal measures (Factors 1, 2, 3, and 4, their use of technology for teaching and learning, and in their sources of information about keeping abreast of changes/innovations in areas of computers in instruction). The detailed results were given in Appendix H.

The tests between-subjects effects for Factor 5, media and methods for acquiring new computer skills and knowledge for instruction, and sources of help/assistance with using computers for instruction were not significant ($p > .05$). The null hypotheses that there were differences among low, moderate and high technology users in the scores for these factors could not be rejected. Hence, statistically speaking, the three groups did not differ in their scores for these factors.

Since the overall multivariate test was significant, follow-up tests were conducted to determine pairwise differences among low, moderate and high technology users mean scores.

The Levene's test of equality of error variance indicated that the assumption of equal variances of error was not significant for Factors 1, 3, 5, Use, Media and methods for acquiring new computer skills and knowledge, sources of help with computer use, and sources of information about technology innovations. So for these factors, it could be assumed that error variances of these factors were equal across the three groups of technology users. However, Levene's tests for Factor 2 ($p = .035$) and Factor 4 ($p = .044$) were statistically significant. Therefore, there were significant differences across groups in error variances of these two factors.

Since the tests of equality of error variances were not all significant and in order to control Type I error, I decided to use Dunnett's C (equal variances not assumed in population) to carry out the post-hoc pairwise comparisons.

Research Question (i)

This research question sought to find if there were significant differences among High, Moderate and Low users in their attitudes towards technology use for teaching and learning. The Dunnett C values of the multiple comparison table (Appendix H) were used to answer this question.

For faculty perceptions and views about technology integration into teacher education curricula, there were significant differences between low and high users, and between moderate high users, with high users having a more positive attitude. There was no significant difference between low and moderate users on this factor.

For faculty motivation for adoption and use of instructional technology, there were significant differences among all three groups pairwise, with higher users having the highest motivation, followed by moderate users.

For faculty perceptions of the effects of use of instructional technology on students' learning and pedagogy, there were significant differences between low and moderate users and between low and high users, with higher users having more positive perceptions, but no significant difference between moderate and high users.

For faculty perceptions of barriers and challenges to adoption and use of instructional technology, there were significant differences between low and moderate users and between low and high users, with higher users perceiving more barriers, but no significant difference between moderate and high users.

For faculty perceptions of their technology professional development needs and concerns, there were no significant differences among low, moderate and high technology users among faculty members of the two universities in their perceptions of technology professional development needs and concerns.

In summary, higher users of technology tended, to some extent, to have more positive attitudes about technology integration, to have higher motivation for using technology, to have more positive perceptions of the effects of technology on students' learning, and to perceive more barriers to using technology.

Research Question (ii)

This research question sought to find out whether faculty members rate communication channels for obtaining information about technology differently, based on the frequency of high-level, moderate-level, and low-level use of technology

To answer this question, data from the survey (Appendix A, Part D) on faculty members' communication channels related to technology adoption and diffusion were used. Participants were asked to rate the level of importance (5 = very important, 1 = not important) on Likert's five-scale interval of each of the following three areas of communication:

(i) Communication media and methods for acquiring new computer skills and knowledge for teaching and learning (8 items)

(ii) Sources of help or assistance with using computers for instruction (7 items), and

(iii) Sources of information for keeping abreast of changes/innovations in the area of computers in instruction (11 items). These dependent factors were scored by computing the mean responses for each factor.

The Dunnett C values of the multiple comparison table (Appendix H) were used to answer this question. There were significant difference between low and moderate technology users on their sources of information about keeping abreast of changes/innovation in the area of computers in instruction (F (2) = 3.378, $\underline{p}$ = .035, η^2 = .05, Power = .628). Low technology users scored higher (mean = 3.91) on this measure than moderate (mean = 3.66) and high users (mean = 3.74).

The main sources of information referred to in this factor included informal network of friends and family; professional colleagues on campus and from other institutions; head of department/deans; university administration; innovative students; popular newspapers, computer magazines, and television; refereed or online computer journals; conferences, demonstrations and workshops; internet (online computer newsgroups and websites); and hardware and software catalogs and brochures.

This finding shows that low technology users rated these sources of information higher than did moderate and high users. A look at the mean scores for these three groups, however, shows that the differences among them are not very much. Furthermore, the results did not show significant difference between high and low users on this factor.

The tests between-subject groups were not significant for (i) communication media and methods for acquiring new computer skills and knowledge for teaching and learning and (ii) sources of help or assistance with using computers for instruction.

The demographic data from this study showed the two Ghanaian universities are heterophilous social systems, where the systems tend to encourage change from system norms. There seemed to be more interaction between faculty members from different backgrounds, which indicated greater interest in being exposed to new ideas (Rogers, 1995). The implication of this finding is that change agents in these institutions should concentrate on targeting the most innovative opinion leaders, who would with time help the innovation to trickle-down to the mainstream faculty members. In effect the interpersonal communication channel may be the most effective means of communicating institutional technology innovations to faculty of these institutions.

The universities' academic leadership may have a strong desire for technology adoption and use by faculty for teaching and learning, but their approach to the implementation may not have given enough attention to the active participation of faculty in shared decision-making about technology issues. The apparent lack of effective communication between academic administrators and faculty members could constitute a great disincentive to innovative faculty members. Eifler, Dinsmore, and Potthoff (2004) observed that the gap between institutional change and faculty attitudes towards such innovations as technology integration into the curriculum is a barrier to faculty adoption and use of technology for teaching and learning. Faculty participation in decision-making process would serve as a motivation for the adoption and continuous use of instructional technology. Effective communication among stakeholders of the learning communities on matters of technology adoption and diffusion would be an added incentive to faculty members.

Therefore change agents could use a combination of these communication media and methods, sources of support, and sources of information to diffuse technology innovations among mainstream faculty members of these two Ghanaian universities.

CHAPTER 5

Conclusions and Discussion

This study investigated the relationship between faculty technology use for teaching and learning as a dependent factor and these five independent factors:

(i) Faculty attitudes towards technology integration into teacher education curricula (Factor 1),

(ii) Faculty motivation for adoption and use of technology for teaching and learning (Factor 2),

(iii) Faculty perceptions of the effects of technology use on students and pedagogy (Factor 3),

(iv) Faculty perceptions of barriers and challenges to adoption and use of technology (Factor 4), and

(v) Faculty perceptions of their technology professional needs (Factor 5).

Teacher education faculty members of two Ghanaian universities participated in the study. The summary of the study, discussions of major findings, implications for practice, and recommendations are presented in this chapter.

Summary

Using Rogers' (1995) theory of diffusion of innovations (DOI) and the concerns based adoption model (CBAM) of Hall and Hord (1987) as theoretical frameworks, this study sought to investigate the extent to which teacher education faculty attitudes relate to faculty use of technology for teaching and learning from the perspectives of faculty of two Ghanaian universities. The focus was on faculty concerns, needs, perceptions, beliefs, and views about technology for teaching and learning.

Both Rogers' (1995) DOI theory and CBAM were relevant for this study. The DOI focuses highly on the characteristics of social systems rather than individual characteristics and tends to have a pro-innovation bias. CBAM, on the other hand, takes into consideration users' needs and concerns as they adopt and use technology for teaching and learning, which are pertinent to planning faculty technology professional development programs.

The investigation of Ghanaian teacher education faculty members' perceptions, views and beliefs about technology integration for teaching and learning, their stages of technology adoption, their technology user levels, and their perceptions of technology professional development needs might give an insight into the adoption of instructional technology in the two universities and also serve as a guide for the development of technology professional programs in these institutions.

The data for this study were collected from the University of Education, Winneba (UEW) and the Faculty of Education of the University of Cape Coast (UCC), the only tertiary teacher education institutions in Ghana. In view of the limited population sizes and fears of poor response rates, a time sample of all faculty members of these two sites was conducted. Of the 316 surveys that were distributed, 143 were returned, representing a 45% response rate. However, through the data screening, it was found that 11 cases were not usable for various reasons. Thus effectively, 132 valid cases were used for the data analyses (42% response rate).

The survey was adopted and modified from various existing survey instruments about teacher attitudes towards technology integration. The modifications took the form of rewording item statements, modifying scale intervals for uniformity, and adding new items to address the target participants' unique situation in Ghana.

The survey consisted of five sections (Appendix A: Part A-Part E). Part A consisted of faculty demographic information and items on faculty technology use for teaching and learning, the dependent factor for the regression analysis. Part B consisted of items for the five independent factors for the regression analysis. Part C was a one-item question about the stages of adoption. Part D was based on Rogers' (1995) communication channels for faculty acquisition of technology skills and knowledge, sources of technical support for faculty technology use for instruction, and sources of information about changes/innovations in computer use for instruction. Part E consisted of general demographic information about participants.

A number of statistical analyses were conducted on the data collected. The most important ones included (i) Reliability tests examined the internal consistency of the scores on the various factors. The Cronbach's Alpha reliability coefficient was the test statistic here. (ii) Factor analysis was used to check the content and factor validity of the survey, (iii) Case summaries and descriptive statistics were conducted to help detect missing values and outliers. (iv) Correlation coefficients were computed to check the relationship among the independent factors and the dependent factor. (v) Multiple linear regression was conducted to answer the Research Question 1. The various conditions for multiple regression analysis were conducted to check violation of these conditions.

(vi) The general linear model was used to run a one-way MANOVA to answer two more supplementary research questions.

Findings

Research Question 1

To what extent are the following factors:

Factor 1: faculty attitudes towards technology integration in curriculum,

Factor 2: faculty motivation for adoption of instructional technology,

Factor 3: faculty perceptions of the effects of instructional technology on students and pedagogy,

Factor 4: faculty perceptions of barriers and challenges to adoption of instructional technology, and

Factor 5: faculty perceptions of technology professional development needs

related, individually and in linear combination, to faculty use of technology for teaching and learning (Use)?

Based on the regression analysis results:

(i) Faculty perceptions of barriers and challenges to adoption of instructional technology,

(ii) Faculty perceptions of the effects of instructional technology on students and pedagogy, and

(iii) Faculty motivation for adoption of instructional technology

were the significant factors that related to faculty use of technology for teaching and learning. These three factors accounted for 50% of the variance in faculty technology use for teaching and learning. The effect size of $R^2 = .52$ was judged to be large (Stevens, 1996).

Faculty perceptions of their technology professional development needs and faculty attitudes towards technology integration into teacher education curricula did not significantly relate to faculty technology use for teaching and learning.

Research Question 2

What are the stages of technology adoption of faculty members about the use of instructional technology, according to the CBAM stages of concerns survey?

The distribution of participants' stages of technology adoption appears evenly divided among Stage 1 – Stage 5, with a few at Stage 6, the highest stage. The majority of participants (55.7 %) were in Stages 1 to Stage 3, 34.4 % in Stages 4 and 5, and 9.9% in Stage 6.

These findings agree quite closely with the findings of the technology user level survey, in which 50% of participants indicated they were in the low-level users category, 34.8% were in the moderate-level users category, and 14.4% in the high-level technology user category.

Based the CBAM stages of adoption survey (Appendix A, Part C) and Roger's (1995) DOI model discussed in Chapter 2, the results of this survey suggested that:

(i) Participants in this study are a heterogeneous group of faculty members, whose needs and concerns about technology and teaching differ from one another considerably.

(ii) The majority of faculty members have not yet started implementing and confirming technology adoption and use for teaching and learning.

Differences among Low, Moderate and High Users

Attitudes towards technology integration. Are there differences among High, Moderate and Low users in their attitudes towards technology use for teaching and learning? The results showed that higher users of technology tended, to some extent, to have more positive attitudes about technology integration, to have higher motivation for using technology, to have more positive perceptions of the effects of technology on students' learning, and to perceive more barriers to using technology.

Communication channels. Based on the frequency of high, moderate, and low use of technology, do faculty members rate communication channels for obtaining information about technology differently?

The results showed that:

(i) Low-level technology users rated their sources of information about keeping abreast of technology innovations in instruction higher than did moderate and high users.

(ii) The differences among the three groups were not significant for (a) communication media and methods for acquiring new computer skills and knowledge for teaching and learning, and (b) sources of help or assistance with using computers for instruction.

Discussion of Major Findings

Faculty Attitudes towards Technology Integration into Tertiary Teacher Education Curriculum (Factor 1)

The regression analysis showed that faculty attitudes towards technology integration into the teacher education curriculum (Factor 1) did not significantly relate to faculty technology use for teaching and learning.

One of the conditions that might explain Factor 1's insignificant relationship with Use is the level of its relationship with the other independent factors. From the correlation matrix (Table 6), it was found that Factor 1 correlated quite highly with *faculty motivation for adoption of instructional technology (F*actor 2), a significant factor in this study, by as much as $r = .71$. Factor 1 also correlated reasonably strongly ($r = .55$) with *faculty perceived barriers and challenges to adoption of IT* (Factor 3), the most significant factor in this study. It would appear, therefore, that when all these three factors (Factor 1, Factor 2, and Factor 3) are included in the regression model, there would be a lot of shared variance among them that is statistically removed due to their overlaps. Thus, the importance of Factor 1 may be subsumed in the contributions of the other two significant factors with whom it correlated highly.

However, the various responses to the open-ended question and interviews indicated that faculty members of these two institutions in Ghana harbor no serious misgivings about the integration of technology into their teacher education curricula, as also evidenced by the mean score for this factor (3.97), which indicates a high positive attitude.

Responses from the open-ended question and interviews indicated that faculty members of these institutions believe in the efficacy of technology integration into the teacher education curriculum. They see technology as a major tool in the teacher education curriculum.

This study supports the view that faculty members no longer resist technology innovation, but rather the lack of technology resources and expertise appeared to be the problem. There is evidence in this study that supports the fact that neither their current curricula nor institutional policy requires the use of technology for teaching and learning. In effect, technology integration into the curriculum is yet to take place, though some individual faculty members have began using technology in their teaching.

Faculty should be encouraged to move beliefs into practice. Data from the open-ended question on the survey and the interviews suggested that faculty members now need hands-on experience with instructional technology. This in line with Rogers' (1995) trialability condition for technology integration, which states that an innovation may experience an increased rate of diffusion if potential adopters perceive that the innovation can be tried on a limited basis before adoption. The innovation systems of these two universities should provide the necessary opportunity for potential adopters to try out technology integration into instruction. As observed by Swain (2006), it is not enough to talk about the benefits of using technology in teaching and learning environments.

Overall, this study provided evidence that faculty members of the two institutions are ready for the wider adoption and use of technology for teaching and learning, if the conditions on the ground are supportive enough.

Faculty Motivation for Technology Integration for Teaching and Learning (Factor 2)

Faculty motivation for technology adoption and use for teaching and learning made a significant unique contribution to the explanation of variance in faculty use of technology for teaching and learning. Motivation, therefore, is an important factor in faculty adoption and use of technology for teaching and learning in this study.

Ely's (1999) conditions for successful technology implementation indicate that faculty members' dissatisfaction with the status quo (feeling a need to change), rewards or incentives (internal and external motivators preceding and following technology adoption) and faculty participation in decision-making are important ways of motivating faculty to adopt and use technology for teaching and learning. As observed by some participants, however, the two institutions do not seem to be giving the desired attention to these issues. The commitment on the part of academic administrators in terms of firm and visible evidence of continuing endorsement and support for technology integration seemed to be lacking or at best half-heartedly practised in the universities.

Some participants cited the beneficial effects of technology on instruction and students' learning as issues that motivate them to adopt and use technology. One area emphasized in the interviews was the belief that information and communications technologies can address the challenges of large class sizes and enhance sources of information for preparing instructional materials. Others see the provision of technology equipment such as computers, presentation equipment and subject-based software as motivating factors in their efforts to integrate technology into teaching and learning.

Faculty members need motivation to integrate instructional technologies into their curricula and instruction. The participating institutions in this study do not require the use of technology in the curricula or instruction, as pointed out by interviewees. But requiring technology integration in teaching would be another way of encouraging faculty to use technology for instructional purposes (Sun et al.; 2000). Other research (Whale, 2006) showed that including technology integration as a criterion in faculty evaluation would motivate them to use instructional technology. Research (Palak, 2004) also indicates that the active involvement of faculty in implementing technology innovations for teaching and learning could motivate them to integrate technology in their teaching and learning.

This study showed evidence that the majority of faculty members were receptive to the use of technology for teaching and learning. In the interviews and open-ended responses, participants reported a strong desire for (i) more technology resources for instruction, (ii) innovative academic leadership and ongoing technical support, and (iii) more professional development related to technology integration into the teacher education curriculum.

Faculty Perceptions of the Effects of Technology Use on Pedagogy and Students' Learning (Factor 3)

Faculty perceptions of the effects of technology use on pedagogy and students' learning was a significant factor that made a unique contribution to explaining faculty use of technology for teaching and learning, when the variance explained by all the other factors in the model was controlled. From the open-ended responses and interviews, faculty members expressed positive perceptions of the likely impact that educational technology integration may have on their instructional strategies and methodology as well as on their students' learning. They saw technology integration into their teacher education curriculum as a way of improving the teaching and learning process. They also believed technology integration in instruction would alleviate problems associated with large class sizes and teaching loads.

This finding is in line with Roger's (1995) theory of relative advantage. Rogers argued that even if individuals are exposed to innovation messages, such exposure will have little effect unless the innovation provides some advantage over the traditional ways of doing things.

This finding showed that faculty members value the importance of technology in their teaching. This study supports the conclusion that faculty members are aware of the beneficial effects of technology integration on pedagogy and students' learning, and were willing to adopt instructional technology, if the contextual conditions were created for them.

Basing their study on technology standards provided by the International Society for Technology in Education (ISTE) and on Rogers' (1995) diffusion model, Finley and Hartman (2004) found that faculty would experiment with technology integration if (i) they feel it is consistent with their teaching style, (ii) they feel they are knowledgeable and competently skilled, (iii) they are supported and rewarded for doing so, and (iv) they can see how it is pedagogically useful.

Based on the interviews and open-ended responses, participants in this study believed that technology is pedagogically useful:

(i) The integration would encourage students to adopt deep learning approaches to their studies.

(ii) When ICT is integrated into the teacher education curriculum, it would equip the teacher to use IT as a tool to teach and also to prepare his/her materials for students.

(iii) ICT would save a lot of man-hours in the classroom attending to students on one-to-one basis.

(iv) ICT could bring the traditional method of teaching much closer to the learner and that the learner will be more inclined to look for information themselves.

(v) ICT could engage students at their own leisure time and is able to correct errors they make for them.

(vi) Technology would enhance both the traditional methods of teaching as well as learners' efforts to find information independent of their instructors.

(vii) When ICT is integrated into the curriculum it would ease the workload of instructors, and students will be able to learn certain aspects of the curriculum on their own and at their own pace.

The results of this study have shown that faculty members are dissatisfied with the status quo and are desirous of change. This result is supported by Ely's (1999) first condition for facilitating educational technology innovations, which states that if potential adopters are dissatisfied with the status quo (feeling a need to change) they are more likely to embrace the relevant innovation.

However, Wilson, Sherry, Dobrovolny, Batty, and Ryder (2001) observed that how the technology fits into existing social purposes and practices will largely determine its prospects for its appropriation and use by the community. Faculty members would not hesitate to adopt a technology innovation if its overall effect will enhance their teaching and students' learning.

As Palak (2004) observed, instructional technology practices of teachers in substantial ways relate to (i) faculty beliefs about teaching and technology, and (ii) the contextual conditions in their teaching environments. In this study, the faculty beliefs about teaching and technology are generally positive, but it would appear that the contextual conditions are lacking for the effective implementation of technology integration in these two Ghanaian universities.

Faculty Perceptions of Barriers and Challenges to the Adoption and Use of Technology for Teaching and Learning (Factor 4)

Faculty perceptions of barriers and challenges to the adoption and use of technology for teaching and learning made a unique significant contribution to explaining faculty use of technology for teaching and learning. Perceived barriers and challenges from the perspectives of faculty are relevant because, according to Rogers (1995), unless these barriers, challenges, needs and concerns are addressed, the technology integration into teaching and learning would remain an illusive educational goal.

The lack of technology resources and facilities were the commonest concerns of participants in this study. Participants also saw the lack of hands-on experience for students and faculty members as one of the barriers to faculty's use of technology for teaching and learning. The lack of communication between faculty and academic administration with regards to technology integration was identified as another barrier in this study.

Other barriers mentioned by faculty members included

(i) the lack of academic administrators' support,

(ii) the lack of time to integrate technology into the curriculum,

(iii) the lack of technology expertise and skills needed for technology integration

(iv) unreliable access to the Internet

(v) the lack of faculty's participation in the technology decision-making process, and

(vi) the lack of effective communication between academic administrators and innovators and faculty members

These observations of the participants in this study indicated that most of Ely's (1999) eight conditions that facilitate the implementation of educational technology innovations were not met in the participating institutions. Ely identified among other issues the lack or availability of *resources* (hardware, software, maintenance support and infrastructure that are needed to make technology integration work), *time* (prioritized allocation of time to make technology integration work), faculty *participation* (shared decision-making, full communication, and good representation of faculty interests), *commitment* (firm and visible evidence of continuing endorsement and support by institutional leadership) and *expertise* (faculty access to the knowledge and skills required to implement technology innovations for teaching and learning) as important factors that influence technology adoption and use by educators.

Unfortunately, the findings of this study showed that these two universities do not yet meet these conditions for a successful implementation of their technology innovation programs. The provision of computer laboratories and setting up of campus wide network are a step in the right direction.

One important barrier participants openly discussed in the interviews was the time constraints, heavy teaching loads and large class sizes. This is one area in which Cuban's (1986) concerns about the effectiveness of technology integration into teaching and learning may be relevant. Cuban argued that teachers are already over-burdened enough without the requirement for them to incorporate computer use as a regular part of instructional practice. Becker (2000), basing his argument on data from the 1998 national survey of teachers, teaching, and computing, agreed with Cuban's position. Faculty members' sense of being overloaded may still limit widespread classroom use of computers.

Becker (2000) suggested a number of conditions that may enhance classroom use of computers. These include (i) faculty members' comfort and skills in using computers, (ii) allocation of some time in the school schedule for students to use computers as part of class assignments, (iii) availability of sufficient technology facilities and equipment, convenient access to these facilities, and (iv) teachers' personal philosophies that support a student-centered, constructivist pedagogy.

This study showed that while issues of out-dated hardware and lack of appropriate software may no longer be a problem in most developed countries, the lack of technology resources and expertise are still a major concern in developing countries like Ghana. The lack of technology resources in the two institutions posed a great frustration to innovative faculty members. Burniske (2003) therefore advises that when introducing educational technology to educators in developing countries, instructional technology educators should understand how limited, and limiting, their choices may be.

Faculty Perception of Technology Professional Development Needs (Factor 5)

Surprisingly, faculty perceptions of their technology professional development needs did not significantly relate to faculty technology use for teaching and learning. This factor did not interact meaningfully with any of the other independent factors either. However, the factor's mean score was 3.84 with standard deviation .40, which indicated that faculty had a high positive view of technology professional development.

Thus, even though faculty members of these two Ghanaian universities may value the importance of technology professional development, they may not have had the opportunity to implement whatever they have learnt because of the lack of resources and technical support, or in fact they may not have had sufficient technology expertise to integrate technology into their teaching and learning.

A myriad of faculty members' needs and concerns were expressed in their responses to the open-ended question and interviews, which relate to this finding. Many lamented their lack of training opportunities, their inability to practice what they have been taught because of the lack of follow-up workshops and minimal focus on their particular needs. Apart from the majority of faculty members' lack of technology expertise and skills, many also observed that the irregular workshops and seminars have not been effective or sufficient to enable them to integrate technology into teaching and learning.

Though this study found that faculty members have a positive perception of their technology professional development needs and concerns, this factor does not significantly contribute to the variance in faculty use of technology for teaching and learning. This finding seems to agree with Lambert (1988) and Wade (1989), who argued that professional development has been only moderately effective in bringing about changes in schools.

It would appear that large-group technology workshops, though they have been helpful in creating a general awareness of technology issues in education, have not had significant impact on faculty use of technology for teaching and learning. This was a common observation from the interviews.

Another possible reason why faculty perceptions of their technology professional development needs appeared to have no significant relationship with faculty technology use may be their lack of technical knowledge and skills needed for effective technology integration into their teaching, as pointed out by many of the interviewees. Research (Becker, 2000; Ely, 1999; Hall & Loucks, 1978, Palak, 2004) indicates that teachers who have a reasonable amount of technical skill and who use computers to address their own professional needs use computers in broader and more sophisticated ways with their students than those who have limited technical skills and no personal investment in using computers themselves.

Faculty members may also be discouraged from the adoption and use of instructional technology by the lack of their involvement in their institutions' technology innovation plans. This observation is in line with Little's (1993), who observed that, in most cases, professional development programs are designed, organized, and delivered based on the skills and knowledge that policymakers and external facilitators assume faculty members need, rather that allowing faculty members to identify their needs and concerns and designing programs to address those needs.

On the contrary, Efler, Minsmore, and Potthoff (2004) pointed out that professional development programs promote faculty members' knowledge, skills, and disposition towards technology and school changes.

In countering Lambert's (1988) and Wade's (1989) argument that professional development has been only moderately effective in bringing about changes in schools, Norris (1993) and Little (1993) reported that the reason behind the limited impact of professional development is that concerns of teachers have not been taken into consideration when planning professional development programs. Little agrees with Swain (2004) when he argues that there is a serious disconnection between school reform and teachers' professional development. There is therefore a lack of effective communication among stakeholders in technology innovations for teaching and learning, as observed by some participants in this study.

Faculty members' perceptions of the effectiveness of their teaching with or without technology may also explain this finding. A study of K-12 teachers' use of technology in the classroom by Kotrlik and Redmann (2005) found that teachers perceived they were effective regardless of whether they had integrated technology. However, there is no evidence in this study to suggest that faculty members harbored such feeling about technology integration in the two participating institutions.

It would appear that large-group technology workshops, though they have been instrumental in creating a general awareness and knowledge of technology issues in education, have not had a significant impact on faculty use of technology. This was a common observation from the interviews. Kelsey and D'souza (2004) and Schell (2003) observed that since the levels of individual expertise and technology use differ significantly among faculty members, the choice of mode of inservice training on the use of technology for instruction should be based on the preferences, expertise level and particular needs of faculty members. The "one size fits all" technology professional development plan does not work with a heterogeneous group of faculty members like those in this study.

Leh's (2005) study of faculty use of technology may be relevant for change agents of the two institutions under the study. Using (i) large group workshops, (ii) small group meetings, (iii) individual mentoring, and (iv) just-in-time training, according to Leh, had a positive impact on faculty members' ability to use technology in instruction.

Many other researchers (Borko & Putman, 1995; Guskey, 1995; Hargreaves, 1995, Kidney, 2004; Sun, Heath, Byrom, Phlegar, & Dimock, 2000) support the view that professional development should involve faculty in the identification of what they need to learn and the process to be used to achieve the desired goals. Faculty members need to be convinced about the relevance and purpose of institutional changes or innovations.

Denying them input in their own professional development is a sure way of inviting them to be cynical and removed from innovation efforts.

The insignificant relationship of faculty perceptions of their technology professional development needs and concerns with faculty technology use for teaching and learning in this study may therefore be explained within the context of faculty members' (i) lack of technology knowledge and skills, (ii) the lack of faculty participation in technology innovation decision process, and (iii) the lack of opportunity to have hands-on experimentation with technology in instruction because of limited or lack of technology resources. These issues suggest that faculty members need an on-going technology professional development program in order to integrate technology into teaching learning.

Research Question 2

This question sought to categorize participants' stages of technology adoption and use for teaching and learning. The majority of participants were in the non-adopter stages of awareness, informational, personal, and management, as explained by the CBAM. From the findings on faculty perceptions of the effects of technology use on pedagogy and students' learning, responses to the open-ended question on the faculty survey, and interviews, however, there is evidence that faculty members have begun trickling to the consequence stage, where faculty focus on the innovation's impact on students and their instruction. But these views of faculty were expressed in general terms, indicating that they were not based on practical experience from implementation. The results of this study showed that:

(i) Participants in this study were a heterogeneous group of faculty members, whose needs and concerns differed from one another.

(ii) The majority (56%) of faculty members have not yet started implementing and confirming technology adoption and use for teaching and learning.

These results indicate that the majority of faculty members at the moment use technology for personal purposes rather than for teaching and learning. Research findings (Wozney, Venkatesh, & Abrami, 2006) indicated that (i) expectancy of success and perceived value of technology integration were the most important issues in differentiating faculty technology use levels, (ii) personal use of computers outside teaching activities was the most significant factor related to faculty use of technology in the classroom, and (iii) faculty use of computer technologies was predominantly for "informative" (i.e. the Internet and World Wide Web, and CD-ROM) and "expressive" (word processing) purposes.

The concerns at the non-adopter stages of awareness, information, personal, and management seemed to be taken care of in these institutions. Change agents should therefore capitalize on this to address the higher concerns at the adopter stages of consequence, collaboration, and refocusing, as explained by Vaughan (2002).

Also the finding that participants in this study are a heterogeneous group means that faculty members' needs and concerns are bound to differ from one another. It also means there is more interaction between people from different backgrounds, indicating a greater interest in being exposed to new ideas (Rogers, 1995).

Other Findings

Faculty Age

When all the other factors were included in the model, age was found to be mildly significantly related to faculty technology use for teaching and learning in this study. One reason age may not have been an issue in this study was because computer-based technology use for teaching and learning is new in Ghana. It could therefore be that young and old faculty members alike are all now being introduced to technology use in instruction. The stages of technology adoption and the technology user level survey findings confirmed this possibility.

Gender Differences

When gender was considered as a possible factor, the analysis found that there were no significant differences among male and female faculty members in their attitudes to towards technology integration.

Findings of Supplementary Research Questions

The study reported that:

(i) There were significant differences between low and high users, and between moderate and high users, with high users having a higher positive attitude, based on the faculty attitudes towards technology integration into teacher education curricula, and faculty motivation for adoption and use of instructional technology.

(ii) There were significant differences between low and moderate users and between low and high users, based on the faculty perceived effects of use of instructional technology on students' learning and pedagogy, faculty perceived barriers and challenges to adoption and use of instructional technology, and faculty perceptions of their technology professional development needs.

High-level users had the most positive perceptions, followed by moderate-level and then low-level technology users on these factors. This finding is supported by research (Becker, 2000; Ely, 1999; Hall & Loucks, 1978; Palak, 2004) indicating that teachers who have a reasonable amount of technical skill and who use computers to address their own professional needs use computers in broader and more sophisticated ways with their students than those who have limited technical skills and no personal investment in using computers themselves.

On communication channels for technology adoption diffusion (Appendix A, Part D), this study showed that low-level technology users rated their sources of information about keeping abreast of innovations about computers in instruction higher than did moderate and high users. A look at the mean scores for these three groups, however, shows that the differences among them are not very much. Nonetheless, this finding is important because it shows that late technology adopters in these two institutions are making efforts to catch up with the more elite technology users for teaching and learning.

Research (Rogers, 1995) has shown that most individuals depend mainly upon a subjective evaluation of an innovation that is conveyed to them from other individuals like themselves who have already adopted the innovation. Change agents should therefore focus on identifying active technology innovators and use them to diffuse the technology integration innovation through interpersonal communication networks. Orr

(2003) has shown that firm attitudes are developed through communication exchanges about an innovation with peers and opinion leaders.

Implications for Practice

In this study, faculty members' perceptions of the effects of technology integration on pedagogy and students' learning, their perceptions of barriers and challenges to technology integration, and their motivation for technology adoption and use for teaching and learning were factors that significantly related to their use of technology for teaching and learning.

The study also showed that faculty attitudes towards technology integration into teacher education curriculum are generally positive (M = 3.97, SD = .53). This factor correlated positively ($.37 \leq r \leq .71$) with faculty motivation for technology adoption and use for teaching and learning, faculty perceptions of barriers and challenges to technology integration, and faculty members' perceptions of the effects of technology integration on pedagogy and students' learning.

Even though faculty technology professional development needs did not appear to significantly relate to their technology use for teaching and learning, the mean score (M = 3.84, SD = .40) on this factor indicated a positive perception of technology professional development needs. This conclusion was also arrived at from an analysis of faculty responses to the open-ended question on faculty technology survey and interviews.

Capitalizing on Faculty's Positive Attitudes towards Technology Integration

This study found that faculty members of the participating institutions had positive attitudes towards technology integration into their teacher education curricula, they were receptive to educational technology innovations, and they held strong beliefs of the efficacy of technology in improving teaching and learning.

According to Palak (2004), faculty attitudes and beliefs towards technology and teaching have to be factored into the overall strategy for technology integration because faculty's beliefs and attitudes are the primary agents when they make decisions about technology. He reported that instructional technology practices of teachers in substantial ways relate to (i) their beliefs about teaching and technology and (ii) the contextual conditions in their teaching environments. He observed that teachers' beliefs are the primary agents for their instructional technology decisions specifically for their selections of technologies for student use, and that the types of technologies teachers have their students use are directly related to the ways teachers approach teaching and technology.

Positive attitudes indicate faculty's readiness to try an innovation. Change agents may find it easier to convince faculty that technology integration has value when they are ready to try innovations. Therefore, change agents and the academic administrators can capitalize on the faculty members' positive attitudes towards technology integration, and diffuse the technology innovation for teaching and learning further into the practical implementation stages.

Addressing Faculty Perceptions of Barriers and Challenges to Technology Integration

In this study, one of the most significant factors that related to faculty technology use for teaching and learning was faculty perceptions of barriers and challenges to their technology adoption and use for instructional purposes. The mean score on this factor (M = 2.84, SD = .66) indicated that faculty members generally disagreed with the nonexistence of the barriers and challenges cast in positive terms (e.g. I have access to computers in my classrooms).

Faculty perceptions of barriers and challenges to their adoption and use of instructional technology are relevant, because, according to Rogers (1995), unless these barriers, challenges, needs and concerns are addressed the technology integration into teaching and learning would remain an illusive educational goal.

The findings from the CBAM stages of technology adoption survey supported the view that the majority of participants (56%) were at the non-adopter stages of awareness, informational, personal, and management or beginning to use technology for information, personal and management tasks. One of the common concerns raised by participants of this study was the non-availability of instructional technology resources, particularly office and classroom computers with appropriate subject-based software, instructional technology equipment, and access to the Internet. Participants were also concerned about the lack of effective communication between university management and faculty on technology decision making. In other words, faculty members were concerned about the failure of external facilitators and management to seek their views, assess their needs, and consider their concerns about the technology integration program.

Research (Palak, 2004) indicates that the active involvement of faculty in implementing technology innovations for teaching and learning is very important. Palak reported that, among other factors, instructional technology practices of teachers in substantial ways relate to the contextual conditions in their teaching environments. Participants of this study desired more technology for instruction, academic administrative and technical support, and greater participation in technology decision making.

Vaughan (2002) observed that if faculty members do not have their concerns first reduced at the non-adopter stages, they will not move on to the adopter stages. Kotrlik and Redmann (2005) observed that (i) as teachers perceive an increase in barriers, their integration of technology decreases, (ii) as the availability of student e-mail and the number of computers with Internet connection in the classroom and/or lab increases, their integration of technology increases.

Meaningful faculty input into the technology integration programs of the participating institutions would go a long way to make such programs relevant to faculty technology needs. The disconnection between policy formulation and implementation due to the nonparticipation of faculty in decision making is a barrier to successful integration of technology in teaching and learning (Eifler, Dinsmore, & Potthoff, 2004).

The interviews and open-ended responses provided evidence that the majority of faculty members use computer-based technology and the Internet mainly for routine tasks such as word processing, students' grade report preparations, and for personal research work. This is an encouraging phenomenon, because research (Becker, 2000; Wozney, Venkatesh, & Abrami, 2006) has shown that the more faculty members use computer-based technology for personal purposes, the more they are likely to adopt and integrate technology into their teaching and students' learning.

Change agents and university administration should address faculty members' concerns about the availability of technology resources and access to the Internet for instructional purposes. The university management should motivate and encourage faculty by helping them to acquire computers and technology equipment and increasing their access to technology resources such as the Internet and software for instructional purposes.

Curriculum-Technology Alignment

Even though participants appeared to be aware of the potential positive impact that technology integration could make on their pedagogy and students' learning, the interviews indicated that technology use for teaching and learning was neither a university policy nor did the curriculum require such technology integration. Yet reading the ICT plans of both institutions, one gets an opposite opinion. Both plans emphasized the deployment of ICT tools in improving the quality of teaching and learning and in increasing access to higher education. This brings to the fore the lack of effective communication between university management and faculty on technology decision making.

Sun et al. (2000) observed that technology integration can become a catalyst for changing instructional strategies. They prescribed a three-phase process for effective use of technology to enhance instructional practices as follows: (i) faculty should first learn the subject content, (ii) design instructional strategies, and (iii) apply appropriate technology integration skills and knowledge. In this context technology integration into the curriculum and for instruction would be need-driven rather than technology driven.

The interviews and open-ended responses indicated that faculty believed appropriate technology integration into the curriculum was a way of equipping preservice teachers with the technology integration skills and knowledge needed for their future professional work. This calls for a rethinking of the curricula and pedagogical issues. Faculty members need to be appropriately equipped not merely with technology expertise but more importantly with the skills and techniques for effectively integrating technology into their curricula and instruction. This could be done through appropriate technology professional development programs and institutional policy that requires technology integration in the curricula and instruction. Such programs would be more relevant and need-based if faculty's technology needs and concerns are taken into consideration.

Addressing Faculty Technology Professional Development Needs

Faculty perceptions of their technology professional development needs and concerns did not appear to relate strongly with faculty use of technology for teaching and learning in this study. The high average score for this factor, however, implied that faculty members value their technology professional development.

It may be that faculty members appreciate the importance of technology professional development, but they have not had the opportunity to implement whatever they have learned from a few workshops, or it may be that they do not have sufficient resources to use technology for teaching and learning purposes.

Evidence from the interviews indicated that (i) faculty members are aware of technology interventions in education and understand and appreciate technology use in their teaching through their large group technology workshops, and (ii) faculty members were diverse in their technology needs and concerns as indicated by the findings of the faculty technology user level and stages of technology adoption surveys.

Faculty members' expressed technology needs included (i) regular technology integration workshops blended with peer-peer and small group mentorship, at the departmental level (ii) technology resources to practise their skills and techniques of technology integration, (iii) subject-based software for instructional purposes, and (iv) reliable access to the Internet for instructional and research purposes. Most participants interviewed also favored decentralized technology professional development programs that address faculty unique needs and concerns.

According to Guskey (1986), faculty perceptions of their technology needs, among other factors, determine their motivation to go the extra mile in the acquisition of technology integration skills and techniques. Guskey observed that the purpose of professional development is to bring about positive changes in the beliefs, attitudes, and classroom practices of teachers. Watson (2006) and Eifler, Dinsmore and Potthoff (2004) agreed with this and indicated that professional development programs promote participants' knowledge, skills, and dispositions towards technology, diversity, and school change.

It is important to consider the concerns of faculty when planning professional development activities since successful implementation will depend on addressing technology needs of the teachers involved in the process (Hope, 1995; Hall & Hord, 1987; Norris, 1993; Todd, 1993; Rutherford, Hall, & George, 1982). Professional development programs should involve faculty in the identification of what they need to learn and in the development of the learning opportunity and process to be used to achieve the desired goals (Borko & Putman, 1995; Guskey & Hargreaves, 1995). Since the levels of individual expertise and technology use differ significantly among faculty members, the choice of mode of inservice training should be based on the preferences, expertise level, and particular needs of faculty members (Kelsey & D'souza, 2004; Schnell, 2003). This means that support for the use of instructional technology in classrooms should be tailored to the diverse needs of faculty in a coordinated way (Schnell, 2003).

Thus academic administrators and technology innovation change agents in these two universities should focus on the expressed needs and concerns of faculty to ensure successful implementation of their ICT programs when designing faculty technology professional development programs. Consequently, it would be advisable to conduct a survey of faculty on their needs and concerns prior to designing their technology professional programs.

This study supports the view that large group technology workshops have not had the desired impact on faculty technology use for teaching and learning. Several reasons were reported in the interviews to explain why this situation has arisen. Faculty strongly felt the sporadic nature of the workshops makes them ineffective, since faculty tended to forget the knowledge gained from such workshops because of the lack of access to computers for practice. Faculty also felt decentralized follow-up workshops, based on unique departmental and faculty needs would be more relevant. All these concerns suggest that a blend of smaller group workshops, peer-to-peer interactions, just-in-time on-demand mentorship, and the large group workshops should be considered in order to meet faculty's diverse needs. These issues also suggest that faculty members need an on-going comprehensive technology professional development program rather than sporadic workshops that lack follow-up.

Motivating Faculty Members to Adopt and Use Instructional Technology

Faculty motivation for technology adoption and use for teaching and learning was one of the three significant factors that related to faculty technology use for teaching and learning. The mean score on this factor was 3.83 (SD = .50), indicating that faculty members had a high motivation for technology adoption and use for teaching and learning. However, the analysis of their open-ended responses and interviews indicates faculty motivation was basically intrinsic (i.e. self-motivated). Even though intrinsic motivation may be better than extrinsic motivation in bringing about lasting changes, many of their responses pointed to the lack of external motivation, which may be classified as (i) the lack of opportunity to practice what they learn at technology workshops due to limited instructional technology resources, (ii) the lack recognition of technologically innovative faculty members, (iii) the lack of faculty participation in technology decision-making process, and (iv) irregularity of technology workshops and follow-up support, which caused them to forget what they had learned.

These observations of participants indicated that the contextual conditions for implementing educational technology innovations as stipulated by Ely (1999) were not in existence in the participating institutions. Faculty members may be motivated by their acquisition of computers for personal and instructional purposes. Another way to motivate faculty as suggested by Whale (2006) is to require technology skills and use in teaching as part of faculty evaluation. Whale's suggestion implied that if faculty members are aware that the use of technology in their instruction is part of their evaluation for tenure, they would take technology integration more seriously. This in itself calls for the integration of technology into the curricula and instruction as an institutional policy and at the same time making sure the contextual conditions for the implementation of educational innovations are in place. The participating institution may also consider the setting up of educational technology standards to guide faculty in their technology integration activities (Collier, Rivera, & Weinburgh, 2004; Finley & Hartman, 2004).

Recommendations

This study investigated the relationship of faculty members' attitudes and their technology professional development needs with their technology use for teaching and learning in two Ghanaian teacher education universities. The findings of this study, therefore, are generalizable to teacher education faculty of these two institutions in particular, and to similar institutions elsewhere in Africa and other developing countries.

It would be more enlightening to include pretertiary teacher educators in a similar study in the future, because such a longitudinal survey is more likely to give a clear insight into technology integration into teacher preparatory programs in Ghana. This would help inform government's ICT policy on education as stipulated in the Ghana government's ICT for Accelerated Development (Republic of Ghana, 2003) policy document.

Another view of the use of ICT for teaching and learning is that all Ghanaian university faculty members, not only teacher educators, need the knowledge and skills for ICT integration into their teaching and students' learning. Therefore, future studies in this area might consider expanding this study to include non-teacher educator faculty members of the other public and private universities in Ghana.

This study has shown that the lack of technology resources, particularly network infrastructure and access to the Internet, is still a major concern to educators in Ghana. This situation may also be applicable to African and developing countries elsewhere. One suggestion that could address this concern is harnessing and integrating the efforts of all tertiary institutions to form a higher education national or regional network. This is likely to cut down broadband and technology maintenance costs. This approach may also enhance collaboration among these institutions, nationally and internationally.

Finally, educational change agents of these two institutions should capitalize on the positive view that faculty members have about the use of ICT for teaching and learning to equip faculty members with the technology knowledge and skills needed for effective technology integration into their teaching and teacher education curricula. The need for an ongoing technology professional program in these institutions cannot be overemphasized.

Limitations of the Study

A major limitation of this study is the consequence of using a non-randomized sample. The population of study was too small for random sampling in view of my focus on only teacher education faculty members at the two sites. Therefore the entire population was considered with the consequence that conclusions based on this sample will be at best tenuous and only applicable to this particular population. However, an analysis of the demographic data assured us that the participants in this study were representative of the actual research site populations as shown in Chapter 3.

Another limitation of this study concerns the fact that it focuses mainly on faculty attitudes related to technology integration into teaching and learning at a particular point in time, rather than on the technology adoption decision process, which takes place over a time period. For this reason, the finer reasons for faculty inclinations to adopt or not to adopt technology for teaching and learning were not investigated in this study. However, the study revealed significant findings with practical implications for change agents and technology innovators. These findings may be applicable to similar populations in the future or elsewhere in other developing countries, however tenuous they may be.

The pilot study used participants outside of my target population because of target population size limitations and low response rate fears. This may have adversely affected the conclusion arrived at in fine-tuning my survey based on the pilot test. However, the reliability and factor analysis on the 132 cases in this study showed that the survey was appropriate for the study.

The major source of data for this study was the self-reported responses of participants. Therefore, issues of participants' bias could affect the quality of my data too. However, complementing the quantitative data with interviews yielded a richer understanding of the relationship between faculty attitudes and their technology use for teaching and learning.

References

Abrams, D. R. (1999). *Introduction to regression*. Princeton University Data and Statistical Services. Retrieved August 20, 2006, from http://dss.princeton.edu/online_help/analysis/regression_intro.htm

Adams, R. D., & Martray, C. (1981). *Teacher development: A study of factors related to teacher concerns for pre, beginning, and experienced teachers*. Paper presented at the annual meeting of the American Educational Research Association, Los Angeles, CA.

Aron, A., Aron, E. N., & Coups, E. J. (2005). *Statistics for the behavioral and social sciences: A brief course* (3rd ed.). Upper Saddle River, NJ: Pearson Education.

Bauer, J., & Kenton, J. (2005). Toward technology integration in the schools: Why it isn't happening. *Journal of Technology and Teacher Education, 13*(4), 519-546.

Becker, H. J. (2000). Findings from the teaching, learning, and computing survey: Is Larry Cuban right? *Education Policy Analysis Archives, 8*(51). Retrieved May 31, 2005, from http://epaa.asu.edu/epaa/v8n51/

Borko, H., & Putnam, R. T. (1995). Expanding a teacher’s knowledge base: A cognitive psychological perspective on professional development. In T. R. Guskey & M. Huberman (Eds.), *Professional development in education: New paradigms and practices* (pp. 35 – 66). New York: Teachers College Press.

Brace, N., Kemp, R., & Snelgar, R. (2006). *SPSS for psychologists: A guide to data analysis using SPSS for Windows* (3rd ed.). Retrieved July 3, 2006, from http://www.palgrave.com/pdfs/0333734718.pdf

Burniske, R. W. (2003). Links in the chain of doing: The ethics of introducing educational technology in developing countries. *TechTrends, 47*(6), 55-61.

Chapman, B. F. (2003). An assessment of business teacher educators' adoption of computer technology. Unpublished doctoral dissertation, The Virginia Polytechnic Institute and State University, Blacksburg. Retrieved August 20, 2006, from http://scholar.lib.vt.edu/theses/available/etd-11052003-152749/unrestricted/ChapmanDiss.pdf#search='Chapman%20Betty%20Foust'

Christensen, R., & Knezek, G. (1998, March 13). *Parallel forms for measuring teachers' attitudes toward computers.* Paper presented at Society of Information Technology & Teacher Education (SITE)'s 9th International Conference, Washington, DC. Retrieved June18, 2006, from http://www.tcet.unt.edu/research/sitetac/sld001.htm

Collier, S., Rivera, M., & Weinburgh, M. H. (2004). Infusing technology skills into a teacher education program: Change in students' knowledge about and use of technology. *Journal of Technology and Teacher Education, 12*(3), 447-468.

Cuban, L. (1986).*Teachers and machines: The classroom use of technology since 1920*. New York: Teachers College Press.

Demarte, P. J., & Mahood, R. W. (1981). The concerns of teachers in rural, urban, and suburban school settings. Paper presented at the annual meeting of the American Educational Research Association, Los Angeles, CA.

Dillon, A., & Morris, M.G. (1996). User acceptance of information technology: Theories and models, *Annual Review of Information Science and Technology*, *31*, 3-32.

Eifler, K. E., Dinsmore, J., & Potthoff, D. (2004). A bucket of eels: A tripartite approach to renewing a teacher education program. *Journal of Teacher Education, 55*(1), 91-101.

Ely, D. P. (1999). Conditions that facilitate the implementation of educational technology innovations. *Educational Technology, 39*(6), 23-27.

Finley, L., & Hartman, D. (2004). Institutional change and resistance: Teacher preparatory faculty and technology integration. *Journal of Technology and Teacher Education, 12*(3), 319-337.

Fullan, M., & Hargreaves, A. (1996). *What's worth fighting for in your schools*? New York: Teachers College Press.

Garson, G. D. (2006). Statnotes: Topics in multivariate analysis. CRC Press Barnes & Noble. Retrieved July 3, 2006, from http://www2.chass.ncsu.edu/garson/PA765/regress.htm.

Government of Ghana. (1995). *Ghan Vision 2020: The first step 1996-2000*. Accra, Ghana: Ghana Publishing Corporation.

Glesne, C. (2006). *Becoming qualitative researchers: An introduction* (3rd ed.). Boston, MA: Pearson Education, Inc.

Graham, C., Culatta, R., & Pratt, M. (2004). Redesigning the teacher education technology course to emphasize integration. *Computers in the Schools, 21*(1/2), 127-148.

Graves, S. B., & Kelly, M. A. (2002, June 17-19). Faculty technology professional development: A pedagogical and curricular reform model. *Proceedings of the 23rd National Educational Computing Conference, Antonio, Texas, USA, 15.* (ERIC Document Reproduction No. ED 475 931). Retrieved August 20, 2006, from http://eric.ed.gov/ERICDocs/data/ericdocs2/content_storage_01/0000000b/80/27/fb/48.pdf

Griffin, D., & Christenson, R. (1999). Concerns-based adoption model (CBAM) levels of use of an innovation (CBAM-LOU). Denton, Texas: Institute for the Integration of Technology into Teaching and Learning.

Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational Researcher, 15*(5), 5-12.

Guskey, T. R. (1995). Results-oriented professional development in education: In search of an optimal mix of effective practices. Retrieved August 20, 2006, from http://www.ncrel.org/sdrs/areas/rplesys/pdlitrev.htm

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

Hall, G. E., George, A. A., & Rutherford, W. L. (1979). *Measuring stages of concerns about the innovation: A manual for use of the SoC survey*. Austin, TX: The University of Texas at Austin, The Research and Development Center for Teacher Education. (ERIC Document Reproduction No. ED 147 342).

Hall, G. E., & Hord, S. M. (1987). *Change in schools: Facilitating the process*. Albany, NY: State University of New York Press.

Hall, G. E., Wallace, R. C., & Dossett, W. A. (1973). *A developmental conceptualization of the adoption process within educational institutions* (Rep. No. 3006). Austin, Texas: The University of Texas at Austin, The Research and Development Center for Teacher Education. (ERIC Document Reproduction No. ED 095 126).

Hall, G., & Loucks, S. (1979). *Implementing innovations in schools: A concerns-based approach.* Austin, TX: Research and Development Center for Teacher Education, University of Texas.

Hargreaves, A. (1995). Development and desire: A postmodern perspective. In Guskey, T. R., & M. Huberman (Eds.), *Professional development in education: New paradigms and practices.* (pp. 9-34). New York: Teachers College Press.

Hassinger, E. (1959). Stages in the adoption process. In E. M. Rogers (1995). *Diffusion of innovations* (4^{th} ed.). New York, NY: Free Press.

Hernandez-Ramos, P. (2005). If not here, where? Understanding teachers' use of technology in Silicon Valley schools. *Journal of Research on Technology in Education, 38*(1), 39-64.

Hope, W. C. (1995). *Micro computer technology: Its impact on teachers in elementary school*. Unpublished doctoral dissertation, Florida State University, Tallahassee. (ERIC Document Reproduction No. ED 384 336).

Iding, M. K., Crosby, M. E., & Speitel, T. (2002). Teachers and technology: Beliefs and practices. *International Journal of Instructional Media, 29*(2), 153-170.

Irani, T., & Telg, R. (2002). Building it so they *will* come: Assessing universities' distance education faculty training and development programs. *Journal of Distance Education/Revue de l'enseignement à distance.* Retrieved October 10, 2005, from http://cade.athabascau.ca/vol17.1/irani.html

Jacobsen, D. M. (1998). Characteristics and adoption patterns of faculty who integrate technology into teaching and learning in higher education. Unpublished doctoral dissertation, University of Calgary, Calgary, Alberta, Canada. Retrieved August 20. 2006, from http://www.ucalgary.ca/~dmjacobs/phd/diss/

Johnson, G. M., & Howell, A. J. (2005). Attitude toward instructional technology following required versus optional WebCT usage. *Journal of Technology and Teacher Education, 13*(4), 643-654.

Johnston, J., Killion, J., & Oomen, J. (2005). Student satisfaction in the virtual classroom. *The Internet Journal of Allied Health Sciences and Practice, 3* (2). Retrieved October 4, 2006, from http://ijahsp.nova.edu/articles/vol3num2/Johnston%20-%20Printer%20Version.pdf

Jones, G. H., & Jones, B. H. (2005). A comparison of teacher and student attitudes concerning use and effectiveness of web-based course management software. *Journal of Educational Technology & Society, 8*(2), 125-135.

Judson, E. (2006). How teachers integrate technology and their beliefs about learning: Is there a connection? *Journal of Technology and Teacher Education, 14*(3)*, 581-597.*

Kelly, T. (2005). A case study of a college faculty's use of technology, professional development and perceptions of organizational support. Unpublished doctoral dissertation, Dowling College, Oakdale, Long Island, NY.

Kelsey, K. D., & D'souza, I. (2004). Student motivation for learning at a distance: Does interaction matter? *Online Journal of Distance Learning Administration,* 7(2). Retrieved September 20, 2005, from http://www.westga.edu/%7Edistance/ojdla/summer72/kelsey72.html

Kidney, G. W. (2004). When the cows come home: A proven path of professional development for faculty pursuing E-learning. *Technology in Higher Education Journal, 31*(11), 12.

Kleinbaum, D. K., Kupper, L. L., Muller, K. E., & Nizam, A. (1998). Applied regression analysis and other multivariate methods. New York: Duxbury Press.

Kotrlik, J. W., & Redmann, D. H. (2005). Extent of technology integration in instruction by adult basic education teachers. *Adult Education Quarterly, 55*(3), 200-219.

Lambert, L. (1988). Staff development redesigned. *Educational Leadership, 45*(8), 665-668.

Leh, A. S. C. (2005). Lessons learned from service learning and reverse mentoring in faculty development: A case study in technology training. *Journal of Technology and Teacher Education, 13*(1), 25-41.

Light, J. L., Singer, J. D., & Willet, J. B. (1990). By design: Planning research on higher education. Cambridge, MA: Harvard University Press.

Little, J. (1993). Teachers' professional development in a climate of educational reform. *Education Evaluation and Policy Analysis, 15*(2), 129-159.

Marso, R. N., & Pigge, F. L. (1994). *Concerns about teaching at four different stages of career development.* Paper presented at the Annual Conference of the Association of Teacher Educators, Atlanta, GA.

Mayer, R. E. (1996). Learners as information processors: Legacies and limitations of educational psychology's second metaphor. *Educational Psychologist, 31*(3/4), 151-161. Retrieved on October 12, 2006 from http://www.bsu.edu/classes/cassady2/EDPSY765/mayer.html

McKinnon, D. H., & Nolan, P. C. J. (1989). Using computers in education: A concerns-based approach to professional development for teachers. *Australian Journal of Educational Technology*, *5*(2*)*, 113-131. Retrieved on June 12, 2006 from http://www.ascilite.org.au/ajet/ajet5/mckinnon.html

Mills, S. C., & Tincher, R. C. (2003). Be the technology: A developmental model for evaluating technology integration. *Journal of Research on Technology in Education, 35*(3). Retrieved August 20, 2005, from http://media.lsi.ku.edu/research/JRTEBetheTechFinal.pdf

Mueller, D. J. (1986). *Measuring social attitudes: A handbook for researchers and practitioners.* New York: Teachers College Press.

National Council for Accreditation of Teacher Education, Task Force on Technology and Teacher Education. (1997). Technology and the new professional teacher: Preparing for the 21st century classroom. Washington D. C.: Author.

Norris, C. (1993). Assessing and evaluating teacher concerns. *Computing Teacher, 20*, 27-29.

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection*. U. S. Congress, Washington, D C: Author.

Orr, G. (2003). Diffusion of innovations, by Everett Rogers. Retrieved May 18, 2005, from http://www.stanford.edu/class/symbsys205/Diffusion%20of%20Innovations.htm

Palak, D. (2004). Teachers' beliefs in relation to their instructional technology practices. Unpublished doctoral dissertation, West Virginia University, Morgantown.

Pallant, J. (2005). *SPSS survival manual (2nd ed.): A step by step guide to data analysis using SPSS*. Open University Press, Milton Keynes, United Kingdom.

Protheroe, N. (2005). Technology and student achievement. *Principal Reston, Va., 85*(2), 46-48.

Republic of Ghana. (2003). *The Ghana ICT for accelerated development (ICT4AD) policy.* Accra, Ghana: Graphic Communications Group Limited.

Rogers, E. M. (1995). *Diffusion of innovations (4th ed.).* New York, NY: Free Press.

Rogers, D. (2000). A paradigm shift: Technology integration for higher education in the new millennium. *Association for the Advancement of Computing in Education Journal, 1* (13), 19-33.

Rutherford, W. L., Hall, G. E., & George, A. S. (1982). A survey for measuring the concerns change facilitators have about their role in guiding change. The University of Texas at Austin, Research and Development Center for Teacher Education. (ERIC Document Reproduction No. ED 221600).

Schauer, J., Rockwell, S. K., & Fritz, S. M. (2005). Implementing distance education: Issues impacting administration. *Online Journal of Distance Learning Administration, 8*(3). Retrieved September 20, 2005, from http://www.westga.edu/~distance/ojdla/fall83/schauer83.

Schnell, M. A. (2003). Technology classroom support: A collaborative effort at Syracuse University. *College & University Media Review, 9*(2), 81-90.

Schuman, H. (1970). *The random probe: A technique for evaluating the validity of closed questions.* In D. P. Forces, & S. Rocher (Eds.). S*tages of social research* (pp. 240-245). Englewood Cliffs, NJ: Prentice Hall.

Soloway, E., & Norris, C. (1999). Teachers & technology: A snap-shot survey. Texas Center for Educational Technology. Retrieved October 4, 2006, from http://www.tcet.unt.edu/research/survey/snaps31b.rtf

Stefl-Mabry, J. (1999). Professional staff development: Lessons learned from current usability studies. *Journal of Information Technology Impact, 1*(2), 81-104. Retrieved May 9, 2006, from http://www.jiti.com/v1n2/stefl-mabry.html.

Stevens, J. (1999). *Intermediate statistics (2^{nd} ed.).* Mahwah, NJ: Lawrence Erlbaum Associates.

Stevens, J. (1996). *Applied multivariate statistics for the social sciences (3rd ed.).* Hillside, NJ: Erlbaum.

Sun, J., Heath, M., Byrom, E., Phlegar, J., & Dimock, K. V. (2000). *Planning into practice: Resources for planning, implementing, and integrating instructional technology*. Durham, NC: SouthEast and Islands Regional Technical Education Consortium.

Surry, D. W. (1997, February). Diffusion theory and instructional technology. Paper presented at the Annual Conference of the Association for Educational Communications and Technology (AECT), Albuquerque, New Mexico. Retrieved May 8, 2006, from http://www2.gsu.edu/~wwwitr/docs/diffusion/

Swain, C. (2006). Preservice teachers' self-assessment using technology: Determining what is worthwhile and looking for changes in daily teaching and learning practices. *Journal of Technology and Teacher Education, 14*(1), 29-59.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (3rd ed.). Harp Collins College Publishers.

Tallman, J., & Fitzgerald, M. A. (2005). Blending online and classroom learning environments: Reflections on experiences and points to consider. *Knowledge Quest, 34*(1), 25-28.

Teng, Y., & Allen, J. (2005). Using Blackboard in an educational psychology course to increase preservice teachers' skills and confidence in technology integration. *Journal of Interactive Online Learning, 3*(4), 1-12.

Thurstone, L. L. (1928): Attitudes can be measured. *American Journal of Sociology, 33*, 529-554.

Todd, N. I. (1993). *Faculty concerns as gateways to teacher competency with computer technology*. Paper presented at the Convention of the Association for Educational Communications and Technology, New Orleans, Louisiana. (ERIC Document Reproduction No. ED 362 209).

Topper, A. (2004). How are we doing? using self-assessment to measure changing teacher technology literacy within a graduate educational technology program. *Journal of Technology and Teacher Education, 12*(3), 303-317.

United States Department of Education. (1994). *National goals report: Building a nation of learners*. Report by the National Educational Goals Panel, Washington, D. C.

University of Education, Winneba. (2006). *Vice Chancellor's annual report and basic statistics.* Winneba, Ghana: Author.

Vaughan, W. (2002). Professional development and the adoption and implementation of new innovations: Do teacher concerns matter? *International Electronic Journal for Leadership in Learning, 6*(5). Retrieved June 13, 2006, from http://www.ucalgary.ca/~iejll/volume6/vaughan.html.

Vitale, D. J. (2005). Developing technology integrators: The role of professional development for instructional technology integration. Unpublished doctoral dissertation, The University of Wisconsin, Madison.

Wade, R. K. (1989). What makes a difference in inservice education? A meta-analysis of research. *Educational Leadership, 43*(4), 48-54.

Watson, G. (2006). Technology professional development: Long-term effects on teacher self-efficacy. *Journal of Technology and Teacher Education, 14* (1), 151-166.

Whale, D. (2006). Technology skills as a criterion in teacher evaluation. *Journal of Technology and Teacher Education, 14*(1), 61-74.

Wilson B., Sherry, L., Dobrovolny, J., Batty, M., & Ryder, M. (2001). Adoption of learning technologies in schools and universities. In H. H. Adelsberger, B. Collis, & J. M. Pawlowski (Eds.), *Handbook on information technologies for education & training.* New York: Springer-Verlag. Retrieved October20, 2006, from http://carbon.cudenver.edu/~lsherry/pubs/newadopt.htm

Wozney, L., Venkatesh, V., & Abrami, P. C. (2006). Implementing computer technologies: Teachers' perceptions and practices. *Journal of Technology and Teacher Education, 14*(1), 173-207.

Yick, A. G., Patrick, P., & Costin, A. (2005). Navigating distance and traditional higher education: Online faculty experiences. *International Review of Research in Open and Distance Learning.* Retrieved October 10, 2005, from http://www.irrodl.org/content/v6.2/yick.html.

Zhang, Y., & Deng, W. (2004). Perception of learning effectiveness in the multimedia classroom vs. the traditional classroom: A case study. *College & University Media Review, 11*(1), 87-107.

Appendices

Appendix A: Faculty Technology Integration Survey

Part A: Faculty Technology Use

In one way or another, faculty members interact with campus-wide computer network systems in our teaching and learning processes. In this study, this researcher would appreciate your views on how you use or would like to use technology for teaching and learning. Your views on technology integration into the tertiary teacher education program of your university are also being requested. The information you provide here will be treated confidentially, and only GROUP data will be reported as an outcome of this study.

Part A1: Information about Participants' Use of Technology in Instruction

Instructions: Please, ***Tick*** *(√)/****mark an X*** *in the box corresponding to your choice or* ***circle the number*** *corresponding to your degree of agreement or* ***write/ type*** *in the box the expected response as appropriate.*

1. I have been teaching full-time as a Faculty/Senior Member for [ ] years.

2. I have been using computer-based technology for the past [ ] years

3. Which of the following best describes the level of technology training that you have had in the past five years?

No training	
Basic computer literacy (windows operations, how to run programs)	
Computer applications such as word processing, spreadsheets, PowerPoint, etc	
Computer integration in classroom curriculum and instruction	

4. How would you describe your level of use of computer-based technology for teaching and learning? Please, select only one level.

Low (I am able to perform basic functions, but I still require help on a regular basis.)	
Moderate (I am competent in a number of computer applications for instruction.)	
High (I am proficient in using a wide variety of computer technologies for instruction)	

5. When do you intend to begin using technology in your instruction, if you are not already using instructional technology?

6. At what stage of your professional practice/development did you first use computers on campus?

As an undergraduate student	
As a graduate student	
As a new faculty member	
As an experienced faculty member	
Have not used computers at all in my career	
Other, please specify:	

7. On the average, how many hours do you spend using a computer per day? hours

Part A2: Faculty Technology Use for Teaching and Learning

(a) How often do you use computer-based technology in the following areas?

Please, rate your frequency of use as follows: Almost Always (AA = 5), Frequently (F = 4), Sometimes (S = 3), Rarely (R = 2), Never (N = 1)

Item	**AA**	**F**	**S**	**R**	**N**
1. Personal communication and document preparation, i.e. email and word processing	5	4	3	2	1
2. Research work, i.e. web browsing	5	4	3	2	1
3. Classroom management and student assessment/evaluation purposes	5	4	3	2	1
4. Teaching and learning activities for your students	5	4	3	2	1

(b) How often do you use the following application software for instruction?

Please, rate your frequency of use as follows: Almost Always (AA = 5), Frequently (F = 4), Sometimes (S = 3), Rarely (R = 2), Never (N = 1)

Item	AA	F	S	R	N
5. Microsoft Word for word-processing and instruction.	5	4	3	2	1
6. Microsoft Excel/Access for instruction and course management.	5	4	3	2	1
7. Microsoft PowerPoint for presentation in class and seminars.	5	4	3	2	1
8. Statistical Package for Social Sciences (SPSS) for data analysis and research work.	5	4	3	2	1
9. Internet/E-Mail for research and instruction.	5	4	3	2	1
10. Subject-based instructional software.	5	4	3	2	1

(c) Please, circle the option that best reflects how you feel about each of the following statements.

Rating Scale: Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), Strongly Disagree (SD = 1)

Statement	SA	A	N	D	SD
11. I would use instructional technology tools more often, if they were available in my classroom.	5	4	3	2	1
12. I would like to use subject/curricular-based software in my instruction.	5	4	3	2	1
13. I would like to use a computer for instruction more often, if it were provided in my classroom.	5	4	3	2	1
14. I would like to perform Internet searches in my classroom.	5	4	3	2	1
15. I would like to use a campus-wide web-based system (e.g. UEW Online Student Information System and UCC Online Student Information System) for instruction online.	5	4	3	2	1
16. I hardly ever use instructional technology in my class.	5	4	3	2	1
17. I use basic computer applications (e.g., word processing, spreadsheets and PowerPoint) for instruction.	5	4	3	2	1
18. If I get the opportunity, I would like to use audio and	5	4	3	2	1

video web-based systems for instruction.					
19. I use the Internet to search for teaching materials.	5	4	3	2	1
20. Overall, the use of instructional technology has been helpful in my teaching and learning tasks.	5	4	3	2	1

Part B: Faculty Attitudes towards Technology Integration Survey

Factor 1: Faculty Attitudes towards Technology Integration into Teacher Education Curriculum

Please, circle the option that best reflects how you feel about each of the following statements.

Rating Scale: Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), Strongly Disagree (SD = 1)

Statement	**SA**	**A**	**N**	**D**	**SD**
1. Using a computer with technology equipment and subject-based software in my instruction would make me a better instructor.	5	4	3	2	1
2. Use of instructional technology requires unnecessary curriculum reforms.	5	4	3	2	1
3. Decentralizing faculty technology professional development programs to the various academic departments would make them more relevant.	5	4	3	2	1
4. The integration of technology into the curriculum results in only minor improvement in learning over the traditional methods.	5	4	3	2	1
5. I will probably never have a need to use a computer in my instructional activities.	5	4	3	2	1
6. I believe that all faculty members should know how to use instructional technology.	5	4	3	2	1
7. Anything that a computer can be used for, I can do just as well some other way.	5	4	3	2	1
8. My inability to manage all that technology integration in the curriculum requires of me discourages me.	5	4	3	2	1
9. I am unsure how to integrate computers into instruction.	5	4	3	2	1
10. It is important that my university's ICT plan includes the use of instructional technology.	5	4	3	2	1
11. I am working hard on using instructional technology to maximize the effects on my teaching and students' learning.	5	4	3	2	1
12. I believe technology integration into the curriculum enriches the	5	4	3	2	1

teaching and learning environment.					

Factor 2: Faculty Motivation for Adoption of Instructional Technology

Please, circle the option that best reflects how you feel about each of the following statements.

Rating Scale: Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), Strongly Disagree (SD = 1)

Statement	**SA**	**A**	**N**	**D**	**SD**
13. The use of instructional technology in my instruction enhances my prestige.	5	4	3	2	1
14. I feel uncomfortable with the use of computer tools for instruction.	5	4	3	2	1
15. I enjoy preparing class activities that integrate instructional technology.	5	4	3	2	1
16. I think it is important to have access to computer technology in my classroom for use in my teaching.	5	4	3	2	1
17. I get bored figuring out how to use computers for a variety of teaching situations.	5	4	3	2	1
18. I know that computers give me more opportunities to learn many new things.	5	4	3	2	1
19. I believe technology is a useful tool in my instruction.	5	4	3	2	1
20. I get a sinking feeling when I think of trying to use a computer in my instruction.	5	4	3	2	1
21. I am satisfied with current campus investment plans with regard to acquiring computer technology for teaching and learning activities.	5	4	3	2	1
22. It is important that the university reward structure should recognize faculty members for integrating computers for teaching.	5	4	3	2	1
23. Interacting with the campus-wide network system is frustrating.	5	4	3	2	1
24. I have avoided the use of instructional technology because computers are unfamiliar to me.	5	4	3	2	1
25. Working with instructional technology would be enjoyable and stimulating.	5	4	3	2	1

Factor 3: Perceptions of the Effects of Faculty Use of IT on Students and Pedagogy

Please, circle the option that best reflects how you feel about each of the following statements.

Rating Scale: Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), Strongly Disagree (SD = 1)

Statement	**SA**	**A**	**N**	**D**	**SD**
26. Students are more enthusiastic about the subjects for which they use computers.	5	4	3	2	1
27. The use of instructional technology is an effective tool for students of all abilities.	5	4	3	2	1
28. The use of computer-based technology in instruction reduces my personal interaction with my students.	5	4	3	2	1
29. When using technology, I am able to tailor students' work to their individual needs.	5	4	3	2	1
30. Computers provide environments that appeal to a variety of learning styles of my students.	5	4	3	2	1
31. The Internet provides a means of expanding and applying what has been taught in class.	5	4	3	2	1
32. When using technology, I see my role more as a facilitator of individual students' learning.	5	4	3	2	1
33. Technology tools enable students to cooperate more on projects.	5	4	3	2	1
34. Computers hinder students' ability with learning tasks (e.g., writing, analyzing data, or solving problems).	5	4	3	2	1
35. E-mail is an effective means of disseminating course material to students.	5	4	3	2	1
36. The use of web-based instruction would make the student feel more involved.	5	4	3	2	1
37. The use of web-based technology almost always reduces the personal treatment of students.	5	4	3	2	1
38. Computer tools would enable me to interact more with students.	5	4	3	2	1
39. I believe by integrating technology in teaching and learning, I am helping students to acquire the basic computer education needed for their future careers.	5	4	3	2	1
40. I feel the use of technology for instruction affects my students' learning and teaching methods in a positive way.	5	4	3	2	1

Factor 4: Faculty Perceptions of Barriers and Challenges to Adoption of IT

Please, circle the option that best reflects how you feel about each of the statements.

Rating Scale: Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), Strongly Disagree (SD = 1)

Item	**SA**	**A**	**N**	**D**	**SD**
41. The frequent changes in technology make it hard to keep abreast with instructional technologies.	5	4	3	2	1
42. I have a convenient access to instructional technology on campus.	5	4	3	2	1
43. Using technology for instruction is too expensive for the Ghanaian situation.	5	4	3	2	1
44. I feel already over-burdened without adding technology professional development workshops.	5	4	3	2	1
45. There are too few training opportunities for faculty members to acquire new computer knowledge/skills for teaching.	5	4	3	2	1
46. I own a computer for personal and home use.	5	4	3	2	1
47. I don't have access to a computer at home with software installed for use in my teaching preparation.	5	4	3	2	1
48. There is a scarcity of printers and presentation equipment in classrooms.	5	4	3	2	1
49. I have insufficient time to develop instructional materials that use computers.	5	4	3	2	1
50. My limited expertise in computer skills prevents me from using instructional technology.	5	4	3	2	1

Factor 5: Faculty Perceptions of their Technology Professional Development Needs

Please, circle the option that best reflects how you feel about each of the statements.

Rating Scale: Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), Strongly Disagree (SD = 1)

Item	**SA**	**A**	**N**	**D**	**SD**
51. I have an immediate need for more training with curriculum that integrates technology.	5	4	3	2	1
52. I need convenient access to more computers for my students.	5	4	3	2	1
53. I need more reliable access to the Internet.	5	4	3	2	1
54. I need more software that is subject/curricular-based.	5	4	3	2	1
55. I would need more technical support to keep the computers working during instruction.	5	4	3	2	1
56. I need more resources that illustrate how to integrate technology into the curriculum.	5	4	3	2	1
57. I need more training opportunities with teaching strategies that integrate technology.	5	4	3	2	1
58. I need more compelling reasons why I should incorporate technology into teaching.	5	4	3	2	1
59. I need more time to change the curriculum to incorporate technology.	5	4	3	2	1
60. I believe faculty members must have a stronger voice in the technology professional development programme.	5	4	3	2	1
61. Attending a few technology workshops and seminars is enough for me to start using instructional technology.	5	4	3	2	1
62. I need more regular instructional technology seminars/workshops.	5	4	3	2	1
63. I would like to collaborate with my colleagues on instructional technology issues.	5	4	3	2	1
64. My effort is primarily directed towards mastering tasks required to use instructional technology.	5	4	3	2	1
65. My university's faculty technology professional development plan meets my technology needs.	5	4	3	2	1

Part C: Faculty Stages of Technology Adoption Survey

Instruction: Please, read the descriptions of each of the six levels related to adoption and use of technology for instruction. Then tick (√) the stage you best fit into. Please, select only one level.

Stage of technology adoption	**I best fit into level**
Stage 1 (Awareness): I am aware that instructional technology exists but I have not used it; perhaps I'm even avoiding it. I am anxious about the prospect of using computers.	
Stage 2 (Learning the Process): I am trying to learn the basics of instructional technology. I am sometimes frustrated using computers. I lack confidence when using computers.	
Stage 3 (Understanding and Application of the Process): I am beginning to understand the process of using technology for instruction and can think of specific tasks in which it might be useful.	
Stage 4 (Familiarity and Confidence): I am gaining a sense of confidence in using the computer for specific instructional tasks. I am starting to feel comfortable using the computer.	
Stage 5 (Adoption to other contexts): I think about the computer as a tool to help me and I am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.	
Stage 6 (Creative application to new contexts): I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.	

Part D: Communication Channels for Technology Adoption and Diffusion

(a) In terms of media and methods for acquiring new computer skills and knowledge for teaching and learning, how important/useful are the following to you?

Please, rate the level of importance as follows: Very Important (VI = 5), Important (I = 4), Not Sure (NS = 3), Not Very Important (NVI = 2), and Not Important (NI = 1) for each medium.

Item	**VI**	**I**	**NS**	**NVI**	**NI**
1. Internet materials or online manuals	5	4	3	2	1
2. Books and other hardcopy text materials	5	4	3	2	1
3. Hands-on experimenting and troubleshooting	5	4	3	2	1
4. Mixture of manuals and hands-on	5	4	3	2	1
5. CD-ROM Tutorials and Instructional material	5	4	3	2	1
6. Workshops and presentations at seminars	5	4	3	2	1
7. Structured courses and guidance	5	4	3	2	1
8. Peer-peer, on-demand, one-on-one interactions	5	4	3	2	1

(b) In terms of help or assistance with using computers for instruction, how important are each of the following sources of support to you?

Please, rate the level of importance as follows: Very Important (VI = 5), Important (I = 4), Not Sure (NS = 3), Not Very Important (NVI = 2), and Not Important (NI = 1) for each medium.

Item	**VI**	**I**	**NS**	**NVI**	**NI**
9. Experienced students	5	4	3	2	1
10. Colleagues on my university campus	5	4	3	2	1
11. Colleagues from another institution	5	4	3	2	1
12. Outside expert in instructional/educational technology	5	4	3	2	1
13. ICT/Media center support staff	5	4	3	2	1
14. Hot-line, or telephone assistance	5	4	3	2	1
15. One-on-one assistance (Internet)	5	4	3	2	1

(c) How important are the following sources of information to you for keeping abreast of changes/innovations in the area of computers in instruction?

Please, rate the level of importance as follows: Very Important (VI = 5), Important (I = 4), Not Sure (NS = 3), Not Very Important (NVI = 2), and Not Important (NI = 1) for each medium for each medium.

Item	**VI**	**I**	**NS**	**NVI**	**NI**
16. Informal network of friends and family	5	4	3	2	1
17. Professional Colleagues on campus	5	4	3	2	1
18. Professional Colleagues from other institutions	5	4	3	2	1
19. Head of Department/Dean	5	4	3	2	1
20. University administration	5	4	3	2	1
21. Innovative students	5	4	3	2	1
22. Popular newspapers, computer magazines, and television	5	4	3	2	1
23. Refereed or online computer journals	5	4	3	2	1
24. Conferences, demonstrations and workshops	5	4	3	2	1
25. Online computer newsgroups and websites	5	4	3	2	1
26. Hardware and software catalogs and brochures	5	4	3	2	1

Part E: Demographic Information

Please, kindly take a few more minutes to provide this researcher with the following demographic information. The information you provide here will be treated confidentially, and only GROUP data will be reported as an outcome of this study.

1. I am a Male ☐ Female ☐

2. I am ☐ years old.

3. I belong to the Faculty of ☐

4. I teach in the Department of ☐

5. I teach in the (please, tick (√)/mark (X) the box applicable to you):

UEW-Winneba Campus	
UEW-Kumasi Campus	
UEW-Mampong Campus	
UCC -Faculty of Education	

6. I am a (please, tick (√)/mark (X) the box applicable to you):

Full-time faculty member	
Part-time faculty member	
Retired but on short-term contract	

7. What is your academic rank? (Please, tick (√)/mark (X) the box applicable to you):

Teaching Assistant	
Tutor	
Assistant Lecturer	
Lecturer	
Senior Lecturer (Assistant Professor)	
Associate Professor	
Professor	

8. What is the average number of undergraduate/graduate students that you teach in a regular semester? Graduates ☐ Undergraduates ☐

9. What is the teaching load per week (in hours) that you do in a regular semester session?

10. Please, give your general view (s) about the integration of ICT into the teacher education curriculum, and for teaching and learning as a teacher educator in the space below:

Thank you so very much for your assistance and time.

Appendix B: Supplementary Interview Protocol

Based on the eight conditions that facilitate the implementation of educational technology innovations (Ely, 1999), this part of the survey will seek the views of university faculty on the use of technology for teaching and learning, faculty technology professional development, incentives for technology users among faculty members, ICT infrastructure and facilities available (networks, computer based technologies/equipment for teaching and learning, curriculum and instructional issues, and perceived barriers of the adoption and use of technology innovations. It is hoped that the responses to these issues will provide insight on the technology integration status in the light of institutional mission and vision statements at all sites of my study. I expect an institutional mental model to emerge from these interviews.

Preliminary Interview Questions

Question 1
In your view, what are the three most important reasons that motivate your institution and faculty members to integrate technology into teaching and learning?

Question2
You may want to suggest some incentives you expect the University to use to encourage faculty to integrate technology into teaching and learning.

Question 3

If you are not currently using technology for teaching and learning, when do you intend to begin using instructional technology in your curriculum? Do you envisage major curriculum reforms for the technology integration/innovation?

Question 4
What, in your view, are the three most important barriers preventing you from integrating computer-based technology in instruction across the curriculum?

Question 5

To what extent were your faculty members involved in your ICT policy design? What is the extent of faculty support for the ICT plan?

Question 6

Does your curriculum or university policy require faculty to use technology in instruction? How does your institution recognize technology innovators who are leaders in the use IT for teaching and learning?

Question 7
What would you say is the average level of technology use for teaching and learning among faculty members?

Does your institution have a consistent ongoing faculty technology professional development plan? To what extend does such a plan factor in faculty technology needs and concerns?

Question 8
How do you determine whether the use and integration of technology is having the intended/desired effects? How do you “know” when using technology has “worked”, and when it has not?

What has been the impact of the periodic workshops and seminars organized for faculty technology professional development in terms of their quality of teaching, students’ learning and achievement?

You may want to share how you evaluate the outcomes of using technology into your teaching with the researcher. Please, elaborate on the ways in which you evaluate the outcomes of using technology in your teaching.

Thank you so very much for your assistance and time.

Appendix C: Invitation to Survey Participants

Dear Colleague,

My name is Issifu Yidana, a second year graduate student of the Department of Educational Studies (Instructional Technology), College of Education, Ohio University at Athens. I am seeking your help in a survey of faculty attitude towards Integration of Instructional Technology in a tertiary teacher education curriculum and instruction. This study is being conducted as a research project for my dissertation. The study will investigate how faculty members' attitudes towards the integration of technology into the curriculum and classroom instruction and their perceptions of technology professional needs influence their levels of technology use in their classroom activities and research. I believe the findings will help give direction to the technology innovation program of your university, particularly in addressing the technology needs of faculty members seen as drivers for technology integration in teaching and learning.

Your responses to this survey will be very much appreciated. It will take approximately 30 minutes to complete the survey. If you agree to participate in the study, you will be linked to a survey site to access the survey items. If you prefer a paper version of the survey, this will be made available in your mailbox in your department/office. Your participation in this research is voluntary, and you may discontinue participation at any time without penalty or loss of any benefits to which you may otherwise be entitled.

By agreeing to complete the survey, I will assume your consent to participate in this study.
The confidentiality of your responses is an ethical issue I will respect in this study. The data gathering, treatment, management, and analysis will be conducted by me and only me. Your professional and personal information is required in anonymous form to protect you individual identity and privacy. Only GROUP data will be reported in this study. The study involves no potential risks.

If you have any questions regarding this study, please contact the researcher, Issifu Yidana at iy305204@ohio.edu or 1-740-590-9246 or Dr. Sandra Turner, the research advisor at turners@ohio.edu or 1 740 593 9826

If you have any questions or concerns regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, 1 740 593 0664

Accept my sincere thanks for your anticipated assistance in this survey,

Issifu Yidana

Appendix D: Invitation Letter to Potential Interviewees

Dear Colleague,

My name is Issifu Yidana, a second year graduate student of the Department of Educational Studies (Instructional Technology), College of Education, Ohio University at Athens. I am seeking your help in a survey of faculty attitude towards Integration of Instructional Technology in a tertiary teacher education curriculum and instruction. This study is being conducted as a research project for my dissertation. The study will investigate how faculty members' attitudes towards the integration of technology into the curriculum and classroom instruction and their perceptions of technology professional needs influence their levels of technology use in their classroom activities and research. I believe the findings will help give direction to the technology innovation program of your university, particularly in addressing the technology needs of faculty members seen as drivers for technology integration in teaching and learning.

I am conducting a supplementary interview to illuminate the findings of the survey. You are one of very few faculty members selected to participate in the interview schedule. Your responses will therefore be very much appreciated. It will take approximately 45 minutes to complete an interview session. If you agree to participate in the interview, you will be given a prior set of questions on which our discussions at the interview will be based. Your participation in this research is voluntary, and you may discontinue participation at any time without penalty or loss of any benefits to which you may otherwise be entitled.

I am also asking your permission to audiotape our discussions for the researcher's use only. By agreeing to be interviewed, I will assume your consent to participate in this study.
The confidentiality of your responses is an ethical issue I will respect in this study. The data gathering, treatment, management, and analysis will be conducted by me and only me. Your professional and personal information is required in anonymous form to protect you individual identity and privacy. The study involves no potential risks.

If you have any questions regarding this study, please contact the researcher, Issifu Yidana at iy305204@ohio.edu or 1-740-590-9246 or Dr. Sandra Turner, the research advisor at turners@ohio.edu or 1 740 593 9826

If you have any questions or concerns regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, 1 740 593 0664

Accept my sincere thanks for your anticipated assistance in this survey,

Issifu Yidana

Appendix E: Reliability Tables

Appendix E1: Use Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.864	.868	19

Item Statistics

	Mean	Std. Deviation	N
1. I would use instructional technology tools more often, if they were available in my classroom.	3.94	1.061	126
2. I would like to use subject/curricular-based software in my instruction.	3.73	1.039	126
3. I would like to use a computer for instruction more often, if it were provided in my classroom.	3.29	1.206	126
4. I would like to perform Internet searches in my classroom.	2.71	1.362	126
5. I would like to use a campus-wide web-based system (e.g. UEW Online Student Information System, and UCC Online Student Information System)for online instruction.	3.56	1.318	126
6. I hardly ever use instructional technology in my class.	2.60	1.333	126
7. I use basic computer applications (e.g. Word Processing, Spreadsheets, and PowerPoint) for instruction.	2.57	1.329	126

8. If I get the opportunity, I would like to use audio and video web-based systems for instruction.	2.65	1.279	126
9. I use the Internet to search for teaching materials.	3.56	1.236	126
10. Overall, the use of instructional technology has been helpful in my teaching and learning.	2.25	1.263	126
11. How often do you use computer-based technology for personal communication and document preparation (e.g. e-mail and word processing)?	4.33	.768	126
12. How often do you use computer-based technology for research work (e.g. web browsing)?	4.19	.817	126
13. How often do you use computer-based technology for classroom management and student assessment/evaluation purposes?	4.13	.906	126
14. How often do you use computer-based technology for teaching and learning activities for your students?	3.53	1.129	126
15. How often do you use Microsoft Word for word-processing and instruction?	4.00	1.028	126
17. How often do you use Microsoft PowerPoint for presentation in class and seminars?	2.90	1.396	126
18. How often do you use the Statistical Package for Social Sciences (SPSS) for data analysis and research work?	3.98	1.092	126
19. How often do you use the Internet/e-mail for research and instruction?	4.10	.967	126

20. How often do you use subject-based instructional software?	3.39	1.239	126

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.442	2.246	4.325	2.079	1.926	.421	19
Item Variances	1.346	.589	1.949	1.360	3.308	.171	19
Inter-Item Correlations	.258	-.252	.720	.972	-2.853	.041	19

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
1. I would use instructional technology tools more often, if they were available in my classroom.	61.45	124.426	.644	.652	.851
2. I would like to use subject/curricular-based software in my instruction.	61.67	125.632	.605	.673	.852
3. I would like to use a computer for instruction more often, if it were provided in my classroom.	62.11	125.284	.520	.512	.855
4. I would like to perform Internet searches in my classroom.	62.68	121.450	.583	.599	.852
5. I would like to use a campus-wide web-based system (e.g. UEW Online Student Information System, and UCC Online Student Information System)for online instruction.	61.84	122.951	.551	.582	.854
6. I hardly ever use instructional technology in my class.	62.79	124.213	.498	.623	.856
7. I use basic computer applications (e.g. Word Processing, Spreadsheets, and PowerPoint) for instruction.	62.83	122.449	.563	.490	.853
8. If I get the opportunity, I would like to use audio and video web-based systems for instruction.	62.75	131.887	.247	.330	.867
9. I use the Internet to search for teaching materials.	61.84	123.927	.557	.445	.853
10. Overall, the use of instructional technology has been helpful in my teaching	63.15	125.169	.496	.518	.856

and learning.					
11. How often do you use computer-based technology for personal communication and document preparation (e.g. e-mail and word processing)?	61.07	130.963	.526	.589	.857
12. How often do you use computer-based technology for research work (e.g. web browsing)?	61.21	132.037	.430	.601	.859
13. How often do you use computer-based technology for classroom management and student assessment/evaluation purposes?	61.26	132.915	.337	.689	.862
14. How often do you use computer-based technology for teaching and learning activities for your students?	61.87	132.198	.282	.433	.864
15. How often do you use Microsoft Word for word-processing and instruction?	61.40	130.417	.397	.526	.860
17. How often do you use Microsoft PowerPoint for presentation in class and seminars?	62.50	125.180	.437	.442	.859
18. How often do you use the Statistical Package for Social Sciences (SPSS) for data analysis and research work?	61.42	133.526	.241	.584	.865
19. How often do you use the Internet/e-mail for research and instruction?	61.30	127.284	.576	.473	.854
20. How often do you use subject-based instructional software?	62.01	127.016	.438	.480	.858

Appendix E2: Factor1 Reliability

Scale: ALL VARIABLES for REGRESSION

Case Processing Summary

		N	%
Cases	Valid	127	96.2
	Excluded(a)	5	3.8
	Total	132	100.0

a Listwise deletion based on all variables in the procedure.

Factor 1 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.771	.790	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
1. Using computer-based technology equipment with subject-based software in my instruction would make me a better instructor.	43.39	35.445	.489	.401	.749
2. Use of instructional technology requires unnecessary curriculum reforms.	44.06	34.227	.398	.282	.757
3. Decentralizing faculty technology professional development programs to the various academic departments would make them more relevant.	43.45	38.027	.230	.244	.771
4. The integration of technology into the curriculum results in only minor improvement in learning over the traditional methods.	43.89	33.893	.453	.327	.750
5. I will probably never have a need to use a computer in my instructional activities.	43.40	33.893	.539	.360	.741
6. I believe that all faculty members should know how to use instructional technology.	43.11	36.178	.482	.496	.751

7. Anything that a computer can be used for, I can do just as well some other way.	43.65	36.373	.282	.208	.769
8. My inability to manage all that technology integration in the curriculum requires of me discourages me.	44.39	33.606	.374	.322	.763
9. I am unsure how to integrate computers into instruction.	44.38	33.554	.379	.375	.762
10. It is important that my university's ICT plan includes the use of instructional technology.	43.16	35.578	.518	.536	.747
11. I am working hard on using instructional technology to maximize the effects on my teaching and students' learning.	43.80	35.604	.372	.285	.759
12. I believe technology integration into the curriculum enriches the teaching and learning environment.	43.17	35.303	.570	.587	.743

Appendix E3: Factor2 Reliability

Case Processing Summary

		N	%
Cases	Valid	124	93.9
	Excluded(a)	8	6.1
	Total	132	100.0

a Listwise deletion based on all variables in the procedure.

Factor 2 Reliability Statistics

Cronbach's Alpha	N of Items
.810	12

Item Statistics

	Mean	Std. Deviation	N
13. The use of instructional technology in my instruction enhance my prestige.	3.73	1.127	124
14. I feel uncomfortable with the use of computer tools for instruction.	3.85	1.141	124
15. I enjoy preparing class activities that integrate instructional technology.	3.69	.868	124
16. I think it is important to have access to computer technology in my classroom for use in my teaching.	4.29	.773	124
17. I get bored figuring out how to use computers for a variety of teaching situations.	3.89	.998	124
18. I know that computers give me more opportunities to learn many new things.	4.48	.727	124
19. I believe technology is a useful tool in my instruction.	4.37	.770	124
20. I get a sinking feeling when I think of trying to use a computer in my instruction.	3.89	1.014	124
22. It is important that the university reward structure should recognize faculty members for integrating computers for teaching.	3.94	.943	124
23. Interacting with the campus-wide network system is frustrating.	2.92	1.285	124
24. I have avoided the use of instructional technology because computers are unfamiliar to me.	4.12	1.001	124
25. Working with instructional technology would be enjoyable and stimulating.	4.27	.664	124

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
13. The use of instructional technology in my instruction enhance my prestige.	43.69	35.873	.430	.800
14. I feel uncomfortable with the use of computer tools for instruction.	43.58	35.205	.476	.795

15. I enjoy preparing class activities that integrate instructional technology.	43.74	37.835	.408	.801
16. I think it is important to have access to computer technology in my classroom for use in my teaching.	43.14	37.355	.528	.792
17. I get bored figuring out how to use computers for a variety of teaching situations.	43.54	36.250	.474	.795
18. I know that computers give me more opportunities to learn many new things.	42.94	37.224	.586	.789
19. I believe technology is a useful tool in my instruction.	43.06	37.794	.482	.796
20. I get a sinking feeling when I think of trying to use a computer in my instruction.	43.54	35.600	.522	.790
22. It is important that the university reward structure should recognize faculty members for integrating computers for teaching.	43.49	37.097	.431	.799
23. Interacting with the campus-wide network system is frustrating.	44.51	36.057	.339	.813
24. I have avoided the use of instructional technology because computers are unfamiliar to me.	43.31	35.450	.545	.788
25. Working with instructional technology would be enjoyable and stimulating.	43.16	38.771	.452	.799

Appendix E4: Factor 3 Reliability

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.808	.824	15

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
1. Students are more entusiastic about subjects for which they use computers.	53.84	43.585	.309	.287	.805
2. The use of instructional technology is an effective tool for students of all abilities.	53.58	40.542	.528	.405	.788
3. The use of computer-based technology in instruction reduces my personal interaction with my students.	54.44	45.436	.081	.386	.829
4. When using technology, I am able to tailor students' work to their individual needs.	54.12	42.188	.487	.409	.792
5. Computers provide environments that appeal to a variety of learning styles of my students.	53.65	41.401	.541	.418	.788
6. The Internet provides a means of expanding and applying what has been taught in class.	53.33	42.505	.558	.462	.790
7. When using technology, I see my role more as a facilitator of individual student's learning.	53.53	42.657	.450	.362	.795
8. Technology tools enable students to cooperate more on projects.	53.78	42.269	.481	.337	.793
9. Computers hinder students' ability with learning tasks (e.g. writing, analyzing data, or solving problems)	53.67	42.721	.370	.246	.801
10. E-mail is an effective means of disseminating course material to students.	53.54	42.438	.419	.419	.797

11. The use of web-based instruction would make students feel more involved in their learning.	53.71	40.709	.601	.462	.784
12. The use of web-based tehnology almost always reduces the personal treatment of students.	54.54	45.344	.124	.265	.820
13. Computer tools would enable me to interact more with students.	53.94	40.996	.540	.462	.788
14. I believe by integrating technology in teaching and learning, I am helping students to acquire the basic computer education needed for their future careers.	53.32	42.297	.547	.402	.790
15. I feel the use of technology for instruction affects my students' learning and teaching methods in a positive way.	53.57	41.404	.523	.408	.789

Appendix E5: Factor 4 Reliability

Factor 4 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	N of Cases
.711	.712	10	129

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
1. The frequent changes in technology make it hard to keep abreast with instructional technology.	25.43	38.435	.322	.191	.696

2. I have a convenient access to instructional technology on campus.	25.73	38.059	.298	.192	.701
3. Using technology for instruction is too expensive for the Ghanaian situation.	25.45	36.171	.427	.293	.679
4. I feel already over-burdened without adding technology professional workshops.	24.99	35.773	.489	.341	.670
5. There are too few training opportunities for faculty members to acquire new computer knowledge/skills for teaching.	26.22	39.035	.276	.165	.703
6. I own a computer for personal and home use.	24.48	38.783	.177	.173	.726
7. I don't have access to a computer with software installed for my use in my teaching preparation at home.	25.28	33.422	.468	.268	.670
8. There is a scarcity of printers and presentation equipment in classrooms on campus.	26.56	40.108	.183	.154	.717
9. I have insufficient time to develop instructional materials that use computers.	25.59	35.119	.516	.394	.664
10. My limited expertise in computer skills prevents me from using instructional technology.	25.40	33.805	.580	.405	.651

Appendix E6: Factor 5 Reliability

Factor 5 Reliability Statistics

Cronbach's Alpha	N of Items
.801	14

Item Statistics

	Mean	Std. Deviation	N
51. I have an immediate need for more training with curriculum that integrate technology.	4.05	.991	127
52. I need convenient access to more computers for my students.	4.20	.836	127
53. I need more reliable access to the Internet.	4.43	.822	127
54. I need more software that is subject/curricular-based.	4.38	.776	127
55. I would need more technical support to keep the computers working during instruction.	4.07	1.001	127
56. I need more resources that illustrate how to integrate technology into the curriculum.	4.16	.921	127
57. I need more training opportunities with teaching strategies that integrate technolgy.	4.32	.863	127
58. I need more compelling reasons why I should incorporate technology.	2.46	1.246	127
59. I need more time to change the curriculum to incorporate technology.	3.20	1.113	127
60. I believe faculty members must have a stronger voice in the technology professional development programme.	4.10	.775	127
61. Attending a few technology workshops and seminars is enough for me to start using instructional technolgy.	3.09	1.099	127
62. I need more regular instructional technology workshops/seminars.	4.10	.844	127
63. I would like to collaborate with my colleagues on instructional technology issues.	4.24	.687	127
64. My effort is primarily directed towards mastering tasks required to use instructional technology.	3.60	.829	127

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
51. I have an immediate need for more training with curriculum that integrate technology.	50.34	39.829	.489	.783
52. I need convenient access to more computers for my students.	50.19	42.472	.344	.795
53. I need more reliable access to the Internet.	49.96	40.705	.529	.781
54. I need more software that is subject/curricular-based.	50.01	40.706	.567	.779
55. I would need more technical support to keep the computers working during instruction.	50.31	38.694	.580	.775
56. I need more resources that illustrate how to integrate technology into the curriculum.	50.23	37.860	.725	.764
57. I need more training opportunities with teaching strategies that integrate technolgy.	50.06	39.298	.636	.772
58. I need more compelling reasons why I should incorporate technology.	51.93	42.066	.204	.814
59. I need more time to change the curriculum to incorporate technology.	51.19	39.821	.417	.790
60. I believe faculty members must have a stronger voice in the technology professional development programme.	50.28	43.300	.296	.798
61. Attending a few technology workshops and seminars is enough for me to start using instructional technolgy.	51.30	43.370	.162	.813
62. I need more regular instructional technology workshops/seminars.	50.28	40.490	.533	.781
63. I would like to collaborate with my colleagues on instructional technology issues.	50.14	43.043	.378	.793
64. My effort is primarily directed towards mastering tasks required to use instructional technology.	50.79	43.423	.257	.801

Correlations

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Item Statistics

	Mean	Std. Deviation	N
51. I have an immediate need for more training with curriculum that integrate technology.	4.05	.991	127
52. I need convenient access to more computers for my students.	4.20	.836	127
53. I need more reliable access to the Internet.	4.43	.822	127
54. I need more software that is subject/curricular-based.	4.38	.776	127
55. I would need more technical support to keep the computers working during instruction.	4.07	1.001	127
56. I need more resources that illustrate how to integrate technology into the curriculum.	4.16	.921	127
57. I need more training opportunities with teaching strategies that integrate technolgy.	4.32	.863	127
58. I need more compelling reasons why I should incorporate technology.	2.46	1.246	127
59. I need more time to change the curriculum to incorporate technology.	3.20	1.113	127
60. I believe faculty members must have a stronger voice in the technology professional development programme.	4.10	.775	127
61. Attending a few technology workshops and seminars is enough for me to start using instructional technolgy.	3.09	1.099	127
62. I need more regular instructional technology workshops/seminars.	4.10	.844	127
63. I would like to collaborate with my colleagues on instructional technology issues.	4.24	.687	127
64. My effort is primarily directed towards mastering tasks required to use instructional technology.	3.60	.829	127

Appendix F: Factor Analysis

Communalities

	Initial	Extraction
1. Using computer-based technology equipment with subject-based software in my instruction would make me a better instructor.	1.000	.712
2. Use of instructional technology requires unnecessary curriculum reforms.	1.000	.720
3. Decentralizing faculty technology professional development programs to the various academic departments would make them more relevant.	1.000	.600
4. The integration of technology into the curriculum results in only minor improvement in learning over the traditional methods.	1.000	.673
5. I will probably never have a need to use a computer in my instructional activities.	1.000	.706
6. I believe that all faculty members should know how to use instructional technology.	1.000	.700
7. Anything that a computer can be used for, I can do just as well some other way.	1.000	.721
8. My inability to manage all that technology integration in the curriculum requires of me discourages me.	1.000	.661
9. I am unsure how to integrate computers into instruction.	1.000	.682
10. It is important that my university's ICT plan includes the use of instructional technology.	1.000	.731
11. I am working hard on using instructional technology to maximize the effects on my teaching and students' learning.	1.000	.668
12. I believe technology integration into the curriculum enriches the teaching and learning environment.	1.000	.733

1. The use of instructional technology in my instruction enhance my prestige.	1.000	.718
2. I feel uncomfortable with the use of computer tools for instruction.	1.000	.766
3. I enjoy preparing class activities that integrate instructional technology.	1.000	.695
4. I think it is important to have access to computer technology in my classroom for use in my teaching.	1.000	.664
5. I get bored figuring out how to use computers for a variety of teaching situations.	1.000	.738
6. I know that computers give me more opportunities to learn many new things.	1.000	.691
7. I believe technology is a useful tool in my instruction.	1.000	.685
8. I get a sinking feeling when I think of trying to use a computer in my instruction.	1.000	.725
9. I am satisfied with current campus investment plans with regard to acquiring computer technology for teaching and learning activities.	1.000	.724
10. It is important that the university reward structure should recognize faculty members for integrating computers for teaching.	1.000	.723
11. Interacting with the campus-wide network system is frustrating.	1.000	.758
12. I have avoided the use of instructional technology because computers are unfamiliar to me.	1.000	.713
13. Working with instructional technology would be enjoyable and stimulating.	1.000	.673
1. Students are more entusiastic about subjects for which they use computers.	1.000	.623
2. The use of instructional technology is an effective tool for students of all abilities.	1.000	.634
3. The use of computer-based technology in instruction reduces my personal interaction with my students.	1.000	.777

4. When using technology, I am able to tailor students' work to their individual needs.	1.000	.718
5. Computers provide environments that appeal to a variety of learning styles of my students.	1.000	.718
6. The Internet provides a means of expanding and applying what has been taught in class.	1.000	.693
7. When using technology, I see my role more as a facilitator of individual student's learning.	1.000	.712
8. Technology tools enable students to cooperate more on projects.	1.000	.668
9. Computers hinder students' ability with learning tasks (e.g. writing, analyzing data, or solving problems)	1.000	.686
10. E-mail is an effective means of disseminating course material to students.	1.000	.730
11. The use of web-based instruction would make students feel more involved in their learning.	1.000	.678
12. The use of web-based tehnology almost always reduces the personal treatment of students.	1.000	.653
13. Computer tools would enable me to interact more with students.	1.000	.704
14. I believe by integrating technology in teaching and learning, I am helping students to acquire the basic computer education needed for their future careers.	1.000	.723
15. I feel the use of technology for instruction affects my students' learning and teaching methods in a positive way.	1.000	.636
1. The frequent changes in technology make it hard to keep abreast with instructional technology.	1.000	.690
2. I have a convenient access to instructional technology on campus.	1.000	.688

3. Using technology for instruction is too expensive for the Ghanaian situation.	1.000	.720
4. I feel already over-burdened without adding technology professional workshops.	1.000	.700
5. There are too few training opportunities for faculty members to acquire new computer knowledge/skills for teaching.	1.000	.735
6. I own a computer for personal and home use.	1.000	.525
7. I don't have access to a computer with software installed for my use in my teaching preparation at home.	1.000	.718
8. There is a scarcity of printers and presentation equipment in classrooms on campus.	1.000	.724
9. I have insufficient time to develop instructional materials that use computers.	1.000	.641
10. My limited expertise in computer skills prevents me from using instructional technology.	1.000	.741
1. I have an immediate need for more training with curriculum that integrate technology.	1.000	.741
2. I need convenient access to more computers for my students.	1.000	.763
3. I need more reliable access to the Internet.	1.000	.642
4. I need more software that is subject/curricular-based.	1.000	.762
5. I would need more technical support to keep the computers working during instruction.	1.000	.736
6. I need more resources that illustrate how to integrate technology into the curriculum.	1.000	.857
7. I need more training opportunities with teaching strategies that integrate technolgy.	1.000	.800

8. I need more compelling reasons why I should incorporate technology.	1.000	.706
9. I need more time to change the curriculum to incorporate technology.	1.000	.659
10. I believe faculty members must have a stronger voice in the technology professional development programme.	1.000	.666
11. Attending a few technology workshops and seminars is enough for me to start using instructional technolgy.	1.000	.798
12. I need more regular instructional technology workshops/seminars.	1.000	.742
13. I would like to collaborate with my colleagues on instructional technology issues.	1.000	.653
14. My effort is primarily directed towards mastering tasks required to use instructional technology.	1.000	.748
My university's faculty technology professional development plan meets my technology needs.	1.000	.734

Extraction Method: Principal Component Analysis.

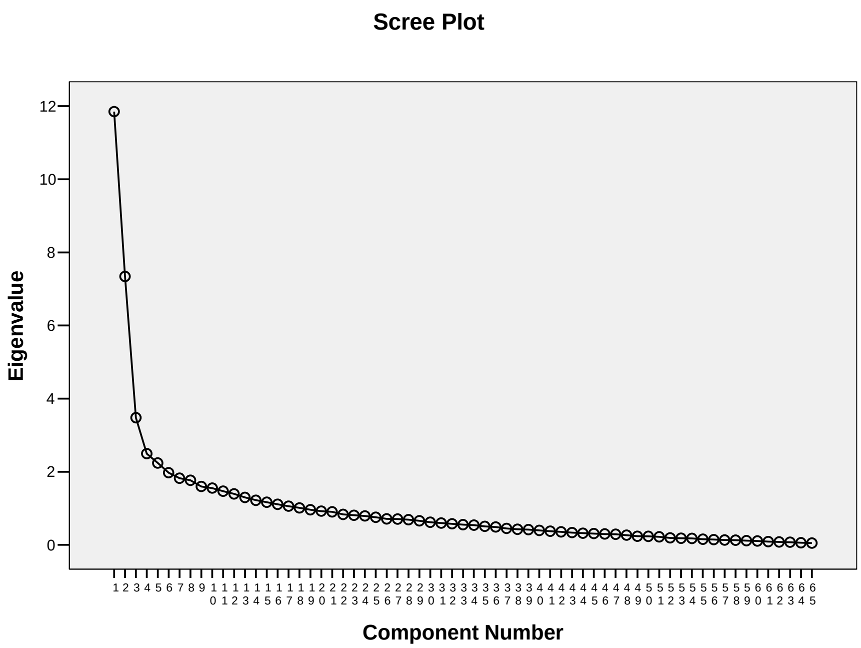
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.849	18.230	18.230	11.849	18.230	18.230
2	7.342	11.295	29.524	7.342	11.295	29.524
3	3.478	5.351	34.875	3.478	5.351	34.875
4	2.493	3.836	38.711	2.493	3.836	38.711
5	2.238	3.443	42.153	2.238	3.443	42.153
6	1.972	3.033	45.187	1.972	3.033	45.187
7	1.820	2.801	47.987	1.820	2.801	47.987
8	1.766	2.718	50.705	1.766	2.718	50.705
9	1.596	2.455	53.160	1.596	2.455	53.160
10	1.552	2.388	55.548	1.552	2.388	55.548
11	1.467	2.256	57.804	1.467	2.256	57.804
12	1.393	2.143	59.947	1.393	2.143	59.947
13	1.297	1.996	61.943	1.297	1.996	61.943

14	1.219	1.876	63.818	1.219	1.876	63.818
15	1.164	1.790	65.609	1.164	1.790	65.609
16	1.110	1.707	67.316	1.110	1.707	67.316
17	1.058	1.628	68.943	1.058	1.628	68.943
18	1.010	1.553	70.497	1.010	1.553	70.497
19	.960	1.477	71.973			
20	.923	1.419	73.393			
21	.901	1.387	74.779			
22	.832	1.280	76.059			
23	.810	1.245	77.305			
24	.790	1.216	78.521			
25	.754	1.160	79.681			
26	.711	1.094	80.775			
27	.705	1.085	81.860			
28	.687	1.057	82.917			
29	.658	1.012	83.929			
30	.617	.950	84.879			
31	.595	.916	85.795			
32	.575	.885	86.680			
33	.553	.850	87.530			
34	.540	.830	88.360			
35	.506	.778	89.138			
36	.489	.752	89.890			
37	.450	.692	90.582			
38	.425	.654	91.236			
39	.415	.639	91.875			
40	.395	.608	92.483			
41	.373	.574	93.057			
42	.355	.546	93.603			
43	.335	.515	94.119			
44	.319	.491	94.609			
45	.308	.474	95.083			
46	.296	.456	95.539			
47	.288	.444	95.982			
48	.264	.407	96.389			
49	.235	.361	96.750			
50	.232	.356	97.106			
51	.217	.334	97.440			
52	.190	.293	97.733			
53	.181	.278	98.011			
54	.175	.269	98.280			
55	.152	.234	98.514			
56	.142	.218	98.733			

57	.132	.203	98.936
58	.128	.198	99.134
59	.115	.177	99.311
60	.104	.160	99.471
61	.089	.138	99.608
62	.078	.120	99.728
63	.072	.111	99.839
64	.057	.087	99.927
65	.048	.073	100.000

Extraction Method: Principal Component Analysis.



Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.849	18.230	18.230	11.089	17.060	17.060	8.854	13.622	13.622
2	7.342	11.295	29.524	6.728	10.350	27.410	6.023	9.265	22.887
3	3.478	5.351	34.875	2.930	4.508	31.918	4.187	6.441	29.328
4	2.493	3.836	38.711	2.016	3.101	35.019	2.782	4.281	33.609
5	2.238	3.443	42.153	1.621	2.494	37.513	2.538	3.904	37.513
6	1.972	3.033	45.187						
7	1.820	2.801	47.987						
8	1.766	2.718	50.705						

9	1.596	2.455	53.160
10	1.552	2.388	55.548
11	1.467	2.256	57.804
12	1.393	2.143	59.947
13	1.297	1.996	61.943
14	1.219	1.876	63.818
15	1.164	1.790	65.609
16	1.110	1.707	67.316
17	1.058	1.628	68.943
18	1.010	1.553	70.497
19	.960	1.477	71.973
20	.923	1.419	73.393
21	.901	1.387	74.779
22	.832	1.280	76.059
23	.810	1.245	77.305
24	.790	1.216	78.521
25	.754	1.160	79.681
26	.711	1.094	80.775
27	.705	1.085	81.860
28	.687	1.057	82.917
29	.658	1.012	83.929
30	.617	.950	84.879
31	.595	.916	85.795
32	.575	.885	86.680
33	.553	.850	87.530
34	.540	.830	88.360
35	.506	.778	89.138
36	.489	.752	89.890
37	.450	.692	90.582
38	.425	.654	91.236
39	.415	.639	91.875
40	.395	.608	92.483
41	.373	.574	93.057
42	.355	.546	93.603
43	.335	.515	94.119
44	.319	.491	94.609
45	.308	.474	95.083
46	.296	.456	95.539
47	.288	.444	95.982
48	.264	.407	96.389
49	.235	.361	96.750

50	.232	.356	97.106
51	.217	.334	97.440
52	.190	.293	97.733
53	.181	.278	98.011
54	.175	.269	98.280
55	.152	.234	98.514
56	.142	.218	98.733
57	.132	.203	98.936
58	.128	.198	99.134
59	.115	.177	99.311
60	.104	.160	99.471
61	.089	.138	99.608
62	.078	.120	99.728
63	.072	.111	99.839
64	.057	.087	99.927
65	.048	.073	100.000

Extraction Method: Maximum Likelihood.

Rotated Factor Matrix(a)

	Factor				
	Attitudes	barriers	TPDev	effects	motiv
13. Working with instructional technology would be enjoyable and stimulating.	.681	.048	.180	.094	.073
12. I believe technology integration into the curriculum enriches the teaching and learning environment.	.657	.264	.248	.095	-.016
11. The use of web-based instruction would make students feel more involved in their learning.	.639	-.056	-.022	.182	-.057
4. I think it is important to have access to computer technology in my classroom for use in my teaching.	.626	.234	.130	.109	-.051
6. The Internet provides a means of expanding and applying what has been taught in class.	.619	.038	-.010	.277	-.172
6. I know that computers give me more opportunities to learn many new things.	.616	.354	.269	.054	.005

14. I believe by integrating technology in teaching and learning, I am helping students to acquire the basic computer education needed for their future careers.	.611	.075	.193	.168	-.030
13. Computer tools would enable me to interact more with students.	.596	.123	-.152	-.019	.104
13. I would like to collaborate with my colleagues on instructional technology issues.	.582	.042	.212	.028	-.019
10. It is important that my university's ICT plan includes the use of instructional technology.	.578	.210	.268	.143	-.182
6. I believe that all faculty members should know how to use instructional technology.	.573	.185	.377	.066	.000
10. E-mail is an effective means of disseminating course material to students.	.555	-.050	-.073	.000	-.079
2. The use of instructional technology is an effective tool for students of all abilities.	.538	-.050	-.049	.305	-.058
7. I believe technology is a useful tool in my instruction.	.531	.074	.176	.408	.053
1. Using computer-based technology equipment with subject-based software in my instruction would make me a better instructor.	.525	.249	.185	.077	.264
5. Computers provide environments that appeal to a variety of learning styles of my students.	.519	.073	.072	.174	.194
10. It is important that the university reward structure should recognize faculty members for integrating computers for teaching.	.513	.152	.104	-.019	.218
8. Technology tools enable students to cooperate more on projects.	.474	.058	-.092	.299	.199
3. Decentralizing faculty technology professional development programs to the various academic departments would make them more relevant.	.464	.014	.241	-.016	.008
4. When using technology, I am able to tailor students' work to their individual needs.	.454	.052	-.062	.114	.128

10. I believe faculty members must have a stronger voice in the technology professional development programme.	.449	.053	.043	-.189	-.274
9. Computers hinder students' ability with learning tasks (e.g. writing, analyzing data, or solving problems)	.358	.343	.066	-.028	.110
2. I need convenient access to more computers for my students.	.344	.141	.313	.002	-.079
14. My effort is primarily directed towards mastering tasks required to use instructional technology.	.342	-.168	.068	.021	.000
8. There is a scarcity of printers and presentation equipment in classrooms on campus.	-.288	.195	-.120	.001	.121
6. I own a computer for personal and home use.	.285	.132	.049	.221	.112
5. I get bored figuring out how to use computers for a variety of teaching situations.	.190	.662	-.074	-.080	-.021
2. I feel uncomfortable with the use of computer tools for instruction.	.041	.615	-.042	.345	-.115
8. I get a sinking feeling when I think of trying to use a computer in my instruction.	.216	.607	-.074	.013	-.121
10. My limited expertise in computer skills prevents me from using instructional technology.	.005	.592	-.348	.194	.139
8. My inability to manage all that technology integration in the curriculum requires of me discourages me.	-.076	.588	-.126	.166	-.024
12. I have avoided the use of instructional technology because computers are unfamiliar to me.	.157	.558	.122	.207	.003
9. I am unsure how to integrate computers into instruction.	.028	.557	-.104	.146	.302
4. I feel already over-burdened without adding technology professional workshops.	.094	.554	.016	.181	-.006
5. I will probably never have a need to use a computer in my instructional activities.	.240	.493	.111	-.059	-.047

9. I have insufficient time to develop instructional materials that use computers.	-.042	.479	-.168	.110	-.024
7. I don't have access to a computer with software installed for my use in my teaching preparation at home.	-.168	.461	-.017	.281	.271
4. The integration of technology into the curriculum results in only minor improvement in learning over the traditional methods.	.258	.413	.107	-.100	-.277
3. The use of computer-based technology in instruction reduces my personal interaction with my students.	.063	.412	-.088	-.284	.090
3. Using technology for instruction is too expensive for the Ghanaian situation.	.149	.403	-.161	.140	.140
9. I need more time to change the curriculum to incorporate technology.	.016	-.400	.298	-.324	-.089
2. Use of instructional technology requires unnecessary curriculum reforms.	.262	.388	.132	-.165	-.145
12. The use of web-based tehnology almost always reduces the personal treatment of students.	-.038	.350	-.278	-.001	.005
11. Interacting with the campus-wide network system is frustrating.	.070	.347	-.033	.055	.249
7. Anything that a computer can be used for, I can do just as well some other way.	.025	.326	.187	.032	.021
1. The frequent changes in technology make it hard to keep abreast with instructional technology.	.009	.304	-.119	-.027	.080
8. I need more compelling reasons why I should incorporate technology.	.225	.265	-.247	.210	-.040
5. There are too few training opportunities for faculty members to acquire new computer knowledge/skills for teaching.	-.141	.218	-.145	.071	.170
6. I need more resources that illustrate how to integrate technology into the curriculum.	.188	-.145	.840	-.079	-.135

7. I need more training opportunities with teaching strategies that integrate technology.	.142	-.090	.822	-.103	-.038
5. I would need more technical support to keep the computers working during instruction.	.086	-.203	.719	.098	-.028
4. I need more software that is subject/curricular-based.	.448	.040	.592	.121	-.085
1. I have an immediate need for more training with curriculum that integrates technology.	.188	-.234	.456	-.117	-.129
3. I need more reliable access to the Internet.	.359	-.091	.401	-.006	-.222
12. I need more regular instructional technology workshops/seminars.	.286	-.290	.326	-.149	-.191
3. I enjoy preparing class activities that integrate instructional technology.	.171	.260	-.100	.597	.074
7. When using technology, I see my role more as a facilitator of individual student's learning.	.381	.018	.116	.574	.019
15. I feel the use of technology for instruction affects my students' learning and teaching methods in a positive way.	.401	.205	.026	.454	-.035
11. I am working hard on using instructional technology to maximize the effects on my teaching and students' learning.	.275	.220	-.011	.450	.178
1. Students are more enthusiastic about subjects for which they use computers.	.190	.105	-.152	.422	.024
My university's faculty technology professional development plan meets my technology needs.	.032	.037	-.041	.042	.650
2. I have a convenient access to instructional technology on campus.	.079	.077	-.180	.233	.611
9. I am satisfied with current campus investment plans with regard to acquiring computer technology for teaching and learning activities.	-.036	-.194	-.078	-.062	.597
1. The use of instructional technology in my instruction enhance my prestige.	.429	.158	.044	.066	.553

11. Attending a few technology workshops and seminars is enough for me to start using instructional technolgy.	-.016	.094	-.089	-.098	.178

Extraction Method: Maximum Likelihood.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 8 iterations.

Factor Transformation Matrix

Factor	1	2	3	4	5
1	.838	.304	.386	.236	-.002
2	-.004	.644	-.669	.282	.241
3	-.371	.687	.416	-.251	-.393
4	-.278	.099	.451	.128	.832
5	.287	.105	-.162	-.886	.308

Extraction Method: Maximum Likelihood.
Rotation Method: Varimax with Kaiser Normalization.

Appendix G: Residual Statistics

Residuals Statistics(a)

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.2468	4.3062	3.4551	.36494	132
Std. Predicted Value	-3.311	2.332	.000	1.000	132
Standard Error of Predicted Value	.033	.154	.073	.021	132
Adjusted Predicted Value	2.2262	4.2956	3.4545	.36548	132
Residual	-.89837	.89394	.00000	.34944	132
Std. Residual	-2.521	2.509	.000	.981	132
Stud. Residual	-2.543	2.587	.001	1.002	132
Deleted Residual	-.91572	.95049	.00065	.36510	132
Stud. Deleted Residual	-2.600	2.648	.001	1.011	132
Mahal. Distance	.162	23.587	4.962	3.744	132
Cook's Distance	.000	.071	.008	.011	132
Centered Leverage Value	.001	.180	.038	.029	132

a Dependent Variable: Use: Faculty use of instructional technology

Appendix H: One-Way MANOVA

Appendix H1: Descriptive Statistics

	How would you describe your level of use of computer-based technology for teaching and learning?	Mean	Std. Deviation	N
Factor 1: Faculty attitudes towards technology integration into teacher education curriculum	Low	3.8278	.50860	66
	Moderate	4.0244	.49446	46
	High	4.3860	.38711	19
	Total	3.9778	.52082	131
Factor 2: Faculty motivation for adoption and use of instructional technology	Low	3.6485	.50949	66
	Moderate	3.9540	.39224	46
	High	4.2355	.38276	19
	Total	3.8409	.49941	131
Factor 3: Faculty perceived effects of use of instructional technology on students' learning and pedagogy	Low	3.7150	.47112	66
	Moderate	3.9464	.38838	46
	High	4.0840	.39253	19
	Total	3.8498	.45284	131
Factor 4: Faculty perceived barriers and challenges to adoption of instructional technology	Low	2.5830	.50873	66
	Moderate	3.0536	.69109	46
	High	3.2386	.72913	19
	Total	2.8433	.66425	131
Factor 5: Faculty perceptions of their technology professional development needs	Low	3.9045	.39107	66
	Moderate	3.8189	.40324	46
	High	3.7237	.32609	19
	Total	3.8482	.38943	131
Faculty use of instructional technology	Low	3.2090	.39810	66
	Moderate	3.6203	.41110	46
	High	3.9763	.44390	19
	Total	3.4647	.49502	131
Media and methods for acquiring new computer skills and knowledge for instruction	Low	4.1319	.50981	66
	Moderate	4.1502	.38178	46
	High	4.2566	.38746	19
	Total	4.1564	.45053	131
Sources of help/assistance with using computers for instruction	Low	3.8290	.60517	66
	Moderate	3.7143	.60309	46

	High	3.6917	.60471	19
	Total	3.7688	.60283	131
Sources of information about keeping abreast of changes/innovations in the area of computers in instruction	Low	3.9127	.51921	66
	Moderate	3.6561	.53831	46
	High	3.7368	.51506	19
	Total	3.7971	.53496	131

Appendix H2: Test of Equality of Covariances

Box's Test of Equality of Covariance Matrices [a]

Box's M	121.900
F	1.161
df1	90
df2	9520.265
Sig.	.143

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept+techUserLevel

Appendix H3: Levene's Test of Equality of Error Variances (a)

	F	df1	df2	Sig.
Factor 1: Faculty attitudes towards technology integration into teacher education curriculum	.334	2	128	.716
Factor 2: Faculty motivation for adoption and use of instructional technology	3.437	2	128	.035
Factor 3: Faculty perceived effects of use of instructional technology on students' learning and pedagogy	1.735	2	128	.180
Factor 4: Faculty perceived barriers and challenges to adoption of instructional technology	3.194	2	128	.044
Factor 5: Faculty perceptions of their technology professional development needs	.422	2	128	.656
Faculty use of instructional technology	.093	2	128	.912
Media and methods for acquiring new computer skills and knowledge for instruction	2.925	2	128	.057
Sources of help/assistance with using computers for instruction	.015	2	128	.985

Sources of information about keeping abreast of changes/innovations in the area of computers in instruction	.016	2	128	.984

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a Design: Intercept+techUserLevel

Appendix H4: Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power(a)
Corrected Model	Factor 1: Faculty attitudes towards technology integration into teacher education curriculum	4.750(b)	2	2.375	9.962	.000	.135	19.924	.983
	Factor 2: Faculty motivation for adoption and use of instructional technology	5.990(c)	2	2.995	14.503	.000	.185	29.006	.999
	Factor 3: Faculty perceived effects of use of instructional technology on students' learning and pedagogy	2.670(d)	2	1.335	7.124	.001	.100	14.248	.927
	Factor 4: Faculty perceived barriers and challenges to adoption of instructional technology	9.476(e)	2	4.738	12.665	.000	.165	25.330	.996
	Factor 5: Faculty perceptions of their technology professional development needs	.543(f)	2	.272	1.814	.167	.028	3.628	.373
	Faculty use of instructional technology	10.402(g)	2	5.201	31.032	.000	.327	62.065	1.000
	Media and methods for acquiring new computer skills and knowledge for instruction	.232(h)	2	.116	.567	.568	.009	1.135	.142
	Sources of help/assistance with using computers for instruction	.489(i)	2	.244	.669	.514	.010	1.338	.161
	Sources of information about keeping abreast of changes/innovations in the area of computers in instruction	1.865(j)	2	.933	3.378	.037	.050	6.756	.628

a Computed using alpha = .05
b R Squared = .135 (Adjusted R Squared = .121)
c R Squared = .185 (Adjusted R Squared = .172)
d R Squared = .100 (Adjusted R Squared = .086)
e R Squared = .165 (Adjusted R Squared = .152)
f R Squared = .028 (Adjusted R Squared = .012)
g R Squared = .327 (Adjusted R Squared = .316)
h R Squared = .009 (Adjusted R Squared = -.007)
i R Squared = .010 (Adjusted R Squared = -.005)
j R Squared = .050 (Adjusted R Squared = .035)

Appendix H5: Post Hoc Tests

How would you describe your level of use of computer-based technology for teaching and learning?

Multiple Comparisons

Dependent Variable		(I) How would you describe your level of use of computer-based technology for teaching and learning?	(J) How would you describe your level of use of computer-based technology for teaching and learning?	Mean Difference: I-J	Std Error	Sig.	Confidence Interval	
							LBound	UBound
Factor 1: Faculty attitudes towards technology integration into teacher education curriculum	Tukey HSD	Low	Moderate	-.1966	.09378	.095	-.4189	.0258
			High	-.5581(*)	.12712	.000	-.8596	-.2567
		Moderate	Low	.1966	.09378	.095	-.0258	.4189
			High	-.3616(*)	.13315	.020	-.6773	-.0459
		High	Low	.5581(*)	.12712	.000	.2567	.8596
			Moderate	.3616(*)	.13315	.020	.0459	.6773
	Dunnett C	Low	Moderate	-.1966	.09610		-.4284	.0353
			High	-.5581(*)	.10866		-.8299	-.2864
		Moderate	Low	.1966	.09610		-.0353	.4284
			High	-.3616(*)	.11490		-.6489	-.0743
		High	Low	.5581(*)	.10866		.2864	.8299
			Moderate	.3616(*)	.11490		.0743	.6489
Factor 2: Faculty motivation for adoption and use of instructional technology	Tukey HSD	Low	Moderate	-.3055(*)	.08728	.002	-.5125	-.0985
			High	-.5870(*)	.11831	.000	-.8675	-.3064
		Moderate	Low	.3055(*)	.08728	.002	.0985	.5125
			High	-.2815	.12393	.064	-.5754	.0124
		High	Low	.5870(*)	.11831	.000	.3064	.8675
			Moderate	.2815	.12393	.064	-.0124	.5754
	Dunnett C	Low	Moderate	-.3055(*)	.08531		-.5111	-.0999
			High	-.5870(*)	.10791		-.8568	-.3172
		Moderate	Low	.3055(*)	.08531		.0999	.5111
			High	-.2815(*)	.10514		-.5457	-.0172
		High	Low	.5870(*)	.10791		.3172	.8568
			Moderate	.2815(*)	.10514		.0172	.5457
Factor 3: Faculty perceived effects of use of instructional technology on students' learning and pedagogy	Tukey HSD	Low	Moderate	-.2314(*)	.08315	.017	-.4285	-.0342
			High	-.3690(*)	.11271	.004	-.6362	-.1017
		Moderate	Low	.2314(*)	.08315	.017	.0342	.4285
			High	-.1376	.11806	.476	-.4175	.1424
		High	Low	.3690(*)	.11271	.004	.1017	.6362
			Moderate	.1376	.11806	.476	-.1424	.4175
	Dunnett C	Low	Moderate	-.2314(*)	.08150		-.4279	-.0349
			High	-.3690(*)	.10711		-.6375	-.1004

		Moderate	Low	.2314(*)	.08150		.0349	.4279
			High	-.1376	.10672		-.4060	.1308
		High	Low	.3690(*)	.10711		.1004	.6375
			Moderate	.1376	.10672		-.1308	.4060
Factor 4: Faculty perceived barriers and challenges to adoption of instructional technology	Tukey HSD	Low	Moderate	-.4706(*)	.11748	.000	-.7492	-.1921
			High	-.6556(*)	.15924	.000	-1.0332	-.2780
		Moderate	Low	.4706(*)	.11748	.000	.1921	.7492
			High	-.1850	.16680	.510	-.5805	.2106
		High	Low	.6556(*)	.15924	.000	.2780	1.0332
			Moderate	.1850	.16680	.510	-.2106	.5805
	Dunnett C	Low	Moderate	-.4706(*)	.11960		-.7597	-.1816
			High	-.6556(*)	.17861		-1.1081	-.2031
		Moderate	Low	.4706(*)	.11960		.1816	.7597
			High	-.1850	.19587		-.6780	.3081
		High	Low	.6556(*)	.17861		.2031	1.1081
			Moderate	.1850	.19587		-.3081	.6780
Factor 5: Faculty perceptions of their technology professional development needs	Tukey HSD	Low	Moderate	.0856	.07433	.484	-.0907	.2619
			High	.1809	.10076	.175	-.0581	.4198
		Moderate	Low	-.0856	.07433	.484	-.2619	.0907
			High	.0953	.10554	.640	-.1550	.3455
		High	Low	-.1809	.10076	.175	-.4198	.0581
			Moderate	-.0953	.10554	.640	-.3455	.1550
	Dunnett C	Low	Moderate	.0856	.07650		-.0991	.2702
			High	.1809	.08896		-.0422	.4039
		Moderate	Low	-.0856	.07650		-.2702	.0991
			High	.0953	.09556		-.1439	.3344
		High	Low	-.1809	.08896		-.4039	.0422
			Moderate	-.0953	.09556		-.3344	.1439
Faculty use of instructional technology	Tukey HSD	Low	Moderate	-.4113(*)	.07863	.000	-.5978	-.2248
			High	-.7673(*)	.10659	.000	-1.0201	-.5146
		Moderate	Low	.4113(*)	.07863	.000	.2248	.5978
			High	-.3560(*)	.11165	.005	-.6208	-.0913
		High	Low	.7673(*)	.10659	.000	.5146	1.0201
			Moderate	.3560(*)	.11165	.005	.0913	.6208
	Dunnett C	Low	Moderate	-.4113(*)	.07794		-.5994	-.2232
			High	-.7673(*)	.11301		-1.0525	-.4822
		Moderate	Low	.4113(*)	.07794		.2232	.5994
			High	-.3560(*)	.11851		-.6545	-.0576
		High	Low	.7673(*)	.11301		.4822	1.0525
			Moderate	.3560(*)	.11851		.0576	.6545
Media and methods for acquiring new computer skills and knowledge for instruction	Tukey HSD	Low	Moderate	-.0183	.08682	.976	-.2242	.1876
			High	-.1246	.11769	.541	-.4037	.1544

		Moderate	Low	.0183	.08682	.976	-.1876	.2242
			High	-.1063	.12327	.665	-.3987	.1860
		High	Low	.1246	.11769	.541	-.1544	.4037
			Moderate	.1063	.12327	.665	-.1860	.3987
	Dunnett C	Low	Moderate	-.0183	.08430		-.2214	.1849
			High	-.1246	.10881		-.3968	.1475
		Moderate	Low	.0183	.08430		-.1849	.2214
			High	-.1063	.10521		-.3710	.1583
		High	Low	.1246	.10881		-.1475	.3968
			Moderate	.1063	.10521		-.1583	.3710
Sources of help/assistance with using computers for instruction	Tukey HSD	Low	Moderate	.1147	.11608	.586	-.1605	.3900
			High	.1373	.15735	.659	-.2358	.5104
		Moderate	Low	-.1147	.11608	.586	-.3900	.1605
			High	.0226	.16482	.990	-.3683	.4134
		High	Low	-.1373	.15735	.659	-.5104	.2358
			Moderate	-.0226	.16482	.990	-.4134	.3683
	Dunnett C	Low	Moderate	.1147	.11600		-.1652	.3947
			High	.1373	.15746		-.2592	.5337
		Moderate	Low	-.1147	.11600		-.3947	.1652
			High	.0226	.16478		-.3918	.4369
		High	Low	-.1373	.15746		-.5337	.2592
			Moderate	-.0226	.16478		-.4369	.3918
Sources of information about keeping abreast of changes/innovations in the area of computers in instruction	Tukey HSD	Low	Moderate	.2566(*)	.10092	.032	.0173	.4959
			High	.1759	.13680	.406	-.1485	.5002
		Moderate	Low	-.2566(*)	.10092	.032	-.4959	-.0173
			High	-.0807	.14329	.840	-.4205	.2591
		High	Low	-.1759	.13680	.406	-.5002	.1485
			Moderate	.0807	.14329	.840	-.2591	.4205
	Dunnett C	Low	Moderate	.2566(*)	.10190		.0106	.5025
			High	.1759	.13434		-.1623	.5140
		Moderate	Low	-.2566(*)	.10190		-.5025	-.0106
			High	-.0807	.14234		-.4383	.2769
		High	Low	-.1759	.13434		-.5140	.1623
			Moderate	.0807	.14234		-.2769	.4383

Based on observed means.
* The mean difference is significant at the .05 level.

Appendix H6: Homogeneous Subsets for Factors

Factor 1: Faculty attitudes towards technology integration into teacher education curriculum

	How would you describe your level of use of computer-based technology for teaching and learning?	N	Subset	
			1	2
Tukey HSD(a,b)	Low	66	3.8278	
	Moderate	46	4.0244	

		N	1	2
	High	19		4.3860
	Sig.		.230	1.000
Ryan-Einot-Gabriel-Welsch Range(b)	Low	66	3.8278	
	Moderate	46	4.0244	
	High	19		4.3860
	Sig.		.056	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .238.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Factor 2: Faculty motivation for adoption and use of instructional technology

	How would you describe your level of use of computer-based technology for teaching and learning?	N	Subset 1	2	3
Tukey HSD(a,b)	Low	66	3.6485		
	Moderate	46		3.9540	
	High	19			4.2355
	Sig.		1.000	1.000	1.000
Ryan-Einot-Gabriel-Welsch Range(b)	Low	66	3.6485		
	Moderate	46		3.9540	
	High	19		4.2355	
	Sig.		1.000	.058	

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .207.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Factor 3: Faculty perceived effects of use of instructional technology on students' learning and pedagogy

	How would you describe your level of use of computer-based technology for teaching and learning?	N	Subset 1	2
Tukey HSD(a,b)	Low	66	3.7150	
	Moderate	46	3.9464	3.9464
	High	19		4.0840
	Sig.		.077	.397
Ryan-Einot-Gabriel-Welsch Range(b)	Low	66	3.7150	
	Moderate	46		3.9464
	High	19		4.0840
	Sig.		1.000	.329

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .187.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Factor 4: Faculty perceived barriers and challenges to adoption of instructional technology

	How would you describe your level	N	Subset

	of use of computer-based technology for teaching and learning?		1	2
Tukey HSD(a,b)	Low	66	2.5830	
	Moderate	46		3.0536
	High	19		3.2386
	Sig.		1.000	.433
Ryan-Einot-Gabriel-Welsch Range(b)	Low	66	2.5830	
	Moderate	46		3.0536
	High	19		3.2386
	Sig.		1.000	.353

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .374.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Factor 5: Faculty perceptions of their technology professional development needs

	How would you describe your level of use of computer-based technology for teaching and learning?	N	Subset
			1
Tukey HSD(a,b)	High	19	3.7237
	Moderate	46	3.8189
	Low	66	3.9045
	Sig.		.139
Ryan-Einot-Gabriel-Welsch Range(b)	High	19	3.7237
	Moderate	46	3.8189
	Low	66	3.9045
	Sig.		.323

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .150.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Faculty use of instructional technology

	How would you describe your level of use of computer-based technology for teaching and learning?	N	Subset		
			1	2	3
Tukey HSD(a,b)	Low	66	3.2090		
	Moderate	46		3.6203	
	High	19			3.9763
	Sig.		1.000	1.000	1.000
Ryan-Einot-Gabriel-Welsch Range(b)	Low	66	3.2090		
	Moderate	46		3.6203	
	High	19			3.9763
	Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares

The error term is Mean Square(Error) = .168.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Appendix H7: Homogeneous Subsets for Communication Channels

Media and methods for acquiring new computer skills and knowledge for instruction

	How would you describe your level of use of computer-based technology for teaching and learning?	N	Subset 1
Tukey HSD(a,b)	Low	66	4.1319
	Moderate	46	4.1502
	High	19	4.2566
	Sig.		.498
Ryan-Einot-Gabriel-Welsch Range(b)	Low	66	4.1319
	Moderate	46	4.1502
	High	19	4.2566
	Sig.		.673

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .204.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Sources of help/assistance with using computers for instruction

	How would you describe your level of use of computer-based technology for teaching and learning?	N	Subset 1
Tukey HSD(a,b)	High	19	3.6917
	Moderate	46	3.7143
	Low	66	3.8290
	Sig.		.623
Ryan-Einot-Gabriel-Welsch Range(b)	High	19	3.6917
	Moderate	46	3.7143
	Low	66	3.8290
	Sig.		.635

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .365.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.

Sources of information about keeping abreast of changes/innovations in the area of computers in instruction

	How would you describe your level of use of computer-based technology for teaching and learning?	N	subset 1
Tukey HSD(a,b)	Moderate	46	3.6561
	High	19	3.7368
	Low	66	3.9127

	Sig.		.117
Ryan-Einot-Gabriel-Welsch Range(b)	Moderate	46	3.6561
	High	19	3.7368
	Low	66	3.9127
	Sig.		.054

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .276.
a Uses Harmonic Mean Sample Size = 33.511.
b Alpha = .05.