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Computer attitude, and the impact of personal characteristics and information and communication technology adoption patterns on performance of teaching faculty in higher education in Ghana, West Africa

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COMPUTER ATTITUDE, AND THE IMPACT OF PERSONAL CHARACTERISTICS AND INFORMATION AND COMMUNICATION TECHNOLOGY ADOPTION PATTERNS ON PERFORMANCE OF TEACHING FACULTY IN HIGHER EDUCATION IN GHANA, WEST AFRICA

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DEDICATION

To

My family: Mom, Pauline, Kofi Larbi-Apau, and Kofi Afriyie Agyeman Jr

The Niiquaye's and,

All my Professors at

Wayne State University.

And to God be the Glory.

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CHAPTER 1

Introduction

Information and communication technology (ICT) is one major national policy designed to improve education, manpower, research, and integrate in the global knowledge-economy in Ghana, West Africa. ICT describes the convergence of computers, communication, and information literacy, and covers disciplines such as programming, telecommunications, systems analysis, and multimedia applications (ICT4AD, 2003). Related ICT devices cited in literature are radio, mobile cellular phone services, computers, facsimile services, digital satellite systems (including satellite broadcasting, videos and televisions), and cable televisions, among others (Assié-Lumumba, 2008; ICT4AD, 2003; Martey, 2004; Plomp, Anderson, Law & Quale,. 2003; van Brakel & Chisenga, 2003).

Myriad factors influenced Ghana ICT policy in education such as the National Education Reform, 2007, the World Forum on Education in Dakar, 2000 that seeks to augment free access to basic education, the Millennium Development Goals (MDG) directed at gender egalitarianism and women empowerment, and the World Summit on Information Society, 2005, 2003. Other supporting initiatives are the New Partnership for African Development (NEPAD), the African Virtual University (AVU) project of the World Bank, and the Association of African Universities (AAU); which among others, aim at addressing challenges, strategizing, networking, and transforming higher education in Africa.

Higher Education and National ICT Policy: Goals and Strategies

Since 1983, ICT has been exploited and deployed by all governmental ministries and departments in Ghana. The major purpose is to build and expand in all areas needed human and non-human capacity to support domestic and global ICT integration. The process intensified in the mid-1990s with some remarkable success (see Appendix A for a summary of the nationwide ICT policy and development plan in Ghana).

Particularly important to this study, is the ICT policy of the Ministry of Education, Science, and Sports, which reiterates not only the development of needed human capital but also the preparation of *all* students for ICT professions (MoESS-ICT4AD, 2003). The Ministry's overarching purpose is to produce graduates with the capacity to confidently and creatively use ICT tools for personal and global goals by 2015. Specifically, this document proposes acquisition of ICT knowledge and skill by every graduate from Ghanaian educational institutions, whether formal or non-formal. This proposal has to be achieved through high-tech educational system, expansion of distance learning, and enhancement of teaching and learning through ICTs in the universities. Emphasized is increased access to computer studies in basic and secondary education levels and Teacher Training Colleges with the purpose of acquiring computer literacy by all students at all levels (ICT4AD, 2003; MoESS-ICT4AD; 2003).

Supporting these ICT initiatives, all public and private universities developed communiqué and restated the need for effective ICT integration in teaching, distance learning and continuing education. They proposed increased access to computers and peripherals in faculties and departments, in addition to, auxiliary expansion of essential ICT infrastructure in the universities and professional development programs to achieve this purpose.

Through the educational system, the ICT policy seeks to achieve required human resources at the basic, middle and top-management levels for social and economic development. However, contextual limiting factors such as finance, capital and technical infrastructure, and human resources render some statements in the ICT educational policy rather ambitious within the specified time frame of 2015. For example, meeting specifications and demands of academics depends on skilled and certified teachers with proficiencies in engaging in classroom-mediated technology. Teachers have to perform professional tasks adequately such as teaching, learning, and research with and through ICTs to influence students' enrollment and achievement. Despite these limiting factors, most provisions in Ghana ICT policies and development plans appear consistent with global trends in education. Global ICT trends in education reports computer-based pedagogy, better information access, social communication systems, research and development, administrative and management functions.

External Influence: ICT development in higher education in Ghana is also influenced by the Association of African Universities (AAU). The aim of the AAU is to pursue common transformation and development agenda of knowledge generation and dissemination, and networking African higher educational institutions through ICTs (AAU, 2003). Community engagement of AAU is proposed as a means to supporting and strengthening quality education through collaborative teaching, learning, and research on the African continent. Besides, the African Virtual University (AVU) Project of the World Bank (AVU, http://www.avu.org) has since 1997 provided distance education to about 27 Sub-Saharan African countries and 50 partner institutions, including Ghana. Specific AVU's programs among others are:

- Developing and disseminating open distance and e-learning.
- Building capacity in African tertiary educational institutions through setting up of state-of-art e-learning centers and training personnel in related methodologies.
- Managing the delivery of open distance and eLearning degree, diploma, and certificate programs.
- Building and managing large consortia of African educational institutions that are working on open distance and eLearning initiatives.

- Carrying out research and evaluation activities.
- Strengthening capacity through seminars and workshops.

Ghana has had tremendous support from other bilateral and multilateral agencies. For instance, between 1996 and 2001, Martey (2004) reported an agreement between Ghana and Microsoft, Atlantic Computers, Network Computer Systems (NCS), Kyoto of Japan, and International Center for Theoretical Physics in Italy for skill training of teachers and students in ICT and computer-related programs. The Ghana Interlibrary Lending and Document Delivery Network (GILLDDNET) and the Danish International Development Assistance (DANIDA) collaborated to sponsor an inter-library consortium, and again, with a British Non Governmental Organization (NGO), the International Network for the Availability of Scientific Publication (INASP) to provide computers and Internet access, and related training programs to six universities and institutions of higher learning; the leaders of transformation.

Higher Education, Leadership, and Emerging Technology

Higher education plays leadership and transformation roles as teaching and research institutions, and prepare individual students for future professions and sustainable societies. Higher education models innovativeness and growth, and is expected to function satisfactorily within information-rich and knowledge-based society and economy. Leadership in innovation defines the fluidity of these institutions in accepting technological change through research, learning and management, and sustaining the accrued benefits. The quality of leadership determines performance value, successful outcome, and desired change.

While some organizations and institutions are more rigid, hierarchically structured and might resist change, others are more dynamic and lither, and can easily adapt and sustain change and innovation. Sustaining an innovation describes the ability or capacity to direct, maintain and restore institutional goals and strategies with the purpose of enhancing all human and non-human forms of capital. Sustaining desired change can be achieved through value-added generation while focusing on overall growth and continuous development of current and future performance of individuals within the institution, the institution itself, and the whole society. Leadership roles are critical in maintaining equilibrium between the forces of stability and change in order to maximize human and collective organizational performance (Taylor & Machado, 2006). An institution or organization such as a university has to be comparably innovative to increase its competitive advantage.

Over the last two decades, ICT and computer-based education has increased exponentially as powerful alternative to traditional systems with the purpose to reaching out to regular and prospective students within and without the confines of the formal university classroom. With expanding demands for ICT systems and ever changing pedagogical strategies, many universities and teachers are responding by offering e-learning programs and courses separately or blended with conventional face-to-face types synchronously, asynchronously or both. However, not all the academic faculty has the expertise to deal with pedagogical issues since many enter the profession without such training (Jacobsen, 1998). One key expectation of the university or college teacher; however, is to contribute to the institution and society by expanding the intellectual and social capacity of the students. As the universities endeavor to implement ICT as a study, alternative or augment instructional delivery strategies, would the academic staff, the main driving force behind this change be responsive, innovative, and exhibit favorable attitude and expertise to perform with the "new" technology? If they are not obligated, what would be the response, and to what degree would the impact be?

In this study, ICT culminates digital learning media and tools that allow individual users to explore, analyze, communicate, and exchange documents and files responsibly for general purpose, teaching, learning, and research. Roles and functions of ICT in higher education are emphasized with the purpose of developing better and comprehensive understanding of teachers' competence and performance regarding courseware, instruction and curriculum. ICT is placed in the context of educational technology, where instructional and educational resources are designed, developed, utilized, managed, and evaluated for their effect on teaching and learning (Januzweski & Molenda, 2008; Seels & Richey, 1994). Kozma (2003) emphasizes exploitation of computer technology capabilities for purposeful integration in education; from specific applications to courseware development and delivery. How the curriculum is changing due to influence of these capabilities to help students and faculty solve pedagogical problems in situated learning context is, particularly, important.

Information technology focuses primarily on literacy, quick and timely access and quality, and how it is adopted and utilized to support and improve professional practices. Information literacy encompasses ability to browse, surf and search different databases, filter, analyze, and retrieve quality resources via technology while observing netiquette, copyright and privacy issues.

Communication technology is defined in the context of purposeful collaboration and participation with the intent to intensify teaching, shared expertise and intelligence through telecommunication and computer networks. ICT as a subject is de-emphasized due to its potential complexities and confounding effects on performance of non technology-related subjects and users. Computer centers are literally referred to as ICT centers in Ghana, and would be used interchangeably in this study.

Statement of the Problem

This study is focused on the link between policies and practices of ICT in higher education. It emphasizes academic staff computer attitude and other personality factors, ICT adoption patterns, influencing factors such as incentives and challenges, and performance. For example, literature reports myriad gaps with modest impact of ICT in higher education.

First, developing countries, particularly, Africa is dependent partly on external agencies, foundations, and financial organizations in setting and globalizing their educational agenda (Assié-Lumumba; 2008). In situations where one size-fits--all projects are designed by these external agents for African nations, indicative results have been consistently skewed towards ineffective performances due to ad hoc measures, uniformed decisions, unpreparedness, and disorganized planning and implementation (Assié-Lumumba, 2008; Martey, 2004; Pauling, 2006). In some cases, resources and investments are wasted and not sustained, especially, in the contexts where host countries have played minimal roles in the decision-making process and investment. Faulty implementations and unrealized impacts call for further studies to situate the challenges and potential remedies in their proper contexts.

Second, empirical studies have reported various downsides to ICT adoption and integration in higher education by suggesting inadequate physical, technical, financial, and capital infrastructure (Martey, 2004; Obeng-Adow, 2003; Rogers, 1998; van Brakel & Chisenga, 2003). However, Prahalad (2010) argued, “executives are constrained not by resources, but by their imagination” (p. 32). Empirical evidence on executive decision making, leadership influence, the strength and limitations of institutional capacity, and performance in ICT is scarce and anecdotal to substantiate these assertions in Ghana.

Third, any meaningful adoption and technological change in the educational system for learning and teaching would involve teachers as leading adopters and users. The teaching faculty can be passive in the adoption and implementation process without adequate ICT-related expertise, which can result in non-performance or rejection over time. Besides, gaining expertise in ICT-related scholarly enterprise such as pedagogical, social, technical, and managerial skills involves a complex system of actions and reactions that can place the novice faculty in a very vulnerable position. If these new experiences are compatible, useful, and less complex to status quo, and complement teachers' personal and professional needs and requirements; it is possible they will adopt and perform with these innovative experiences, and vice versa. A dearth of empirical research necessitates examination of these theoretical assertions in higher education.

Fourth, besides developing ICT expertise, not all teachers in the university possess the pedagogical know-how (Jacobsen, 1998) for this adjustment or will adopt the technology innovation, though every member has the potential to adopt an innovation (Rogers, 2003). Many empirical innovation-adoption studies have ignored critical personality factors such as attitude, skills, motivation, and innovation bias. Known studies of personality traits incorporate self-efficacy or computer attitude in estimating teachers' computer behavior with minimum emphasis on other influencing factors such as age, gender, academic discipline, and professional status in higher education. For example, a paucity research of age on technology adoption decisions in an organizational context is argued by Morris and Venkatesh (2000). However, age could influence technology use due to changes in emotional, cognitive and physiological factors, which could in turn impact computer technology-based tasks. Again, results of the few studies are inconsistent (Jacobsen, 1998; Jegede, 2008; Jegede & Josiah, 2005; Wheeler, 2002). Similar studies could help in developing deeper understanding of ICT and related demographic strategies, build conceptual framework for ICT adoption and utilization, in addition to establishing all inclusive meaningful pedagogical engagements.

Fifth, suffice to say, public universities in Ghana are promoting, practicing and integrating by blueprint the information and communication technology for accelerated development (ICT4AD) policy, it becomes imperative that they justify the investment in both human and non-human resources. If the ICT4AD projects work well as projected and provide enough evidence at the strategic, tactical and operational levels, then new approaches such as learning and course management systems, and other performance strategies could be explored, adopted and expanded for greater returns. Further investment in collaborative research, student enrollment, online instruction, and computer-mediated distance learning could be explored and expanded. Potential students who otherwise would not attend regular universities would be served through online courses. For example, most electronic-based learning are reported to provide comparable access and quality education to that of conventional classroom types (NSSE, 2009), though others have reported some failures (e.g., Greenagel, 2002; Romiszowski, 2004), which can be expected.

Summarizing, information and communication technology has become an important component as an alternative workstation to conventional face-to-face teaching in academe. Its adoption is influenced by complex and myriad factors such as access, adaptation, implementation, impact, and evaluation. However, there is a paucity of comparative studies to match the specifications at all these levels (ICT4AD, 2003; Martey, 2004; Rogers, 1998). Though, adoption and performance differ significantly, they also complement each other; yet, both have not been adequately examined together to advance the course of ICT for in higher education due to its complexities. Bridging gaps in performance implies examining changing and transitioning roles as well as needs of the institutions and teachers to inform decision making and ensure buy-in of all stakeholders for desired results.

Scope and Conceptual Framework

ICT in higher education: Utilizing information and communication technology and distance education is not new to sub-Saharan Africa (van Brakel & Chisenga, 2003). For over three decades, ICT services and programs have been offered in the universities as subjects, course delivery systems, and for administrative functions. Sandwiched and modular programs are designed for professionals to provide needed expertise via campus ICT centers. These centers are deployed in myriad capacities such as commercial sites, components of the library system, or integrated at college, faculty or departmental levels. However, these deployments may not, necessarily perform as credible as part of the universities' culture due to inadequate resources, thus, leaving ICT practices in disequilibrium.

ICT-based education could fill a niche in the universities by providing the needed services to tens of thousands of prospective college and university students. Well-integrated synchronous or asynchronous courses or leaning management systems could serve both regular and distance students such as matured learners constrained by time, employment and family engagement, and others interested in lifelong and continuing education. Well-integrated ICT and computer-based technology for pedagogy and management functions can improve communication and access to quick information, research resource, and serve as a repository for students' document (Motschnig-Pitrik & Holzinger, 2002; Nett, 2008). Technology-based pedagogical strategies are reported to save instructional delivery time, assist in exploratory learning (DiBiase, 2000), and increase employment opportunities for graduates (Guerra-Lopez & Rodriquez, 2005). For example, in a knowledge-based economy where economic productivity and growth is a function of the development and application of knowledge, ICT is considered the driving force in creating a growing demand for the highly technological and educated work force (Scott, 1999 cited in Park & Moser, 2008).

ICT also links professionals all over the globe. Over the years, universities in Ghana have partnered with international institutions including but not limited to Leeds, Cambridge, and Oxford Universities in the United Kingdom, Universities of Georgia, the Massachusetts Institute of Technology, and Washington in the United States of America, as well as Japan SOKA University and Noguchi Memorial Institute for Medical Research. This collaborative process suggests the university communities have had access to the required technological knowledge and skills to communicate, collaborate, and research (sometimes “virtually”) in a community of practice (COP) at home and abroad. A community of practice involves small groups of learning communities that ensure effective collaboration for scholarly presentations, teaching, research, and publications. The level of feasibility, transition, participation, and performance using the ICT medium could be of interest and vital for personal, academic and professional interest, and institutional growth.

ICT adoption and the teaching faculty: Increased access and application of computer technology and ICT in education does not necessarily imply universal adoption among the teaching faculty, integrated effectively in the curriculum, or improved pedagogy. What it means for adoption is: First, the target institution must be malleable and not mechanistic in accepting and managing systematic change. Second, the institution should establish functional support systems to better serve the community including staff and students. Third, compatibility of ICT innovation is required for inclusive developments, achievements, and breakthroughs. For instance, meaningful pedagogical practices require effective classroom management and instruction design functions, and these functions depend on teachers' aptitude regarding type of communication media and learning environment, attitude, personal teaching and learning philosophy, and institutional support. Compatibility is, therefore, a very vital determinant in ICT adoption and utilization. Performing professional tasks such as teaching, learning and research, together with other academic engagements with ICTs depends on better human relations, collaboration and development of social skills, which in turn is a function of the individual's persona.

Demography and ICT/Computer attitude: Empirically, personal traits such as computer attitude and self-efficacy have been responded to as potential indicators for ICT/computer adoption and usage (Jegede & Josiah; 2005; Jones & Liu, 2001; Selwyn, 1997; Soh, 1998a, 1998b; West, 2003). Though implied, the relationship of attitude, other personality traits and user's actual performance is not specified or explored. Computer attitude studies, in most cases, emphasize perceptions and computer behaviors, while self-efficacy deals with discernible personality, but not practices or performances, unless otherwise combined with other theories in some of these studies (e.g., Jacobson, 1998).

However, demographic factors such as age, gender, academic discipline, and professional status could influence ICT adoption and integration in education. For example, Oyelaran-Oyeyinka and Adeya (2004) found age to be positively associated with ICT adoption and usage. For example, younger teaching faculty less than 40 years in age was reported to use the computer and Internet more frequently than their adult counterparts. On the other hand, gender had no significant differentiation in Internet use in Kenya and Nigeria universities according to these authors. In contrast, Becker (2000) found male teachers to be exemplary computer-technology users than their female counterparts in a study to examine teachers' backgrounds and experiences in using computer technology in education. A difference between technology experience and generation gaps is important for tracking ICT adoption patterns and for what purpose. According to Prensky (2001), youth are leading the transition to fully wired and mobile nations.

Patterns of ICT adoption: Innovativeness explains the degree at which users adopt an innovation earlier than their counterparts in an institution or social setting (Rogers, 2003). It is a shift from the status quo and advanced thinking about the positive or negative aspects of an idea or object. However, changing a mind-set is not an easy task: Such as differentiating between effective and efficient solutions or believing that the solution is absolutely correct. Innovativeness can be quantified and measured by differentiating the variables into a set of exhaustive, continuous and mutually exclusive categories over time.

Mean scores, standard deviations and standardized percentages are computed. Standardized percentages are modeled as a normal distribution curve over time, and interpreted as an initial increasing gain until a learning capacity is reached at which point the curve begins to decline (e.g. Erumban & de Jong, 2006; Kirkup & Kirkwood, 2005; Oyelaran-Oyeyinka & Adeya, 2004; Rogers, 2003; Wheeler, 2002). This decline could be interpreted as demand for new, more, better, or change in the "old" practice or status quo. A priori, indices such as innovation-adoption-decision process, communication channels, how knowledge about the innovation is gained, and dissemination are examined. For example, Nasierowski (2010) reported of consistent gaps between the macro and micro viewpoints of innovativeness, and proposed composite indices for better measurement of innovation's adoption.

Competence versus performance: Competence is antecedent to performance, and is defined as a set of knowledge, skills, and attitudes that enables individuals to function effectively or exceed the expected performance standard in a given profession or occupational context (Richey, Fields, & Foxon, 2001). However, performance explains the way in which something or someone functions with an overarching goal of closing gaps or satisfying needs. Gaps in performance are discrepancies between expected and actual performance (Kaufman, 1998; Wedman, 2007), and such discrepancies or gaps can trigger innovation while knowledge about the existence of the innovation launches the innovation process (Roger, 2003). Closing the performance gaps and adding value imply developing the needed competency or expertise and attitude to practice and perform, since real performance is valued output (Swanson, 1999).

"Expertise comes with complete fusion of decision making and actions and is associated with much longer exposure in situated context" (Winn. 2004, p. 92). Expertise, therefore, stretches competency into functions of knowledge, skills, and extensive hours of quality practice, time management, and perseverance. Expertise in ICT is defined by performance in specific computer-based algorithms such as controlling and managing the processes and systems involved. For example, performance of expert teachers is found to be comparatively higher in computer-based teaching than novice teachers (Jacobsen, 1998; Morris, Xu & Finnegan, 2005). The issue is how many teachers possess ICT expertise to perform effectively in higher education, particularly, in developing countries that seek to integrate in global education and technology-driven job and market place?

Factors influencing ICT integration in the classroom: Besides technical, capital infrastructure and teachers' competencies, other influencing factors of ICT integration at the micro level are re-conceptualization of the curriculum, educational benefits, teachers and students' ability to telecommunicate, continuous professional development, and breakdown of traditional norms and barriers. For example, re-conceptualizing the curriculum involves a more interactive synchronous and asynchronous engagement of teachers and students in an ICT mediated environment as opposed to only onsite conventional practices. ICT capabilities cut across physical, space and social barriers by providing easy platform for students with different disabilities and high-risk learners, and access to people around the globe; in both developed and developing nations via the Internet.

Also, undermining the capacity to make effective use of ICT in educational settings are inadequate preparation of teachers, shortage of properly trained instructional designers, and educational support personnel (Spector & de la Teja, 2001). As a result, these authors recommended continuous development of competencies to improve online teachers' use of technology in learning and instruction. Research in ICT innovation is of interest for theory and practice in education, learning and teaching in a digitized world. University teachers are accomplished and thoughtful individuals with the propensity to respond to rapid changes by adjusting and developing deeper understanding of the change such as that of emerging educational technology and related pedagogical strategies. Examining changes in staff development in ICT policies in education, and issues with curriculum, and staff development across multination in more than 30 studies, Anderson (2003) asserted

> sustaining, transferring, and developing the innovative practices now emerging in many countries will depend on not only providing the teachers with professional development opportunities, but also on the development of emerging goals and models of teacher education to foster the establishment of learning communities. These factors, he asserted, will generate, refine, consolidate, and disseminate emerging pedagogies and professional competencies (pp. 11-12).

Objective of the Study

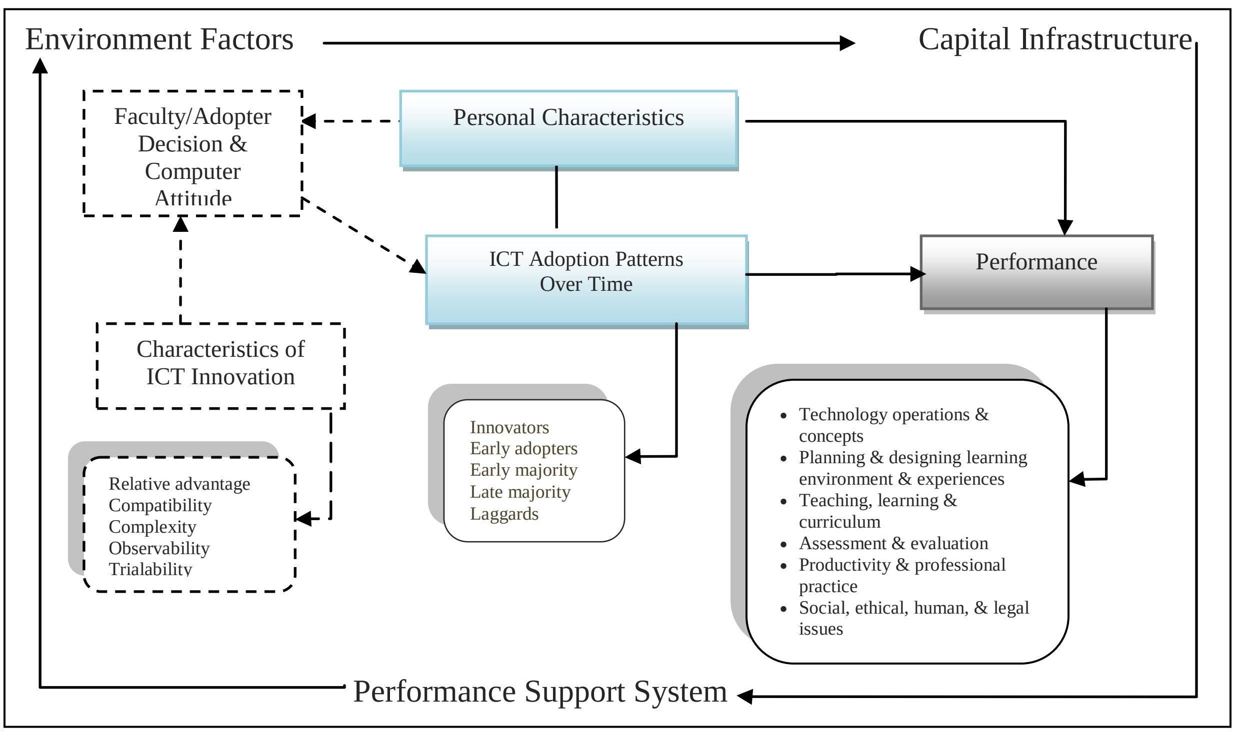
This study focused on examination of computer attitudes, and the impact of personal characteristics and ICT adoption patterns on performance of teaching staff in three public universities in Ghana. Reasons for ICT adoption, incentives and challenges will be explored to triangulate the findings. General research questions are: What is the strength of combined personal characteristics and ICT adoption patterns on performance of teaching faculty in higher education? Specific research questions to address the issue are:

1. What is the demography of the teaching faculty?
2. What are the teaching faculty's computer attitudes?
3. What is the pattern of ICT adoption?
4. What is the strength of the mean differences between personal characteristics and ICT performance factor levels?
5. What is the impact of personal characteristics and ICT adoption patterns on performance?
6. What are the reasons for ICT adoption?
7. What incentives mitigate ICT integration in higher education?
8. What are the challenges to ICT adoption and utilization in higher education?

Genesis to this study is computer attitude, which is reported to influence ICT/computer behaviors. Other key parameters to be examined and analyzed are personal characteristics, ICT adoption patterns, and performance in ICT for pedagogical practices and research. Explanatory variables are gender, age, years of teaching experience, professional status, and academic discipline. Others are average number of hours spent on ICT/computer per day, and ICT adoption patterns. Outcome variable is performance.

The study (T-FIIPHE) is constructed within the theoretical framework of innovation-diffusion theory (Rogers, 2003, 1995), computer-attitude theory (Selwyn, 1997) and the ISTE-NETS-T professional performance standards (ISTE, 2000). T-FIIPHE is defined as *Teaching Faculty ICT Integration and Performance in Higher Education,* and the conceptual model is summarized in Figure 1.

Figure 1: Conceptual Model of Factors Influencing ICT Adoption and Performance of the Teaching Faculty in Higher Education (T-FIIPHE)



Source: Conceptual model of the study (Larbi-Apau, 2009).

The T-FIIPHE model explains: a) the decision to adopt ICT based on perceived influence of the ICT characteristics such as relative advantage, compatibility, complexity, trialability, and observability, b) the adoption of ICT innovation as a function of personal attributes such as knowledge and skills, age, gender, professional status, and academic discipline, c) ICT performance as a combined influence of personal attributes and innovation-adoption patterns, and d) effects of environmental conditions, infrastructure and performance support systems. All these factors are assumed to work directly or indirectly for desired pedagogical impact in higher education. Indirect but vital influence is represented by dotted lines. Continuous lines represent research factors for the final estimate of performance impact model and assumed direct effects. Influence of teaching faculty computer-attitude and the ICT innovation's attributes are not included in the final estimation model of differential personal characteristics and adopter categories on performance; however, together with, adopter decisions, they will be explored for meaningful phenomenal insight. Theoretical foundations of the model are expanded in Chapter 2.

A priori, it is expected: a) the majority of the teaching faculty will express general positive computer attitude through combined influence of affective, usefulness, control, and behavioral attitude constructs, b) the mean differences in the six ICT performance levels defined by the ISTE-NETS-T (2000 version) are equal across age, gender, professional and academic discipline, and c) given that environmental conditions, capital infrastructure, and performance support systems are contextually well situated and fixed, the predictor variables of gender, age, teaching experience, professional status, academic discipline, average number of hours spent on computers per day, and ICT adoption categories would combine to predict large and significant performance impact. The general assumption is when the level of effort is higher; the performance outcome is equally higher, and vice versa.

Reiterative, computer technology and ICT is transposable in this study since computer centers and Internet cafés are literally referred to as ICT centers in Ghana; likewise and synonymous are lecturers, academic staff, and teaching faculty, except for when lecturers are defined as covariates of professional status. Research factors of professional status are defined as professors, assistant professors, senior lecturers, lecturers, and teaching and research assistants

Significance of the Study

This study is significant for the following reasons: a) utilizing ICT for pedagogy and professional engagements could establish the performance link between practice and ICT policies in education, b) new knowledge and ICT innovation could result in the design of innovative curriculum and teaching strategies, and that these inputs and strategies could in turn produce increased effectiveness and efficiency if they are adopted and utilized, c) ICT goal is realized when faculty adopts the new orientation, believing that it is a useful medium for advancing equal access and quality education, d) teachers in the universities have the propensity to adopt and perform productively with educational technology in support of institutional and national ICT goals, and e) how they perform could ultimately influence the achievement of their students in a positive way.

Effective teaching is a function of student learning and achievement through better understanding and application of various instructional methods and strategies. Results of this study could lead to workable solutions and promotion of better ICT implementation and performance improvement strategies in higher academe with predictable ripple effects in secondary and teacher education. Localized performance gaps between policy statements and practices could be narrowed or closed. For example, the results could potentially improve universities' decision making processes regarding bridging performance gaps between and among faculty members, departments, faculties, supporting staff, and students. Comprehensive understanding of personal characteristics, adoption patterns, and performance of the subjects studied will provide the means for widespread scale-up of ICT at all educational levels.

Innovation-diffusion theory is silent about user personal traits (except for attitude and belief systems) and pro-innovation. Computer attitude theories explain only perceptions and predictions of future computer behaviors without indicating how they relate to competency and actual performance. Examination of these parameters could provide essential results for enhanced information distribution, communication networks, ICT expertise for learning, teaching, and research, and management of education services and products.

Reiterating earlier arguments, few research studies are being conducted on the role and impact of ICT-based pedagogy in higher education and to justify investment, training, professional development, (see Bitter & Pierson, 2005; Januszweski & Molenda, 2008; Roblyer & Knezek, 2003; Tangen, 2004). This study is one of the few designed to test the consistency of the few and similar studies, particularly, in developing countries. Measuring faculty performance in ICT could be of significant interest for academics, practitioners (Tangen, 2004), policies, and future investment and growth.

Incorporating incentives and challenges to utilizing ICT in this study has the potential to improve or expand needed manpower and infrastructural support for better utilization (ICT4AD, 2003; Law & Plomp, 2003; Morris, Xu & Finnegan, 2003; Roblyer & Knezek, 2003; Spector & de la Teja, 2001; Tangen, 2004). This study is justified as a means to exploring how educational institutions in less developed economies sustain efforts, overcome myriad challenges, and grow in diversified demands for technology-based knowledge and learning needs in the 21st century.

Besides, this study is intended to provide theoretical support, expand knowledge and empirical literature, and provides the framework for further studies into ICT adoption and performance behaviors that could ultimately influence overall growth and development of technology-based pedagogy and research in higher education, particularly, in developing countries and elsewhere.

Organization of the Study

The study is organized into five sections and commences with contextual flux of ICT policy statements and functions, development, adoption, and utilization in national and higher education. Problems are stated within the context of human and non human support systems, while research questions are objectively framed and theoretically explored with a model for better visualization. This chapter concludes with assumptions, general research hypotheses, and significance of the study.

Chapter 2 provides a review of literature that defines and raises fundamental questions regarding the research. ICT policy and practices in higher education such as demography and innovation-adoption diffusion concepts are defined. Empirical evidence of ICT practices and impact in higher education are compared and contrasted. Performance of teaching faculty and constrains to ICT utilization are examined. Also reviewed are empirical studies and approaches such as different measurements of variables and methods of assessment of technology integration in higher and global education.

Chapter 3 describes the study context, participants, and methods of data collection and analysis of the data. Study sites, research design, instrumentation, and general procedures to conducting the investigation are espoused. General and specific testable hypotheses establishing the relationships between variables are presented. Concluding this chapter is a brief description of data analysis and statistical tests.

Chapter 4 presents the analysis and interpretation of the empirical results. Quantitative results of descriptive and multivariate analyses such as MANOVA and multiple regressions (MRAs) are presented in figures, tables and transcript summaries. Qualitative findings are presented in thematic tables and interpreted.

Chapter 5 discusses the significance of the results and concludes the study with suggestions for improving general practices and utilization of ICT in higher education. Contribution to theories, knowledge and future research directions are indicated.

CHAPTER 2

Literature Review

Connected to the research questions, this section reviews global policies, functions and impacts of information and communication technology in higher education. Theories of innovation-adoption-diffusion and computer attitude are examined. ICT studies and research approaches, measurements, findings, and reports are compared and contrasted. Also explored are teaching faculty roles and ICT performance indicators, professional development, drivers and limitations to ICT integration in higher education.

Global ICT Policy and Education

ICT adoption in education in the early 1990s was mainly focused on secondary and vocational education with Europe and the United States playing leading roles. Other countries adopted a *laissez faire* attitude and approached these innovations with caution and skepticism, particularly, with developing economies as a result of cultural, economic and social factors, and lack of political will. However, current global trends indicate ICT is embraced in most countries and offers greater intercultural and societal interactions among people across borders and boundaries.

Many policy makers adopt ICT based on its potentials for information exchange, knowledge-oriented economy, and social change. ICT is used for accessing, organizing, retrieving, sharing, and managing knowledge, information, and communication. Each of these processes and concepts are implicated with theories and practices, which ultimately complicate ICT adoption and utilization. Unlike one-shot innovation, ICT application in education is still evolving with constant mobility of players of young and old, changing social dynamics and virtual learning communities. Demography and social networking further complicate characterization of adopters, adoption patterns, and innovation-adoption studies**.** For example, differences in the aging process such as senescence, decline in vision and psychomotor skills could profoundly influence purpose and application of computer technology and ICT use. Anderson (2003) reported that the rapid and pervasive pace of ICT and Internet in education is forcing social institutions to expand infrastructure and making changes in the curriculum and staff development.

Generally, ICT policy in education is implemented in curricula as a subject such as programming computer science, systems analysis, integrated course delivery system, as well as educational media and resource. Law and Plomp (2003) differentiated ICT in the curriculum in the 1990s into three unique roles as follows:

1. Learning about ICT: ICT as a subject of learning in the school's curriculum such as computer or ICT literacy, computer science, and information literacy.
2. Learning with ICT: The use of various computer capabilities such as computation, multimedia, the Internet as a medium to enhance instruction or as a replacement for other media without changing beliefs about the approach to and the methods of teaching and learning, and
3. Learning through ICT: In which case ICT is integrated so completely as an essential tool in a course or curriculum that the teaching and learning of that course or curriculum is no longer possible without it (p. 16).

However, they also reported an evolution of this taxonomy over the years into: a) learning about ICT, and b) integrating ICT to enhance the teaching-learning process. The latter provides the basis for this study's model and supports Kozma's (2003, 1994b) assertion that not only should computer technology (ICT) be considered as a subject in the curriculum, but also as a multi-system with the capabilities to extend teaching and learning and influence student achievement. In the 1990s and early 2000s, Kozma studied computer technology in education and described learning with this medium as a complementary process within which representations are constructed and procedures performed. Evidences from his study supported the view that the process of learning is influenced by the capabilities of the computer technology, learner control, and creativity of the instructional designer in exploiting these capabilities for teaching and learning purposes. Kozma argued research in instructional media should focus on ways through which their capabilities influence learning for particular students, task to perform, and situations rather than whether media influence learning. In contrast, Clark (1983) and Clark and Feldon (2005) defended the position that learning differences cannot be attributed to instructional media or delivery; only the content of the instruction influences achievement. Learning, they argued, is influenced only by what the teacher does. Issues with effective utilization of computer capabilities in education are still debated and studied (e.g., Clark & Feldon, 2005; Dede, 2000; 1999; Kozma, 2003, 1994a, 1994b; Mayer, 2002; Roblyer & Knezek, 2003) with varied and inconsistent results.

Studies in support of education technology encourage its application for information exchange, knowledge mobilization, dissemination and management systems, and utilization with the potential to transforming education (Anderson, 2003; Kozma, 2003; Law & Plomp, 2003; Melle, Cimelaro & Shulha, 2003; Wheeler, 2002). Others have suggested replicating existing teaching practices such as improving quality presentations and making external resources available in the classroom (Kirkup & Kirkwood, 2005).

However, all opposing school of thoughts agrees that technology media are not a panacea to all pedagogical problems in education. For example, establishing ICT centers on campuses in compliance to domestic and global ICT policy dictates do not automatically reform and transform education or improve teaching and learning without the necessary support and teachers’ willingness to engage with the media for the rightful purpose. Contemplative issues include how to merge the capabilities of ICT media, instructional design functions, and teaching strategies to better present lessons and courses to improve learners understanding and academic achievement; how electronic learning environment can change individual's access to quality information and improve communication; and how ICTs can improve access to learning resources and distance learning compared with no ICTs.

ICT Functions in Higher Education

ICT/computer technology is used to support core teaching (Frank, 2003-2004; Kirkup & Kirkwood, 2005; Rummel & Spada, 2005; Spector & de la Teja, 2001) and research (Roblyer & Knezek, 2003) in higher education (Assié-Lumumba, 2008). For example, Frank (2003-2004) argued computer mediated communication (CMC) provides teachers and educators the option to additionally engage students in reflective thinking. Through CMCs, teachers can post course documents, open discussion and forum, encourage peer reviews, and give quizzes in both online and traditional face-to-face classroom; however, each setting requires specialized knowledge in the variations of teaching strategies for effective learning and instruction. Teaching synchronously, asynchronously or both depends on availability of ICT media and usability to support teachers' competence and performance via these routes.

In a predominantly technology-based learning environment, the teachers' role is shifted to not only pedagogical, but also managerial, social, and technical functions (Plomp, Anderson, Law, & Quale, 2003; Doutrich, Hoeskel, Wyckoff & Thiele, 2005; Kirkup & Kirkwood, 2005; Morris, Xu & Finnegan, 2005; van Brakel & Chisenga, 2003). Morris Xu and Finnegan (2005) reported three primary perceived roles of faculty in online teaching, which are: a) course customization (managerial and pedagogical purposes; b) course facilitation (managerial, pedagogical, and social), and c) grading and assessment (pedagogical). In each case, qualification and different sets of skills were suggested to transit from the conventional teaching to performing successfully with the technology media.

ICT integration in education also transforms the teacher into becoming a facilitator, moderator, coach or guide (Morris, Xu & Finnegan, 2005; Motschnig-Pitrik & Holzinger, 2002; Salmon, 2002), and shifts the students' orientation into more active and participatory roles. Again, these distinguishing roles require specialized knowledge and adaptation by both stakeholders; students and teachers. Researching these influences on teachers' resourcefulness and expertise, and students' roles and engagements in authentic environment is needed for conceptual modeling and pragmatism. According to Roblyer and Knezek (2003), Kozma's theoretical and methodological contributions regarding educational technology have helped in redirecting studies on technology-based methods and student achievements. Related studies have shifted from myopic to broader and more comprehensive approaches to effect type of technology innovation, change and results.

Diffusion of Innovation

Innovation is synonymous to novelty, modernization, modernity, or originality of idea, purpose, project or program, and is created or developed through applied research and practice to solve problems and response to a need or needs (Rogers, 2003). Innovation is diffused in a social system for adoption or rejection, and a social system is defined as a set of interrelated units that engages members in collaborative problem-solving with the intent to accomplishing a common goal. To communicate or diffuse innovation requires “catalysts”, referred to as change agents (Rogers, 2003) through varied communication channels. Diffusion; therefore, involves dissemination of innovation from the source to the target, while innovation's adoption is a function of its features and the nature of innovation-decision making process. Both adoption and diffusion account for variances in the adoption rate, which means the rate of adoption is dependent on time, communication channels, nature of social systems, and levels of change agents' promotional efforts. Sufficient knowledge about the innovation is required to minimize its level of risk and uncertainty (Rogers, 2003; 1995).

General Innovation Attributes

Perceived innovation's attributes such as relative advantage, complexity, compatibility, trialability and observability influence its adoption (Rogers, 2003). Relative advantage is indicated by social prestige, economic profitability, low initial cost, incentives and immediacy of reward. Also indicated are time and effort saved, decreased discomfort, reduced workload, and improved performance. Relative advantage defines the degree to which the innovation is perceived as better than the status quo and is positively related to innovation's adoption.

Compatibility explicates the congruence of the innovation with the users' values, knowledge, skills, experience, and perceived needs. For example, the functionality of ICT in higher education has practical and theoretical implications for technical, pedagogical, and managerial consistencies with existing institutional structures. Inherent conflicts of these factors could negatively influence its adoption rate, and positively related to innovation's adoption is when users are agreeable with its merits and usage.

Complexity describes perceived complicated or uncomplicated innovation. Complex innovations stand to be rejected, while user-friendly innovations are positively related to adoption and utilization. Multifaceted, ill-defined and inconsistent innovations could be responded to with lower success and adoption rates due to their convolutions.

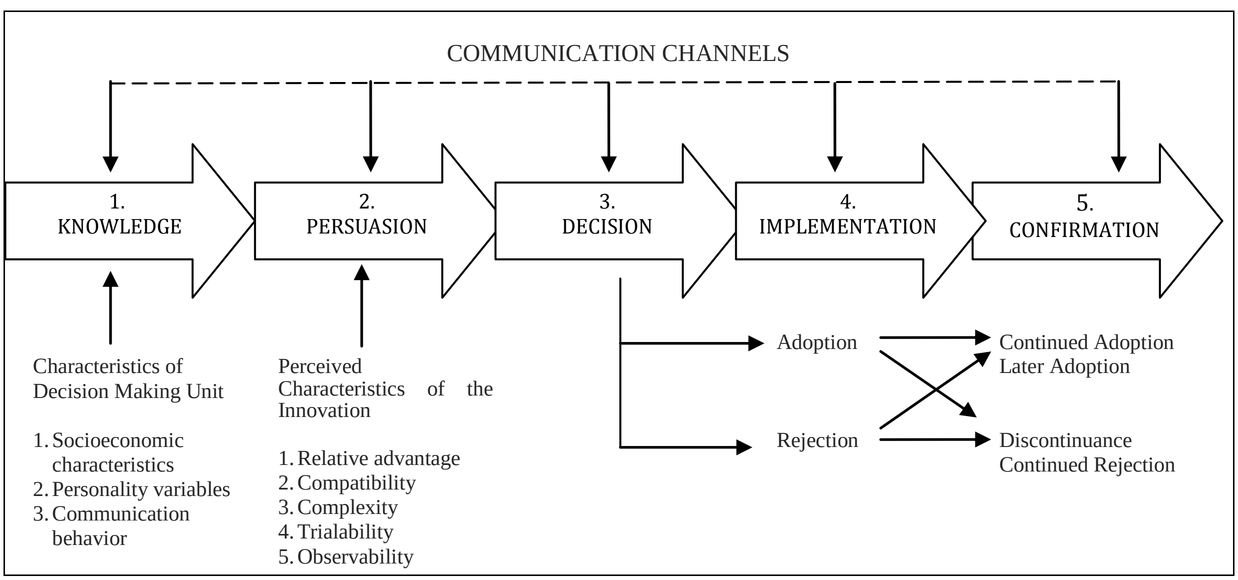
Trialability "is the degree to which an innovation maybe experimented with on limited basis" (Rogers 1995, p. 16) prior to blanket adoption and implementation. An innovation that can be tried is associated with less uncertainty and greater adoption rate, which implies users' should be able to experiment with the innovation in parts over time before full-scale implementation.

Observability explains the visibility of the innovations' results to others. Whereas innovators have no precedents to follow in the adoption process, results are noticeable to later adopters, which tend to positively influence decisions to adopt and adoption rate.

Innovation-Decision Process

Innovation-decision process precedes adoption and is critical for successful implementation and sustainability. Rogers (2003, 1995) characterized the actions and decisions of the innovation adoption process into five phases of knowledge, persuasion, decision, implementation, and confirmation which occurs over time. These phases are summarized in Figure 2. The rate of adoption is the relative speed with which an innovation is adopted by members of a social system via varied communication channels.

Figure 2: The Innovation-Decision Process



Adapted from Rogers (2003)

Gaining active *Knowledge* about the innovation and its functions in order to make an informed decision begins the process in Phase 1. Knowledge acquisition is characterized by socio-economic, personality, and communication behaviors. Personal behavior describes attitudes and belief systems of the adopter. Types of knowledge that could possibly influence innovation-adoption decisions are awareness, how-to, and principles. *Awareness* defines consciousness of innovation's existence; the *how-to* describes required knowledge and information on using the innovation; and the *principles* entail the functions underlying the idea or the innovation (see Rogers, 2003).

Phase 2 is *Persuasion*. The individual adopter is persuaded to form favorable or unfavorable attitudes towards the innovation based on perceived features of the innovation. Persuasion is affective rather than cognitive, and though mutually exclusive, they are complementary in the adoption-decision-making process. *Decision* is made in Phase 3 to adopt or reject the innovation in quest. Given conflicting messages about the innovation and its trialability, the individual or decision-making unit could validate or invalidate the earlier decision to continue or reject the innovation. *Implementation* occurs when the innovation is utilized in Phase 4. Relative to the first three phases, this phase is typified by both cognitive and affective processes, which are exhibited through overt actions or observable behaviors. Implementation could be more constrained by organizations and institutions rather than by the individual due to bureaucracies, hierarchical structures and culture. Phase 5 is *Confirmation* that occurs when the individual reinforces an earlier decision to adopt and implement the innovation. Confirmation exemplifies human behavior, which is partly dictated by the individual's state of internal equilibrium or disequilibrium. This internal state can be excited by pro-innovation messages via change agents and communication media.

In general, information about the innovation is transmitted through interpersonal or mass communication, and time is a major control factor in the adoption decision process. According to Rogers (2003; 1995), the characteristics of the innovation and its adoption rate could predict and account for users' reaction at a variance between 49 and 87 percent.

Innovativeness and Adopters

Nasierowski (2010) cited Dahlman (1999) to define innovativeness as "network of agents and set policies and institutions that affect the introduction that is new to the economy" (p. 43). While Rogers (2003) emphasized innovativeness by individual users and the social system, Nasierowski applied it in the national context. However, both authors highlighted the importance of innovativeness for economic development and continuous improvement through adoption and investment. Rogers distinguished innovation adoption into five distinct adopter stages based on relative time of adoption and modeled it as a standardized normal distribution curve. This distribution curve is a product of a set of mean scores, cumulative percentages, and standard deviations. These adopter groups are classically characterized in succession as innovators, early adopters, early majority, late majority, and laggards.

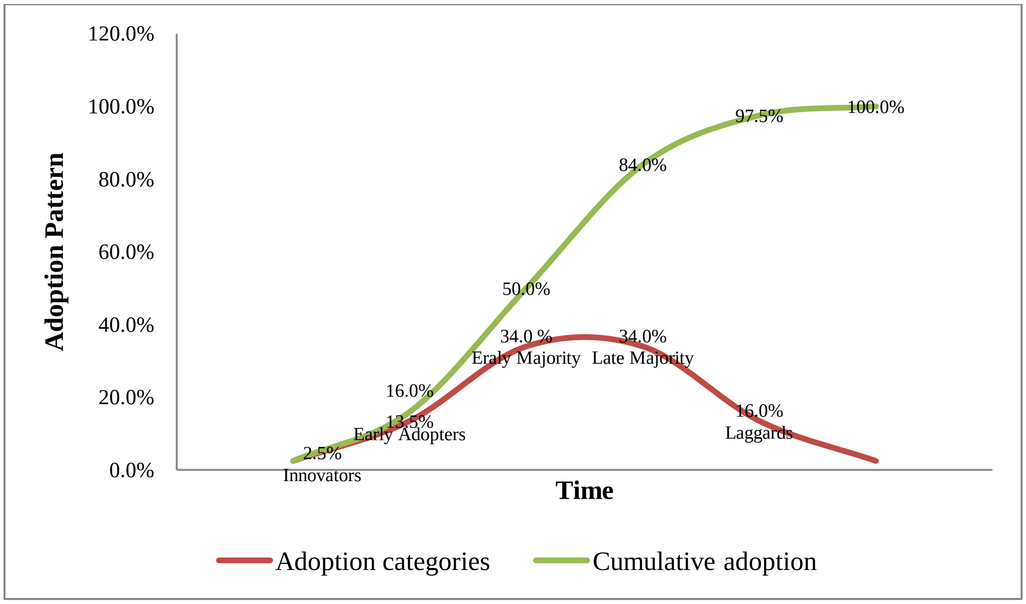
Innovators constitute the first group to adopt the innovation and represents 2.5% of the target population who can cope with higher levels of uncertainties. They are classified as active information seekers and audacious individuals with high degree of mass media exposure and wider interpersonal networks. On the other hand, early adopters constitute 13.5% and are more integrated than innovators in the organization, institutions or social system. Usually, they are respected for their views and information about the innovation and act as opinion leaders and role models in the diffusion process.

Early majority represents 34% and adopts the innovation relatively earlier than the typical members. They are characterized as very interactive with deliberative behaviors and hold a position between the early adopters and late majority. Comparable in proportion (34%) to early majority in the standardized distribution, the late majority is described as incredulous and guarded, and adopts the innovation after the adoption by the middling members. Their decisions to adopt an innovation are influenced by economic factors, financial lucidity and increased pressure from peers. They become comfortable with the idea or innovation when most of the uncertainties associated with it are removed.

Laggards represent the final 16% of the total membership and lag in innovation adoption. Characterized as locals and traditional, laggards are reported to have no opinions and are suspicious of innovation and change agents, which tend to prolong their process of innovation-decision due to limited knowledge and utilization of the innovation and resources.

Preceding the adoption is a series of processes such as recognizing, prioritizing, developing and determining the innovation's impact through research and evaluation. Again, Rogers (2003) defined a five-stage innovation process of agenda setting, matching, redefining, clarifying, and routinizing prior to adoption. The five-stage innovation process is characterized into two broad activities of initiation and implementation. Initiation is explained as a process of information gathering, conceptualizing, and planning for the innovation's adoption, while implementation describes all events, actions, and decisions of putting the innovation into use. Implementation occurs at varying degrees depending on individual characteristics and context. A critical mass or learning curve is reached when adoption of the innovation becomes self-sustaining. The successive adoption patterns are illustrated in Figure 3.

Figure 3: Classical Cumulative and Innovation Adopter Distribution



Source: Adapted from Rogers (2003, 1995)

Innovation-Adoption Research

Similar to Rogers, most research on adopter categories characterizes the mean scores, and standard deviation, and the respondents are marked with standardized percentages in each category (e.g. Erumban & de Jong, 2006; Kirkup & Kirkwood, 2005; Oyelaran-Oyeyinka & Adeya, 2004; Rossi, Russo & Succi, 2007; Wheeler, 2002). These standardized percentages are then modeled against the normal distribution curves when plotted over time. Cumulative adopter points represents S-shaped curve portrayed by the initial adoption rate to a later adoption growth where a saturation point is reached over time. Individuals continue to use the innovation to its full potential or call for a change. The question is: Will the pattern of ICT adoption by the teaching staff fit the description of this standardized pattern of adoption? What roles are played by the distinctive categories of adopters? What is the saturation point? What is the level of participation?

Gaps in Innovation-Diffusion Theory and Research

A major criticism of the innovation-diffusion theory in earlier years is the pro-innovation bias, which assumed an innovation must be adopted by all members and diffused more rapidly in the social system (Rogers and Shoemaker, 1971). It implied an innovation should neither be rejected nor re-invented. However, underestimating the significance of innovation bias suggests critical intellectual impasse and possible underestimation of research findings. ICT systems and modus operandi are not static. ICT innovation is continuous with new adopters along different points on the cumulative curve.

Second, recalling data by participants in cross-sectional research to estimate time factor in the diffusion process could lead to misrepresentation of actuality. Third, equality and access issues, coupled with holding individuals exclusively culpable for innovation-diffusion problems rather than the whole system is irrational. Fourth, externalities such as socio-economic gaps and political will pose major limitations of innovation adoption to influence the results of the study. Fifth, Rogers' innovation-decision process seems very practical, yet it oversimplifies complex adoption patterns such as that of ICT. For example, it could underestimate the influence of unique personality profiles, competency and performance. Simply defining adoption patterns into five adopter categories ignores diverse attributes such as age, abilities, skills, attitudes, and motivation; hence, it is difficult to classify individual users only on time of adoption.

Though, unique stages could be used to predict and explain a general cycle of technology adoption (Rogers, 1995), it cannot explain the causality of technology adoption patterns and individual adoption decisions (Kirkup & Kirkwood, 2005). In addition, less attention is given to the relationships between the five innovation attributes. Technology adoption and implementation are mutually exclusive variables in research studies, yet, they are interrelated in practice and applications. It is unreasonable to adopt a technology innovation without considering the impact of its implementation in policy study and research.

Attempts by Rogers in the late 1990s and 2000 to address some of these issues involved appropriate designs for data collection and triangulating the research with archival records, field experiments, longitudinal and case studies. These factors, he suggested could capture time element and ascertain validity and accuracy of data and information. Series of possible strategies to deal with the complexities of innovativeness and indicators in research are also argued by Nasierowski (2010).

Nevertheless, most innovation-adoption-diffusion studies have been based solely on Everett Rogers or in combination with other innovation theories to provide a more comprehensive and quantitative results (e.g. Jacobsen, 1998; Karahanna, Straub & Chervany, 1999; Tangen, 2004). These research results are comparable and seem to corroborate the original qualitative nature of Rogers in rural sociology and medical studies. For example, Karahanna, et al. (1999) found the combination of theory of reasoned action (TRA) developed by Fisbein and Ajzen in 1975 and some aspects of Rogers innovation-diffusion theory useful in a study of ICT adoption across time. Jacobsen (1998) found Rogers' diffusion theory combined with the General Self-Efficacy Scale (GSES) developed by Schwarzer and Jerusalem in 1995 relevant in investigating adoption patterns and characteristics of faculty who integrate computer technology for teaching and learning in two universities in Canada. Kirkup and Kirkwood (2005) recommended a combination of activity theory (AT) and Rogers (1995) innovation-diffusion model as a relevant analytical framework to developing the understanding of the actual impact of ICT upon teaching practice. Erumban and de Jong (2006) found the Hofstede's Cultural framework more appropriate in a cross-country study of ICT adoption and implementation. Each of these studies is unique and methods adopted were considered apt for the intended purposes.

Relevance of Rogers' to the study: Rogers' innovation-adoption-diffusion theory has been applied and validated by a plethora of both quantitative studies and qualitative inquiry across disciplines, subjects, as well as multi-social, cultural and political contexts, and is found applicable for this study. Similar to others, this study will incorporate other theories to capture the effect of personality traits, performance and other confounding factors such as incentives, limitations, and performance support systems. Mixes of quantitative, qualitative and extant data will capture more evidences, themes and influences of time factor.

Evidence of ICT/Computer Technology Adoption in Higher Education

Literature reports variations in ICT adoption and web-based instruction by the teaching faculty in higher education (e.g. Harrington, Gordon & Schibik, 2004; Kirkup & Kirkwood, 2005; Morris, Xu & Finnegan, 2005; Wheeler, 2002). In a study conducted in Indiana University, Wheeler (2002) found a rapid adoption of course management systems (CMS) by teaching faculty members. For example, he reported that the range of adoption increased from 3% in spring 1999 to 65% by spring 2002 suggesting significant difference in the adoption rate over time. By the same period, students' adoption rate also increased from 3% to 81%. Differences in scores were explained by perceived ease of use and usefulness of the CMS to the adopters. In this study, early adopters were found to demand more advanced functionality, while late adopters preferred simplicity, few changes to basic functions, usefulness of applications, and ease of use. Besides perceived features of the CMS (innovation), the differences in the adoption rates were also explained by the levels of expertise, which was determined as a function of purposeful practice, adequate knowledge, and time factor.

Similarly, Kirkup and Kirkwood (2005) reported very large variability in adoption patterns of ICT utilization in United Kingdom Open Universities. Over a period of 13 years, these authors reported an increase of adoption from 56% in mid-1990 to 85% in 2003 by the tutors (teachers) who used ICT for creating and storing students' records. Over a period of seven years, Jacobsen (1998) reported nearly 70% adoption of computer technology for general professional tasks in 1986 and 93% by 1993 in two Canadian Universities. Adoption rates for research were estimated at 63.1% (1986) and 89.4% (1993), while computer technology adoption for teaching task increased from 43.4% (1986) to 75% (1993). On the other hand, Harrington, Gordon and Schibik (2004), reported a cumulative score of 20.8% adoption rate for course management systems (CMS) by the academic department chairpersons for over five years period in a national survey of American Association of State Colleges and Universities in 42 different states in the U.S. First CMS adoption was reported in 1995 at 13.9% with cumulative adoption rate of 79.8% by 2004. Over a total of nine years, the difference in CMS adoption is estimated at nearly 66%.

Findings like these and similar others support the relevance of innovation-diffusion theory, adoption patterns and cumulative adoption of information and communication technology in higher education for pedagogical engagements. However, mixed results could be attributed to the differences in the drivers of change such as rate of innovation-diffusion, rationale for adoption, institutional contexts, infrastructural support and adopters' persona among other factors.

Computer Attitude: Indicators and Assessment

Attitude is a theoretical construct that represents individuals' positive, negative, or ambivalence towards an object or issue. A change in attitude could result from direct experience or observational learning. Attitude influences cognition process or thoughts about issues or situations and is considered a very critical factor in decision making and self-efficacy. Attitude leads to persuasion and decisions, while self-efficacy explains combined perception and user's ability to deal with emotions and situations.

Myriad empirical techniques and measurements are adopted to quantify attitude and self-efficacy in computer technology and ICT studies (see Jones & Liu, 2001; Schwarzer & Jerusalem, 1995; Selwyn, 1997; Soh, 1998a; West, 2003). Examples of these assessment models and techniques are Selwyn's, 1997 computer attitude scale (CAS), Schwarzer and Jerusalem's, 1995 generalized self-efficacy scale (GSES), teachers' self-efficacy scale (TSES) by Tschannen-Moran and Woolfolk Hoy, 2001, and the Hofstede's Framework, 2001; 1984.

The CAS was developed and validated by Selwyn (1997) of the University of Cardiff as a theoretical instrument in response to what he called unstructured and haphazard nature of attitudinal research and implementation of information technology. Selwyn's study is based on that of Ajzen's, 1975 theory of planned behavior, which suggests a link between attitude and computer behavior. Considered as one of the most predictive persuasive theories, the theory of planned behavior has been applied in many disciplines in studies related to belief systems, behavioral intentions and attitudes. Selwyn's CAS instrument was initially used to measure and examine degrees of variations in computer attitude of students between ages 16 and 19 years in different contexts.

Selwyn's Attitude Constructs: In examining the overall computer attitude, a combined perceived affective, usefulness, control, and behavioral constructs were applied. Affective construct assesses possible fear, apprehension, and hesitation or discomfort displayed by the computer user. Perceived usefulness assesses whether the user finds the computer helpful, productive, imaginative, and interesting relative to the respondents work. Perceived control applies to the user's perceived ability to manage the computer system, while behavioral construct measures the regularity of computer use. A defense component was added later and validated by Soh (1998a, 1998b) in Singapore to increase the constructs to five. Defense component measures whether the user has guarded attitude towards computer use, such as distrust and suspicions. The CAS can be correlated with other socio-economic and demographic factors.

The CAS instrument has provided a comparative measure for computer attitude studies to educators and researchers in many organizations, including health and education due to its high significant internal consistency, reliability score of between 0.87 to 0.93 coefficient of stability, and significant construct validity ($p < 0.001$). This 21-item survey is presented on a 5-point Likert scale of *Strongly Agree* to *Strongly Disagree*. The total score yields the attitudinal effect. The CAS can be correlated with other socio-economic and demographic factors. For example, Jegede and Josiah (2005) applied the Selwyn-Soh to examine computer attitudes of college teachers and analyzed the results with ANOVA (analysis of variance) statistics. The mean score of the overall computer attitude of the teachers was reported at 79.0. Further analyses indicated no significant differences across professional status; however, for academic disciplines, science teachers showed relative significant difference in computer attitude at a mean score of 82.6 over core education (78.6), technical (74.3), vocational (75.8), and arts (76.5). In addition, computer attitude was found to be significantly influenced by computer access.

Mixed results were reported by Chin (n.d.) of teachers in a Singapore University in a comparable study. On a scale of 10, a general positive mean score of staff computer attitude was calculated at 7.04. Disaggregating the attitudinal constructs, an affective component mean score was highest at 8.05 followed by the usefulness component at 7.52, behavioral at 6.96, and the control factor at 6.47. Differentiating the mean scores by subjects, a relatively higher positive attitude was recorded for staff in English and Literature at 7.13 apiece, while Mathematics, Physical Education and Science were estimated at 7.27, 7.80, and 6.84 respectively. While Jegede and Josiah (2005) found science teachers' to exhibit relatively higher computer attitude scores than other subjects, Chin's findings indicated otherwise.

Compared to the CAS, the Generalized Self-Efficacy Scale (GSES) differs in content and composition and seeks to measure one's competency and ability to cope with a broad range of stressful challenging demands. The GSES was developed by Schwarzer and Jerusalem (1995) and had been adopted and translated in over 28 languages. Indicators include social-cognitive constructs such as general intention, well-being, health behaviors, coping with stress, and computer-related behaviors. A set of 10-items on a 4-point Likert type scale on behaviors are assessed with the GSES. Typical items are *Thanks to my resourcefulness* and *I can handle unforeseen situations*. Responses could range from *Exactly True* to *Not At All True*, and the mean score or range is calculated to establish group performance. The GSES can be correlated with other personality traits such as actions or decisions, and has been adopted for many studies due to its high validity, stability, and construct reliability (Albion, 1999; Jacobsen, 1998; Leganger, Kraft & Roysamb, 2000;

Luszcynska, Scholz & Schwarzer, 2005; Schwarzer, Mueller & Greenglass, 1999).

For example, Luszcynska, Scholz and Schwarzer (2005) found GSES a universal construct with meaningful relations to other psychological constructs, while Jacobsen (1998) found a relatively high self-efficacy of teaching faculty innovativeness in computer integration in higher education. Internal consistency of the GSES yielded 0.91 similar to the original GSES and other similar studies. The TSES is a 12-item scale developed by Tschannen-Moran and Woolfolk Hoy, 2001 cited in Klassen, Bong, Usher, Chong, Hua, Wong, & Georgiou, 2009). Validity of the Teachers' Self-efficacy Scale (TSES) was further explored and tested in five countries: Canada, Cyprus, Korea, Singapore, and the United States, and the results showed strong relationship of self-efficacy with teachers' job satisfaction in all the five contrasting settings using multi-group confirmatory factor statistics (Klassen, et. al, 2009). Albion (1999) suggested that with careful design of appropriate instruments, the self-efficacy model can be very useful in estimating the effects of teacher education initiatives to better prepare graduates for technology use.

The Hofstede's Cultural Framework was developed by Hofstede's, 2001; 1984 and has received a great deal of attention as a model for research in different cultures and ICT adoption studies. This framework originally consisted of four cultural dimensions of power distance, uncertainty avoidance, individualism, and masculinity and could be modified and customized in different context. In contrast, SITE-Modules are largely qualitative and have been extensively employed in cross-national ICT studies (Kozma, 2006; Plomp et. al, 2003).

Despite the validity and reliability of the above models, the CAS was found to be consistent with the purpose of this study due to its distinct subscales and appropriateness of contents to the target audience. For example, while the Hofstede's Framework places too much emphasis on cultural dimensions; the generalized self-efficacy models are oriented towards personality as perceived by others, stress factors and competency rather than performance, and the SITE-module is generally qualitative.

Performance Indicators and Measurements

Most studies point to four major performance indicators in computer-based teaching and learning, and these are pedagogical, social, managerial, and technical (Berge, 1995; Bonk & Dennen, 2003; Maor, 2003; Morris, Xu & Finnegan; 2005). Berge (1995) studied and reported these four categories with subs as the most important responsibilities for facilitating computer conferencing. He related pedagogy to intellectual tasks, social to community building, managerial to organizational, procedural, and administrative functions, and technological to technical functions. Similarly, Bonk and Dennen (2003) studied pedagogical, social, managerial, and technological strategies for the web and online learning environment, while Morris, et al. (2005) modeled the typology of Berge's in a study to examine the faculty's role in teaching asynchronous undergraduate courses.

In another study, Maor (2003) examined and discussed the extent to which the teacher established and maintained the community of learners in Australia. Four performance indicators of pedagogical, managerial, social, and technical were evaluated either simultaneously, or as separate actions relative to the activities of the instructor. Pedagogy appeared to be the most relevant in terms of promoting interactive learning; however, the social component was the factor that supported and kept interpersonal communication. Performing these functions professionally required competencies in each of these four arenas.

Measuring professional competency and performance in the work place, the International Board of Standards for Training, Performance and Instruction (IBSTPI, 2001) developed a set of competencies which are adopted by professionals, academic institutions and organizations with the purpose of identifying knowledge, skills, attitude, capabilities and tasks that enable one to perform to an expected standard in a given occupation. These standards can be applied in different settings, and the contents can be customized for the intended purpose. Nonetheless, Spector, Klein, Reiser, Sims, Grabrowski & de la Teja (2006) have suggested further discussion of issues related to the IBSTPI competency model and criteria in order to improve individual and organizational learning and performance. Open for debate are problems related to its creation, validation, use, and influence on professional practice and technology-based instructional design.

Particularly important for this study are the modules developed by the International Society for Technology in Education's National Educational Technology Standards for Teachers (see Bitter & Pierson, 2005; ISTE, 2008, 2000). The 2000 version of the ISTE-NETS-T is organized into six broad professional performance categories with 23 sub tasks. The primary ISTE-NETS-T performance standards are:

1. Technology Operations and Concepts (TOC), which demonstrates introductory knowledge, skills and comprehension of concepts and continual growth to cope with current trends and emerging technologies.
2. Planning and Designing Learning Environment and Experiences (PDLEE), and consists of effective planning and designing of technology-related learning environment.
3. Teaching Learning and the Curriculum (TLC) that assesses how teachers implement curriculum plans including methods and strategies for applying technology to maximize students learning.

4. Assessment and Evaluation (AE) for application of technology for students' assessment such as data collection, analyzes, and communicating the findings to improve instructional practices and students performance. AE also assesses applications of multiple evaluation methods in order to determine appropriate use of technology resources for communication, learning, and productivity.
5. Productivity and Professional Practice (PPP) measures how teachers apply technology to engage in ongoing professional development. It is intended to help evaluate and reflect on professional practice, and to increase productivity, in addition to assessing communication and collaboration with peers and the larger community in order to promote student learning through technology.
6. Social, Ethical, Legal, and Human issues (SELH), which measures safety promotion, diversity, legal, and netiquette as well as equitable access to technology resources for all students.

The ISTE-NETS-T has provided the roadmap since 1998 for improved teaching and learning by educators in U.S. and several countries (ISTE, 2008, 2000). For example, based on these standards, the Massachusetts Department of Elementary and Secondary Education has developed a set of self- assessment tools for : a) teachers to determine their own levels of technology proficiency as well as identify personal technology professional development needs, b) schools and districts to assess their professional development needs and plan professional development activities that will help all teachers become proficient in technology, and c) the state to gather and report data on technology competencies and professional development (MDESE, Massachusetts Technology Self-Assessment Tool, 2008). The ISTE-NETS-T performance standards seem appropriate for this study in concept, content and practice. Justification for the selection of the 2000 version for this study is articulated in Chapter 3 under instrumentation.

Performing with ICT and Related-Computer Technology

Diverging results of empirical studies on achievement and performance of ICT and computer technology integration by the teaching faculty and online instructors are documented. For example, Morris, Xu and Finnegan (2005) examined faculty roles as perceived and enacted in teaching asynchronous undergraduate courses and reported wide variations and participations between experienced and novice instructors. Effect of faculty workload and perceptions of facilitation in online environment are reported. They recommended more studies in this direction to ascertain these findings. In contrast, Oliver (2002) found no difference between the performances of beginning teachers with formal training in computer use from their peers with no formal computer training for teaching purposes. Morris, Xu and Finnegan (2005), again, reported lack of performance due to little awareness of collaborative learning, lack of social presence, and community building by novices and first time online instructors. However, they suggested that over time, conventional face-to-face instructors gained experience in distance programs and online instructional strategies to impact performance. The teachers learned the technical skills required for effective communication and online practices over time.

Despite ambitious ICT policies and pressure from policy makers and school administrators, what the teacher does and controls in the classroom are the most crucial to the adoption of ICT and change process. With tight schedules, workloads, and competing demands for time and resources, the teacher's competence and performance can be compromised leading to resistance to change. Faculty workload and schedule, time spent or saved in online teaching relative to the face-to-face approach are very critical. For instance, in a study of university faculty in online teaching and learning, Visser (2000) reported that the overall time for developing, delivering, and assessing courses in a blended Internet-based instruction and two-way interactive television was more than twice that of the traditional courses. In contrast, DiBiase (2000) reported preparing distance education courses for students online took less time (2.7 hours) than face-to-face traditional setting (3.2 hours). Researching to corroborate these findings could help to model strategies for better integration and performance, while minimizing challenges for the needed balance.

Faculty Performance Support Systems

A wide range of professional development courses, learning communities and general discussion of pedagogical issues are recommended to improve technical capabilities of reluctant academic staff, general performance in teaching and learning online, and effective use of ICT and computer technology in education. Strategies such as learning communities are proposed to improve individual and group performance systems.

Learning communities or Community of Practice (COP) seems to be working well as a means to sharing knowledge and practicing for improvement in the information society (Dede, 1999; Nett, 2008; Plomp, et al., 2003; Spector & de la Teja, 2001). For example, Dede (1999) identified “knowledge networking” and learning communities as a generalized means to enhance many forms of reflective human activities. Knowledge networking is explained as a type of engagement where scientists meet in virtual communities to create, share, and master knowledge. With this process, real-time data are exchanged, alternative interpretations are deliberated, meanings of findings are discussed, and collectively, these cohorts come up with new conceptual frameworks for professional development. Vibrant learning communities enable richer and deeper understanding of issues related to evolution and distribution of the innovation, implementation, and evaluation.

Nett (2008) corroborates the use of COP as a very valuable practice for educational innovation and promising model to supporting the performance of law tutors trying to improve education through computer technology. Results showed that exchange of information between expert and novice tutors improved self-organization, development of mutual trust and power, and the change process. However, the major challenge to the COP in this study was the inability of the tutors to identify and ask the right questions from expert colleagues without endangering individual reputations. Reportedly, disciplinary competition and modes of responsibility, representation, and cooperation in academe posed major problems for these tutors/teachers. Nett's study focused on using educational software, *JurMoo* as an open source platform for educational purpose and inter-tutor communication and cooperation in Australia.

Spector & de la Teja (2001) recommended continuous development of competencies to improve teachers' ability to make effective use of technology; while Plomp, et al (2003) suggested increase in student-centered teaching and skills in problem solving. However, Maor (2003) proposed the need to improve decision making by involving the teaching staff in ICT implementation. He recommended provision of effective technical and logistical support to assist academic staff in taking on the challenges of teaching online. Assessing a program of teaching teachers to teach with technology, Doutrich, et al. (2005) identified ongoing faculty development as a key component to delivering effective graduate course online.

Recommended for African schools and universities are better implementation of ICT policies and practices, better infrastructure, digitized library systems with accessible databases, curriculum reform, and teacher competency and professional development (Assié-Lumumba, 2008; Martey, 2004; Maor, 2003; Plomp, et al. 2003; Oliver, 2002). In addition, Assié-Lumumba (2008) proposed studies of real potential opportunities to remedy possible challenges and major side effects of ICT integration in education, dependency, and effects of neo colonial dominance in Africa. Martey (2004) proposed research resources for users via the Internet, while Oliver (2002) argued for enhanced competency and performance-based curricula such as access to a variety of information sources and resources.

In general, teachers need professional assistance and institutional support to perform effectively with ICT for teaching and research. There is the need for coherent picture of demographic influence due to differences in personality factors, and other elements such as instructional and curriculum association, academic discipline, and performance standards to develop consistent ICT policy framework and utilization for professional tasks.

This section has compared and contrasted practical, empirical and theoretical concepts of innovation-adoption and diffusion, computer attitude, and performance. For example, indicators and measurements of computer attitudes and self-efficacy are examined relative to research questions. ICT in higher education was examined relative to teachers' role and performance. Performance indicators, measurements, and evidence of computer technology and ICT use in higher education are analyzed. Faculty performance support systems and recommendations for individual and group performance improvement are reviewed relative to better ICT integration and desired change. Chapter 3 addresses the methodology, the research design, data collection, and procedures for data analysis

CHAPTER 3

Methodology

The research design is a cross-sectional survey of three public universities and randomly sampled multidiscipline teaching staff. Computer attitude, and combined personal characteristics and ICT adoption patterns on performance, together with other explanatory factors such as incentives and drawbacks to ICT integration in higher education were examined. Mixed methods of qualitative and quantitative instruments were employed in collecting data and information. Data were analyzed using descriptive, multivariate analysis of variance (MANOVA) and multiple linear regression statistics (MRA) by means of the Statistical Package for the Social Sciences (SPSS 17.0, 18.0) and Microsoft Excel 2007. Qualitative cases were analyzed for thematic patterns and better insight.

Study Context

The field study was conducted in Ghana in three public institutions of higher education. Ghana is a tropical West African country that lies in latitude 5^0 36' North, and longitude 0^0 10' East and 2^0 West with an average annual temperature of 79^0 F. Ghana is sandwiched by 3 Francophone countries; Burkina Faso, Cote d’Ivoire, and Togo. To the south is the Gulf of Guinea and Atlantic Ocean (Figure 4). She occupies an area of 93, 087 sq miles (238, 540 sq km), slightly smaller than Oregon in the United States. Population is estimated at 24 million with a growth rate of nearly 1.9% per annum and literacy rate at 75% (National Geographic, 2009; ICT4AD, 2003). Ten administrative regions are defined with varied sizes and population densities. Greater Accra region is the seat of government and has the second highest population, next to the Ashanti region. As a commonwealth nation, the medium of instruction is English. Ghana operates on a 6-3-4-4 Educational System. Formal education commences with two years kindergarten; Primary school is 6 years; Junior High is 3 years, followed by 4 years Senior High School, and 4 years Baccalaureate. Public universities are located in almost all the administrative regions and are represented with black stars in Figure 5.

Figure 4: Location of Ghana in West Africa

Source: Adapted from www.investghana.org

Figure 5: The Administrative Map of Ghana Showing the Locations of the Public Universities in Black Stars.

Source: Adapted and modified from www.mapsofworld.com

Study Sites

The Ghana Institute of Management and Public Administration, the University of Cape Coast and the Kwame Nkrumah University of Science and Technology were surveyed. These conventional urban institutions were selected because of large population of academic staff and students, multiplicity of programs and courses, and longevity in the educational arena for over 40 years. Criteria for selection also include continuous use of ICT for over 20 years, geographical locations, and accessibility of teaching faculty. Executive and administrative position is held by the Vice-Chancellor (UCC and KNUST) and Rector

(GIMPA), which are equivalent to that of American university president. All these universities are accredited with memberships at the International Association of Universities (AIU), the Association of Commonwealth Universities (ACU), the Leagues of World Universities (LWU), and the Association of African Universities (AAU) among others. Besides, these institutions serve as sites for ICT courses and programs as well as the African Virtual University project of the World Bank. They grant academic degrees, from short-term certification to doctoral programs; however, each has its special focus.

For example, the Ghana Institute of Management and Public Administration (GIMPA) is unique as a leading management development institution and centre of excellence for training in leadership, business management and public administration. Established in 1961 as a corporate body, the institute provides the venue for discussing and resolving key contemporary national and international issues on business, public management, training, consultancy, and research. GIMPA runs undergraduate and post-graduate level degrees in Leadership, Accounting, Finance, Banking, Business Administration, Economics, Marketing, Entrepreneurship, Hospitality Management, Information and Communication Technology, and Public Administration.

Competency-based short courses are offered for career development, management, specific function and skill training in the above-stated disciplines and several others including but not limited to senior management development, health administration, and human resource, budgeting. Others are women in management, computer studies, monitoring and evaluation, and strategic planning.

GIMPA continues to maintain excellence in public and private sector middle and top level executives training programs, and other essential services to Non-Governmental

Organizations (NGOs) in Ghana and abroad. Its vision is to become the leading management development institute in sub-Saharan Africa. The Institute is located in Achimota, about 13 miles north of the city of Accra, and in close proximity to the University of Ghana, Legon. Compared to the two other universities studied, GIMPA has academic, financial and administrative autonomy and the least population of about 81 academic staff relative to the other two universities. (http://www.gimpa.edu.gh/).

The Kwame Nkrumah University of Science and Technology (KNUST) gained autonomy in 1961 as an accredited higher institution of learning. It had existed as the Kumasi College of Technology in the 1950s to grant degrees in Bachelor of Engineering and Pharmacy for the London University Certification. KNUST had a School of Architecture for Town Planning and Building at this period. The name changed in 1996 to the University of Science and Technology (UST), and later named after the First President of Ghana, Dr. Kwame Nkrumah (KNUST) posthumous in 1998. KNUST is specially recognized for excellent development programs in science and technology.

The university operates under six major colleges: College of Agriculture and Natural Resources, College of Architecture and Planning, College of Engineering (Mechanical, Chemical, Civil, and Agriculture), College of Health Sciences (including Medical School, a Teaching Hospital, Pharmacy, and Dentistry), College of Sciences (Biological and Physical), and College of Arts and Social Sciences, with many affiliated institutions such as Ghana Telecom, and the Osei Tutu Institute for Advanced ICT Studies among others.

As a member of the global consortia of universities, KNUST is collaborating with the Royal Netherlands Embassy, Heineken International, and the Ministry of Education, Sports, and Science to offer ICT programs and degrees at the master’s and doctoral levels at the Osei

Tutu Institute. This institute was established in 2002 with the purpose of developing ICT needs such as skilled human resources in support of industrial, governmental, social, financial institutions, universities, and other educational programs. KNUST is located in Kumasi in the Ashanti Region, with a population of about 27,000 students and 640 academic staff (http://www.knust.edu.gh/pages/).

The University of Cape Coast (UCC) is located in Cape Coast in the Central Region. The Cape Coast town is endowed with schools of high academic standards and some of the best senior high schools in the country. UCC was established in 1962 and attained full university status in 1972. UCC offers many courses and academic programs; however, its main focus over the years is to produce certified teachers and educational administrators at all levels of education. It is best known as "*Teachers' College*" with over 45 years of excellence service, quality teaching, research, and extension programs.

Faculties and schools include Agriculture, Arts, Education, Social Sciences, Medical, Physical and Biological Sciences, and Business. Programs offered include General Education (Primary, Secondary, and Post-secondary Teacher Certification), Educational Planning and Administration, Commerce, Home Economics, and Information and Communication Technology. Over the last decade, programs such as Optometry, Nursing, Actuarial Science, Business Administration, Labor Studies, Tourism, and Computer Science are offered.

Affiliated to UCC are many Teacher Training Colleges and specialized teachers' diploma awarding institutions. The University of Cape Coast has a population of over 35,000 students consisting of 15,000 regular students, 2,000 summer semester enrollment, and 18,000 distance education students. Teaching staff population is estimated at 400 (http://governance.ucc.edu.gh/aboutucc).

Study Participants

A total of 270 multidiscipline academic staff across all professional status was systematically sampled randomly with apt representation from GIMPA (7%), UCC (38%), and KNUST (55%) from the complete list provided by the three universities. With a return rate of 625%, a total of 167 participants were pooled together for the analysis. A 30 minute follow-up onsite interview was conducted with a subset of 17 subjects (13 regular teaching staff and 4 ICT coordinators). The venue for the interview was the interviewee's office. Prior to individual engagement, approval to conduct the field study was obtained from the Vice-Chancellors and the Rector of the institutions (see Appendix B and C for references). Academic staff was formally invited through personal contact and letters to participate in the study and respond to survey questions voluntarily.

Data Collection

Two data types were collected using questionnaire and interviews (see Appendix D & E). Both print- and electronic-based surveys were used depending on Internet access and how comfortable respondents were with the electronic medium. Print-based materials were personally administered by the principal investigator at the various university campuses to avoid unreliable mailing systems and to ensure increased return rate. Participants were provided with needed assistance to either complete the questionnaire on paper or electronically. Participants had the option to choose between the two systems. Rationale for the two delivery systems was flexibility and choice. Electronic-based material was emailed to respondents with further instruction to complete the survey using the *SurveyMonkey* platform. The survey was programmed to ensure anonymity and confidentiality of respondents. In addition, the online survey was structured to allow participants the flexibility to later change wrong responses once the data were entered before final submission, as is the case of the print-based medium. Results were reported with only codes for confidentiality. Cumulative online data were stored and downloaded for subsequent statistical analyses.

Onsite Interview: In-depth structured and unstructured questions (see Appendix E) applied in the onsite interviews with randomly selected respondents from the initial sample (subset). The purpose of the interview was to explore emerging patterns and themes in ICT adoption, implementation and practices. Structured questions examined respondents' performance in basic computer concepts, operations and applications. Open-ended questions explored opinions and views for triangulation. Responses were repeated to respondents for confirmation before reporting. Special unstructured interviews were granted by four coordinators of the ICT programs. A gesture of appreciation was extended to participants who completed the questionnaire within reasonable time. Laser-pen-pointers were given, together with Wayne State University College of Education folder with brochures on Instructional Technology Programs. Data were collected from January 20 to April 30, 2010.

Rationale for Mixed Methods

Mixed methodology was employed for its augmenting value. Both quantitative and qualitative methods connect theories and practices of scientific research and everyday psychological ideas (Rudestam & Newton, 2007). They provide accurate representation of the investigated phenomenon and increase the credibility of the results. Each method complements and builds on the strength of the other (LeCompte & Schensul, 1999; Rudestam & Newton, 2007, 2001; Todd, Nerlich, McKeown, & Clarke. 2004). However, these benefits may not be realized when different questions are used to study the same phenomenon. In addition, triangulation validates and accurately determines patterns of behavior; therefore, other extant data and sources of information such as National, Ministry of Education's policies, and the universities' ICT policy documents, pedagogical materials, newsletters, *communiqué*, and any relevant published and unpublished papers were reviewed for validity and consistency.

Instrumentation: Measurement of variables

General criterion instruments for this comprehensive study were: a) 111 structured, semi-structured and unstructured questionnaire items, and b) 15 structured and unstructured interview questions (see Appendix D & E). Questions were carefully designed, selected or modified from existing instruments to adequately respond to research questions (Jacobsen, 1998, ISTE-NETS-T, 2000; Selwyn, 1997). Modified versions of adapted instruments were pilot tested for content and construct validity by two expert reviewers and six academic staff. Validity and reliability of all measured items were tested with Cronbach's alpha (α), and the results are reported to add to the body of literature as evidenced by the study in Chapter 4.

Subscale 1: What is the demography? First section of the survey was composed of self-rated set of 13-item ordinal, nominal and interval demographic data (based on Jacobsen's, 1998; Jegede, Dibu-Ojerinde & IIori, 2007). Respondents were identified and categorized by gender (male or female), age (measured as biological years), professional status (measured as academic rank), major departments and field of specialty, years of teaching experience at the university, college level or both, primary institutional affiliations as employee, and similar items as indicated in Appendix D. Results were statistically analyzed, described and presented in texts, tables and figures.

Subscale 2: Measurement of computer attitude: The purpose of this measure was to explore the lecturers' unique computer attitude and perceptions. Modeling Selwyn's

(1997) computer attitude, the teaching staff was assessed with a 21-item 5-point Likert type scale self-rated responses from *4-Strongly Agree, 3-Agree, 2-Neutral, and 1-Disagree, and 0-Strongly Disagree*. The CAS was adopted for its high internal reliability coefficient (0.87-0.90), test-retest reliability (0.93), and significant construct validity ($p < 0.001$). It has been applied in different contexts including education (e.g. Chin, n.d.; Jegede, 2008; Jegede & Josiah, 2005; Soh, 1998a; 1998b).

Scores from each item on the four-level computer-attitudinal constructs: Perceived affective construct, perceived usefulness construct, perceived control construct, and perceived behavioral construct were totaled to represent individual scores. Summated values of the individual score were calculated as the overall attitude of the respondents towards ICT and computer technology, ranging from 0 to 84.

Results were reported as percentiles, means and standard deviations. Computer attitude is a control factor, but critical to understanding the lecturers' perceptions and behaviors towards ICT. It is hypothesized the majority of the academic staff will fall within the 75th percentile, suggesting high positive ICT/computer attitude and behaviors.

Subscale 3: Measurement of patterns of ICT/Computer technology adoption and use: ICT adoption pattern and threshold for pedagogy and research in the universities were measured, compared and contrasted with Rogers' model (2003).

A 15-self-rated item of ordinal, nominal and interval data on initial ICT adoption were collected. Participants responded to questions related to years ICT was initially accessed such as computer purchase and applications for teaching, general purpose, and research. Computer ownership, initial computer skills acquisition, average of hours spent on ICT/computer per day, and ICT use for professional work on campus, home or both were examined. Questions related to whether respondents teach ICT or computer-related subjects and at what course levels, plus roles in which they first used ICT and computer technology were responded to.

Based on self-reported initial year of ICT adoption, responses were categorized into standardized percentage scores for four different adoption patterns indicated by: a) year computer was first purchased, b) year ICT/computer was first used for teaching, c) year ICT/computer was first used for general purpose such as emailing, presentations, word processing, and similar engagements, and d) year ICT/computer was first used for research. Each of the four adoption patterns was disaggregated into five adopter categories of innovators (adoption before 1990), early adopters (1991-1995), early majority (1996-2000), late majority (2000-2005), and laggards (2006-2010). The models could not be merged for analysis due to their oddity in adoption periods; hence the four different patterns.

Results were compared with Rogers (2003; 1995) standardized innovation-adoption distribution and other models (e.g. Erumban & de Jong, 2006; Kirkup & Kirkwood, 2005; Oyelaran-Oyeyinka & Adeya, 2004; Rossi, Russo & Succi, 2007; Wheeler, 2002). Results of computer ownership, access, and acquisition of initial computer skills, roles in which participants first used computers on campus and similar questions (Appendix D, items 35-49) were analyzed, described and reported. Responses will provide insightful information on participants' ICT adoption patterns and usage.

Subscale 4: Measurement and estimation of mean differences in the ICT performance levels: The purpose of this section was to quantify respondents' ICT performance levels and examine whether significant differences existed among the mean scores of each factor level on age, gender, professional status, and academic discipline.

The content of this measurement was adapted from the ISTE-NETS-T (2000). The 2000 version of the performance standards was found appropriate for this study because it is rigorous and has applied successfully as a roadmap since 1998 in several disciplines such as education and business to assess and measure performance, skills and required knowledge in computer technology in the United States and several other countries. In comparison to the 2008 ISTE standards, the 2000 version is basic, more specific and structured in content and performance tasks, and more relational to the research needs. The version 2008 standard is new, untested, and more advanced in content and approach for the target audience.

As a measurement instrument, the 2000 ISTE standard was organized into six major categories with a total of 32 performance task items to respond to. Compound objects in the original such as "select and apply…." were separated into single and mutually exclusive items. Contents and constructions were validated through expert reviews and field testing with six participants. Items were rated on a 4-point Likert-type scale of 0-*Unable, 1-Basic, 2-Intermediate, 3-Advanced* as follows:

1. Technology operations and concepts (5 items).
2. Planning and designing learning environments and experiences (5 items).
3. Teaching, learning and the curriculum (5 items).
4. Assessment and evaluation (6 items).
5. Productivity and professional practices (5 items)
6. Social, ethical, legal and human issues (6 items).

Rating oneself *Unable* meant the respondent could not perform any of the ICT or computer technology functions. *Basic* meant respondents could perform basic ICT or computer technology functions such as word processing, downloading and uploading files, saving documents, and similar functions. *Intermediate* measured "good" performance by being able to access ICT or computer technology resources for effective teaching, learning, and research. *Advanced* measured "exceptionally good" performance with the ability to teach others most ICT or computer-technology skills for teaching, instruction and curriculum design, plus research (see Appendix D, items 50-81).

Total score on each of the ICT performance factor levels was described. Arithmetic means were computed and analyzed for differences in variability (MANOVA) based on selected personality profiles. MANOVA was used for this analysis due to the multiplicity of factors and factor levels. A multivariate model generalizes the normal distribution and allows for correlation among several variables and pattern of variances (Keppel & Wickens, 2004). The main effect for the initial multivariate analysis was significant; hence, a post hoc test was run to determine: a) which level of the dependent variables differs from the other, and b) whether significant differences existed between the means of the independent variables via univariate tests (ANOVA). The specific hypotheses validated were:

H1: The mean scores of the ICT performance factor levels are equal for each of the independent variables; age, gender, and professional status.

H2: The mean scores of the ICT performance factor levels are unequal for academic discipline.

It was assumed the within-group variances and inter correlations across subjects' group means are homogenous and scores are independent of each other for the different groups indicated. Results are reported and interpreted in Chapter 4.

Subscale 5: Estimation of the impact of personal characteristics and ICT adopter categories on performance: This estimation was to answer the question: To what extent would the combine influence of personal characteristics and adopter categories predict performance impact in ICT, and if it did, what is the strength of each of the predictors on the outcome variable in the prediction?

***Independent variables*:** The independent variables for the empirical estimate were: a) five selected personal attributes comprising age, gender, academic discipline, professional status, and years of teaching experience in a college or university, b) five adopter categories represented by innovator, early adopter, early majority, late majority, and laggards categorized by initial year of adoption such as first computer purchase, and first use of ICT or computer technology for general purpose, teaching, and research, and c) average number of hours spent using ICT or computer-technology for professional tasks.

***Dependent variable*:** The dependent variable was performance, measured as the summated score of individual ICT professional performance tasks. Scores of all the six ICT or computer technology performance tasks were totaled for this representation. It was assumed the dependent variable is normally distributed for each of the independent variables; that the mean variances are constant; and the differences between observed and predicted values of the dependent variable are linear and uncorrelated.

The specific general linear regression model of ICT performance, $PICT_{ij}$, or the Y_{ij} of the *ith* academic staff in the university *jth* is presented as

$$PICT_{ij} = \alpha + \beta_{1j}PA_{ij} + \beta_{2j}PG_{ij} + \beta_{3j}PP1_{ij} + \beta_{4j}PP2_{ij} + \beta_{5j}PP3_{ij} + \beta_{6j}PP4_{ij} + \beta_{7j}PS1_{ij} + \beta_{8j}PS2_{ij} + \beta_{9j}PS3_{ij} + \beta_{10j}PS4_{ij} + \beta_{11j}PS5_{ij} + \beta_{12j}PS6_{ij} + \beta_{13j}PS7_{ij} + \beta_{14j}PY_{ij} + \beta_{15j}NH_{ij} + \beta_{16j}IN_{ij} + \beta_{17j}EA_{ij} + \beta_{18j}EM_{ij} + \beta_{19j}LM_{ij} + \beta_{20j}L_{ij} + e_{ij} \quad (1)$$

where PICT represents the total score of ICT performance, α is the constant to be estimated, β the estimated coefficient (slope or change), PA is age (measured as biological age to the nearest uppermost years of the respondents), PG represents participants gender (whether male of female), PP is participants professional status (represented by PP1 = professor/professor emirita/emiritus, PP2 = associate professor, PP3 = senior lecturer, lecturer, and PP4 = teaching/research assistants), PS is for participants' academic discipline (measured by respondents' self-reported academic department/specialty represented by PS1 = Agriculture, PS2 = Arts/Social Science/Humanities, PS3 = Business & Management, PS4 = Computer Sciences, PS5 = Engineering, PS6 = Science/Medicine/Nursing, and PS7 = Education). PY is for years of teaching experience (measured by the number of years of teaching in a university or college), and NH is average number of hours spent on using ICT or computer technology per day. Innovator is represented by IN (measured as first ICT adoption before 1990), EA for early adopter (measured by first ICT adoption between 1991 and 1995), EM for early majority (defined by first ICT adoption between 1996 and 2000), LM for late majority (measured as first ICT adoption between 2001 and 2005), and L for laggard (defined by first ICT adoption between 2006 and 2010). The random error term with standard assumptions was represented by *e*. All qualitative variables such as gender, academic discipline, professional status, and adopter categories were coded into dummies. For example, gender is represented in the equation as 0=Male; 1=Female; academic discipline by Education=1; Otherwise=0 and repeated for other variables in this group; Early adopters=1, Otherwise=0 and repeated for other variables in this group. Dummy or coded variables are found useful because they enable the researcher to use a single regression equation to represent multiple groups (Trochim, 2006).

A priori, it was predicted that at least one of the specified independent variables will be positively associated with higher ICT performance levels, all other things being equal. For example, if the five adopter categories were measured in levels, then, their regression coefficients (βs) would be interpreted as the proportional change in performance due to an increase of one level of adopter category to another (e.g., from innovator to early adopter). Similar interpretation is applied to other personal characteristics such as age, holding other factors equal. Therefore, specific a priori expectations on the estimated parameters of equation (1) were:

$\beta1 - \beta6 < 0$

$\beta7 - \beta13 > 0$

$\beta14 - \beta16 > 0$

$\beta17 - \beta20 < 0$

That is, the coefficients of age, gender and professional status (β1–β6) will predict low and no significant impact on performance. Types of academic discipline, years of teaching experience, and average number of hours spent on using ICT or computer technology per day (β7–β13) will predict high and significant impact on performance. Innovators, early adopters and early majority (β14–β16) will predict high and significant impact on performance, and late majority and laggards (β17–β20) will have low and no significant impact on performance. In an expanded form, where H_0 is the null hypothesis and H_1, the alternative hypothesis, and HE representing higher education, the study tested the following specific hypotheses:

A. H_0: $\beta1 - \beta6=0$; H_1: $\beta1 - \beta6<0$

where

H_O: = Age has no significant impact on ICT performance in HE.

H_O: = Gender has no significant impact on ICT performance in HE.

H_O: = Professional status has no significant impact on ICT performance in HE.

B. H_0: $\beta7 - \beta13 = 0$; H_1: $\beta7 - \beta13 > 0$

where

H_I: = Academic discipline is large and significant on ICT performance impact in HE.

H_0: = Average number of hours spent on ICT/computer per day will predict large and significant on ICT performance impact in HE.

H_I: = Years of teaching experience will predict large and significant on ICT performance impact in HE.

C. H_0: $\beta14 - \beta16 = 0$; H_1: $\beta14 - \beta16 > 0$

H_I: = Innovator is large and significant on ICT performance impact in HE.

H_I: = Early adopter is large and significant on ICT performance impact in HE.

H_1: = Early majority is large and significant on ICT performance impact in HE.

D. H_0: $\beta17 - \beta20 = 0$; H_1: $\beta17 - \beta20 < 0$

where

H_0: = Late majority has no significant impact on ICT performance in HE.

H_0: = Laggards has no significant impact on ICT performance in HE.

Multiple regressions allow for more efficient simultaneous examination of the influence of the multiple factors on the dependent variable, and is considered apt for assessing complex and unique relationships (Cohen, Cohen, West, & Aiken, 2003). It also separates influences of two or more independent variables on the dependent variables for the estimation. For example, the coefficient of correlation (R^2) can be used to directly estimate the amount of variance shared by the variables (Kerlinger & Lee, 2000). Multiple regression models have been used by other studies to estimate the relationship between cultural dimensions and ICT adoption (e.g., Erumban & de Jong, 2006), the effect of professional status, subject discipline, and computer access on computer attitudes among teachers (e.g. Jegede & Josiah, 2005), and education on productivity (Larbi-Apau & Sarpong, 2010). Larbi-Apau and Sarpong used dummy variables to represent the qualitative subgroups for the study's statistical analysis.

Subscale 6: Exploring reasons for ICT adoption – Qualitative: Semi-structured and unstructured onsite interviews were conducted as a complement to the quantitative study. Open-ended questions were included for a general assessment of ICT's influence on students' learning, and teaching and research. Narrations are analyzed and reported for this subscale.

Subscale 7: Assessing incentives to integrating ICT in higher education: It is assumed that the individual makes decisions and adopts the technology innovation based on perceived attributes of the ICT innovation (Rogers, 2003). The academic staff is assumed to be motivated when incentives to adopting the ICT/computer technology are perceived better than the status quo. Apart from perceived attributes of the innovation other decisions depend on factors such as economic incentives, social prestige, time factor, personal gratification, and others explored with questions 82 to 94 (Appendix D). From *5-Very Important, 4-Important, 3-Neutral, 2-Not Important, and 1-Not very Important*, participants self-rated the extent to which these propositions influence their decisions to adopt and integrate ICT and computer-related technology for pedagogy and research. Results were subjected to descriptive analysis and reported with texts and inductive thematic summaries.

Subscale 8: Assessing challenges of ICT integration in higher education: Many researchers have reported myriad challenges to ICT or computer technology integration for teaching and learning purposes (e.g., Assié-Lumumba, 2008; Martey, 2004; Plomp, et al. 2003). Exploring this phenomenon, a self-rated 16-item 5-point Likert type scale questions from 5-*A Great Deal, 4-Much, 3-Somewhat, 2-Little, and 1-Never* were generated to identify and rate major barriers to integrating ICT in higher education. Included items were time constrain, student to computer ratio, teacher to computer ratio, inadequate computer peripherals, unstable hardware and software, inadequate provision of ICT in the general curriculum, cost and financial structures, capital infrastructure, unstable network connectivity, inadequate technical support and professional training, and lack of faculty knowledge in the convergence of ICT and online instruction, among others.

Open-ended question were asked with the purpose to discuss or expand on any item(s) by the respondents. In practice, teachers make conscious efforts and decisions to alter the curriculum or reschedule their time to eliminate or reduce potential limitations, while adjusting and increasing their ability to be successful in ICT for personal and professional practices. Emergent issues can be useful for making recommendations and future directions.

Data Analysis

Data were analyzed with SPSS 17.0/18.0 versions and Microsoft Excel 2007. Negative worded computer attitude responses were reversed and recoded before computation. Descriptive, multivariate analysis of variance (MANOVA) and simultaneous multiple regression statistics (MRA) were the major statistical approaches employed. For example, descriptive statistics were applied in categorizing ordinal and scale variables such as ICT/computer attitude assessment, adoption patterns, performance, incentives, and barrier items. Frequencies were used for ordered and continuous variables such as coded adopter categories and together with means scores in plotting distribution curves.

Mean differences in variability of ICT adopters, and other explanatory variables such as age, gender, professional status, academic discipline, and differences in the six ICT performance levels were estimated with MANOVA. The Levene's test of homogeneity of error variance was significant for age and academic discipline and nonsignificant for gender and professional status; hence, both gender and professional status were excluded from the final univariate estimations. MRA statistics was applied in the estimation of impact of selected personal attributes and adopter categories on performance. Dummy or coded variables represented qualitative data in the equation. Qualitative data comprising open-ended questions and onsite interviews were analyzed for relevant patterns and themes.

Of 270 administered questionnaires, 167 were returned constituting almost 62%. Three obviously incomplete questionnaires with several missing values were eliminated to reduce their potential influence on the analysis. Data from 164 participants were again prescreened for accuracy, outliers, missing values, and models of best fit, and were found accurate and within expected range.

In sum, this chapter has articulated the research design, methods of data collection, instrumentation, and types of data analysis. The results are presented next in chapter 4.

CHAPTER 4

Analysis and Interpretation of Results

Findings of the T-FIIPHE study are reported and interpreted in this section. Demographics, computer attitudes, four different adoption patterns of information and communication technology for research, general use, teaching, and by computer purchase are presented. Also reported and interpreted are outcomes of inferential multivariate analysis (MANOVA) of mean differences between six ICT performance factor levels and age, gender, professional status, and academic discipline, and multiple linear regression results (MRA) on the impact of selected personal profiles and ICT adoption patterns on performance. Inductive reasons, plus incentives and barriers to ICT integration in higher education are articulated.

Demographic Information

Figure 6 illustrates gender proportion of the 164 participants. Twenty-six representing about 16% are females and 138 (84%) males implying a ratio of approximately 1 to 5.

Figure 6. Gender

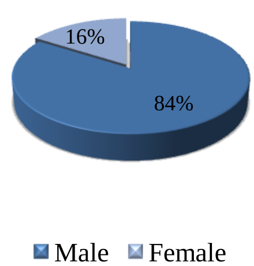
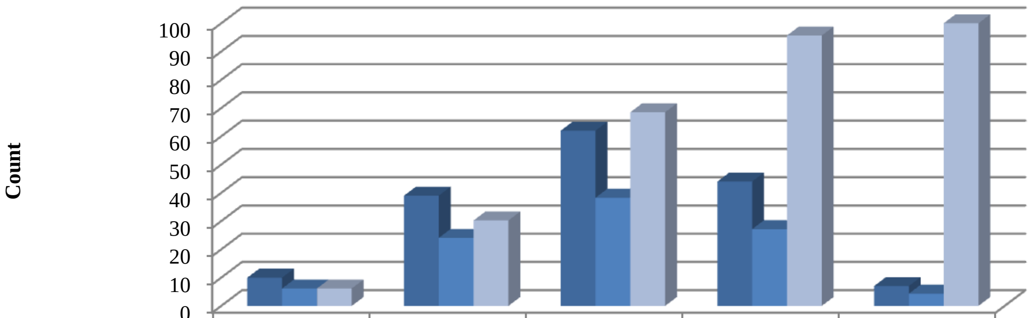


Figure 7 shows the frequency, mean, standard deviation, and percentages of respondents' age. Mean age of the group is computed at 45.4 years with a range of low 23 to a high 66 years. Total representation on this item is 162.

Figure 7. Respondents' Age

Mean = 45.41
Std. Dev= 9.605
N = 162

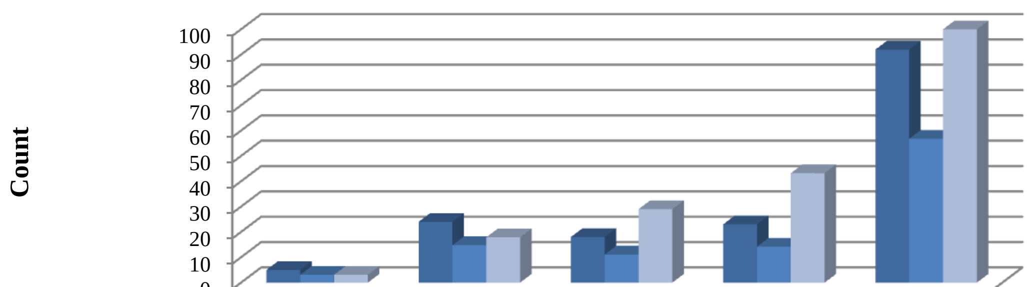


	30 or less	31-40yrs	41-50yrs	51-60yrs	60+ yrs
Frequency	10	39	62	44	7
Percent	6.2	24.1	38.3	27.2	4.3
Cumulative Percent	6.2	30.2	68.5	95.7	100.0

Age in Years

Note: Computed from survey data.

Figure 8: Administrative Positions of Academic Staff



	Deans	HODs	Exam Coordinators	HTs, ACs, Others	N/A
Frequency	5	24	18	23	92
Percent	3.1	14.8	11.1	14.2	56.8
Cummulative Precent	3.1	17.9	29	43.2	100

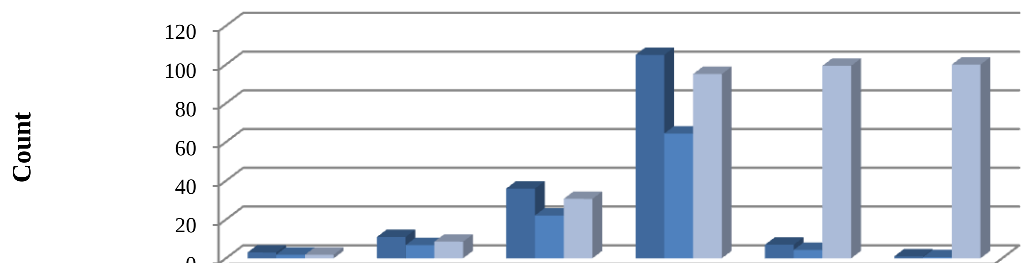
Administrative Position

Note: Computed from survey data. HOD = Heads of Departments, HTs = Hall Tutors, ACs = Academic Counselors

Figure 8 summarizes the frequency and percentage distribution of academic staff by administrative positions. In addition to holding teaching appointments, 70 (43.2%) of the respondents work as deans and heads of department, academic counselors, examination coordinators, hall wardens, and other specified jobs, although the majority of 92 (56.8%) do not. Nearly 97% holds full-time appointments, 1.8% are part-timers, and 1.2% are on short-term contracts, sabbatical or visiting as research fellows for one or two years.

Figure 9 presents the counts of respondents' professional status indicated by academic ranks. Of the 164 respondents, 3 (8.5%) are professors, 36 (23%) are senior lecturers, and 105 (87%) are lecturers. There were no professor emerita or emeritus and assistant professors. By convention, assistant professors' rank does not apply in Ghana.

Figure 9. Professional Status of the Academic Staff



	Professor	Asso. Professor	Snr. Lecturer	Lecturer	TA/RA	Snr. Research Fellow
Count	3	11	36	105	7	1
Percent	1.8	6.7	22.1	64.4	4.3	.6
Cumulative Percent	1.8	8.6	30.7	95.1	99.4	100.0

Note: Computed from survey data. Asso. = Associate, Snr = Senior, TA/RA = Teaching Assistant/Research Assistant.

Total years of teaching experience are presented in Table 1. Almost 30 percent of the respondents have 11 to 35+ years of teaching experience in the college or university level. The majority (70%) has taught between one to ten years, with a range of 3 months to 33 years. The highest frequencies occurred between 2 to 5 years, followed by 6 to 10 years.

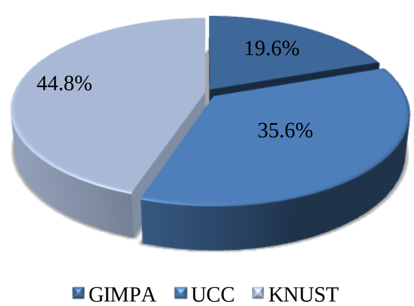
Table 1

Years of Teaching Experience in Higher Education

Years	*f*	%	Cumulative %
Up to 1	13	8.1	8.1
2 - 5	61	37.9	46.0
6 - 10	39	24.2	70.2
11 - 15	20	12.4	82.6
16 - 20	6	3.7	86.3
21 - 25	12	7.5	93.8
26 - 30	8	5.0	98.8
31 - 35	1	0.6	99.4
37+	1	0.6	100.0
Total	161	100.0	

Figure 10 shows the distribution of respondents' primary affiliated universities. The highest percentage (44.8%) was represented by the Kwame Nkrumah University of Science and Technology (KNUST), followed by the University of Cape Coast (UCC) at 35.6 percent and the Ghana Institute of Management and Public Administration (GIMPA) at 19.6 percent.

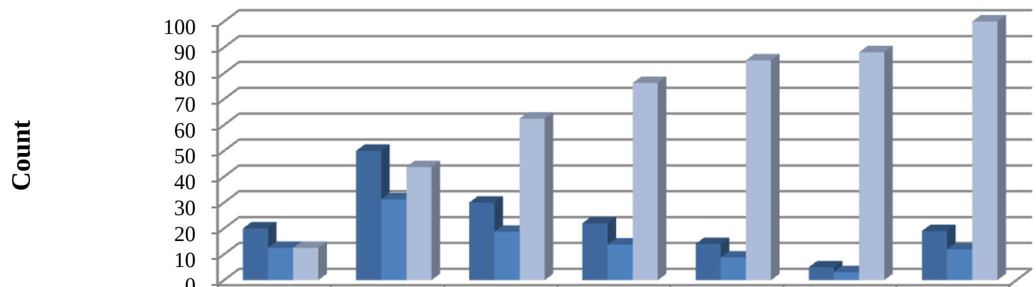
Figure 10. Academic Staff 's Afilliated Institution



This ratio is expected; however, the KNUST's return rate of administered questionnaire was lowest at 51%. GIMPA and UCC were reasonably higher at 66 and 70% respectively. Total effective response rate of pooled sample is relatively high at 62%. The total population of the teaching staff in the three institutions is estimated at 1100.

Figure 11 illustrates the distribution of self-reported academic disciplines, which were aggregated into 7 major programs as follows: Arts, Social Sciences and Humanities at 50 (31.3%), Business and Management at 30 (18.8%), Education at 19 (11.9%), and Computer Science at 5 (3.1%). Almost all respondents (approximately 94.4%) teach and supervise graduates, undergraduate students or both with estimated negligible missing data of 0.6 percent. Total representation on this item is 160.

Figure 11. Distribution of Teaching Staff by Academic Discipline



	Agric	Arts/Soc. Sc/Hum	Bus & Magt	Sc/Med/ Nur	Eng	Comp. Sc	Educ
Frequency	20	50	30	22	14	5	19
Percent	12.5	31.3	18.8	13.8	8.8	3.1	11.9
Cumulative Percent	12.5	43.8	62.5	76.3	85.0	88.1	100.0

Academic Discipline

Note: Computed from survey data. Agric = Agriculture; Arts/Soc/Sc/Hum = Arts, Social Science & Humanities; Bus & Magt = Business and Management; Sc/Med/ Nur. = Sciences, Medicine& Nursing; Eng = Engineering; Comp. Sc = Computer Science; Educ = Education.

Distribution of the average numbers of students taught per semester is reported in Figure 12. For example, 74 teaching faculty (47%) teach over 200 students, 8 teach more than 400 students, and 6 teach between 600 and 700 students per semester on the average. Computed standard deviation is largely dispersed at 151.09 with an equally large mean score of 192. The total number of respondents on this item is 156.

Figure 12. Average Number of Students Taught Per Semester

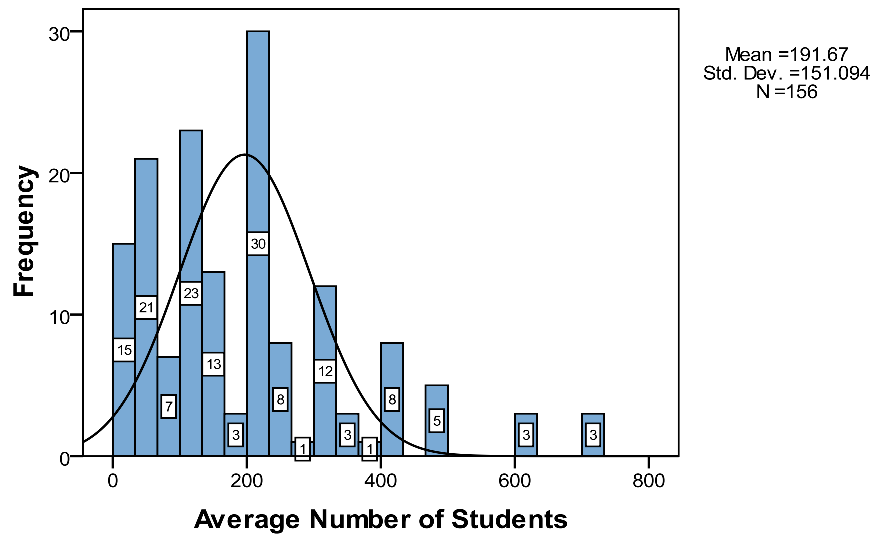
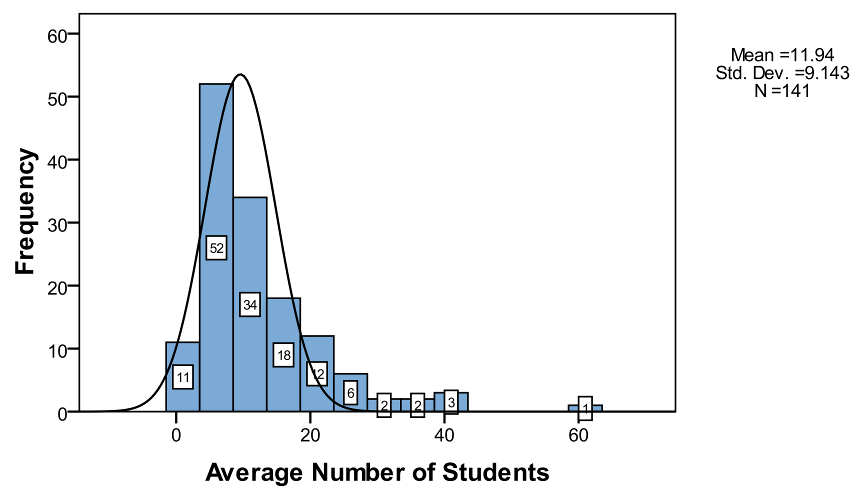


Figure 13. Average Number of Students Supervised Per Academic Year



In addition to teaching large numbers of students, majority of the participants (87.7%) also supervise students' projects, theses, and dissertations (see Figure 13). The average number of students supervised ranged from 1 to 60 students with a mean score of about 12 students per academic year. The highest frequency was computed at 52 (37%)

which is considered rather large. Twenty-six participants supervise more than 20 students' projects on the average per academic year.

Report on the total number of students supervised concludes the first general description of academic staff's demography and answers research question 1. Besides teaching and supervising large class sizes, this demographic group is evocative of any conventional higher education and institution.

Evidence of Computer Attitudes

ICT/computer attitude (ICTCAS) was examined as part of the academic staff's personal attribute. Modified Selwyn' (1997) computer attitude instrument comprising affective, usefulness, control, and behavior were tested for internal consistent reliability and the result is summarized in Table 2.

Table 2

Reliability Statistics of ICT/Computer Attitude Scale (ICTCAS)

Items	No of Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Sig.
General Computer Attitude	21	.868	.868	
Affective Component	6	.836	.836	.000
Usefulness Component	5	.865	.870	.000
Control Component	5	.734	.735	.000
Behavior Component	5	.953	.952	.000

Note: Computed from Survey Data. N = 162; $p < .001$

Results show high and significant overall percentage reliability construct validity score for *computer attitude* at Cronbach's (α) is 86.8% at $p < .01$. *Behavior component* is highest of the four constructs at 95.3%, *Usefulness component* at 86.5%, *Affective component* at 83.6%, and *Control component* at 73.4%. All scores are positive and higher than .70

suggesting good measures of retained and modified ICTCAS instrument (see Cohen, et al. 2003; Morgan, Leech, Gloeckner, & Barret, 2004).

Descriptive statistics of the computer attitude are summarized in Table 3. Faculty computer attitude (TFICTA) score was derived from a 5-point Likert type scale items that were ranged from 0 to 84. Mean score was computed at 70.84 and a standard deviation of 10.30. Total cut-off score at the 25th percentile was 65; the 50th percentile was at 73.5 and the 75th percentile at 79. Overall results ranged from a low 23 to a maximum 84 with 67 (41%) subjects scoring 70 and above.

Table 3

Statistics of Overall Computer Attitude and Comparative Affective, Usefulness, Control, and Behavior Constructs

		Computer Attitude Subscales			
Statistics	*Overall Computer Attitude*	Affective Component	Usefulness Component	Control Component	Behavior Component
N	164	163	163	164	164
Mean	70.83	21.80	17.10	15.87	16.06
Median	77.00	24.00	18.00	16.00	19.00
Mode	79.00	24.00	20.00	20.00	20.00
Minimum	23.00	9.00	0.00	6.00	0.00
Maximum	84.00	24.00	20.00	20.00	20.00
SD	10.30	3.78	3.34	2.52	5.81
Skewness	-1.38	-2.50	-1.93	-.28	-1.91
Kurtosis	3.07	6.88	5.28	.64	2.43

Note: Scores computed from survey data. N = total number; SD = standard deviation.

Of the four computer attitude constructs, the least mean score is reported for control (16 out of 20) and behavior components (16.06 out of 20). Mean score of affective component is highest at 22 out of 24. All scores are negatively skewed. The control component is the least dispersed and closest to normal distribution, while affective and usefulness components reflected the highest leptokurtic behaviors at 6.9 and 5.3 respectively. Computer attitude level was represented by a total score of 20 on 3 constructs and 24 on one construct (see Footnote of Table 3). Estimated parameters provided the building blocks for further inferential analysis and concluded the demographic information.

Evidence of Patterns of ICT Adoption

Patterns of ICT adoption were examined to answer research question 3 (Appendix D, items 35 to 49). Respondents self-reported on initial ICT adoption by indicating years they first purchased computers and integrated ICT for teaching, general use, and research in higher education. Comparative descriptive statistics are presented in Table 4.

Table 4

Descriptive Statistics of ICT Adoption Patterns of Computer Purchase, General Use, Teaching, and Research

	Four ICT Adoption Patterns			
Statistics	Year first purchased	Year first general used	Year first used for teaching	Year first used for research
N	157	159	142	158
Mean	3.46	2.75	4.06	3.16
Median	4.00	3.00	4.00	3.00
Mode	4.00	3.00	4.00	3.00
SD	1.065	1.091	.944	1.034
Variance	1.135	1.189	.890	1.068
Skewness	-.568	-.137	-.987	-.406
Kurtosis	-.314	-.817	.907	-.284
Range	4.00	4.00	4.00	4.00
Minimum	1.00	1.00	1.00	1.00
Maximum	5.00	5.00	5.00	5.00

Note: Computed from survey data.

Mean, median, and mode are fairly close, suggesting little dispersion for all four adoption patterns; however, the least dispersed is general use adoption pattern. The standard deviations are almost equal to plus or minus one (e.g., 1.065, 1.091, -.944, and 1.034 in Table) implying nearly 34 percent of the scores are one standard deviation above or below the computed mean score. Skewness is negative and markedly, low (e.g., -.568, -.137, -.987, and -.401) for all four adoption patterns. Missing data on these items were highest for ICT adoption pattern for teaching (13%) and lowest for general use (3.7%).

Table 5 shows comparative distribution of frequency and percentages of the four ICT adoption patterns indicated by computer purchase, general use, teaching, and research. Each is described, compared and contrasted with the standardized normal distribution and that of Rogers' (2003, 1995) innovation-adoption model.

Table 5

Comparative Frequency, Percentage and Cumulative Percentage of Adoption Patterns of Computer Purchase, General Use, Teaching, and Research by Adopter Categories

		Distribution of the Four ICT Adoption Categories														
		Innovators (Before 1990)			Early Adopters (1991-1995)			Early majority (1996-2000)			Late majority (2001-2005)			Laggards (2006-2010)		
Adoption Patterns	N	*f*	%	Cum%	*f*	%	Cum%	*f*	%	Cum%	*f*	%	Cum%	*f*	%	Cum%
Computer Purchase	157	8	5.1	5.1	23	14.7	19.9	36	23.1	42.9	68	43.6	86.5	21	13.5	100.0
General use	159	27	17.0	17.0	33	20.8	37.7	57	35.8	73.6	37	23.3	96.9	5	3.1	100.0
Teaching	142	3	2.1	2.1	5	3.5	5.6	26	18.3	23.9	55	38.7	62.7	53	37.3	100.0
Research	158	13	8.2	8.2	23	14.6	22.8	58	36.7	59.5	53	33.5	93.0	11	7.0	100.0

Note: Computed from survey data, N = 164. Cum = Cumulative, *f* = Frequency, N = Number of respondents..

Adoption by computer purchase: Frequency and percentage scores for innovators by computer purchase are estimated at 8 (5.1%), early adopters at 23 (14.7%), early majority at 36 (23.1%), late majority at 68 (43.6%), and laggards at 21 (13.5%). Compared to the standard normal distribution, innovators' percentage score in the study is higher by about 3 percent, early adopters by 1%, and late majority by 9%. Both early majority and laggards' percentage scores are lower than that of Rogers' and the standardized normal curve. Recall, Rogers' (2003. 1995) adopter distribution constitutes innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16.0%). Cumulative ICT adoption through computer purchase is calculated at 86.5% by the end of 2005 implying a substantial increase of 81.4% adoption from the 1990s.

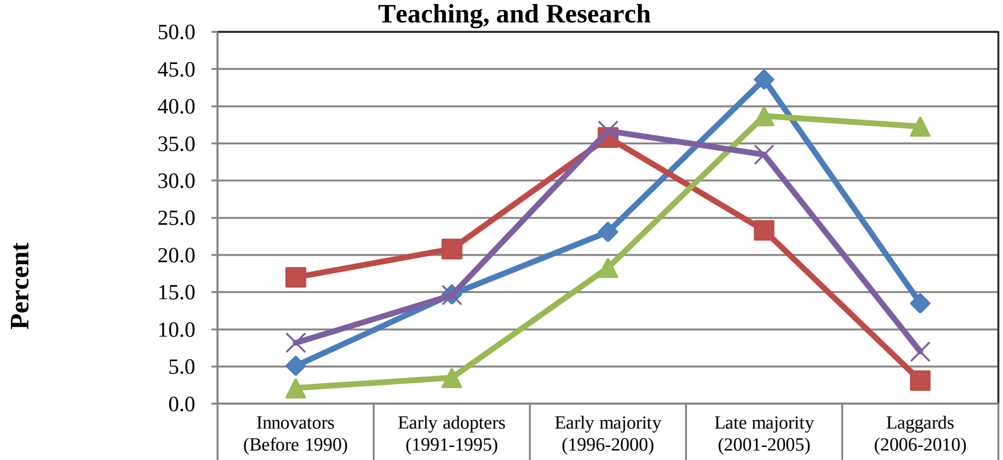
***Adoption for general use*:** Results in this category shows a highest frequency and percentage scores for early majority at 57 (35.8%) followed by late majority at 37 (23.3%). Percentage scores of early majority and late majority are comparable, but slightly higher than that of Rogers'. On the other hand, the frequency and percentage scores of laggards are the least at 5 (3.0%) suggesting a decline in ICT use for general purpose over the years and a possible shift to more professional oriented activities. Disparity in laggard score relative to Rogers' is large at almost 13%; however cumulative percentage over 15 years (before 1990 to end of 2005) is almost 97%, showing an increased ICT adoption for general use by about 84%.

Adoption for teaching: Scores of adoption pattern indicated by the year ICT or computer technology was first used for teaching suggest that the majority of the faculty (134) constituting almost 94% adopted ICT for teaching by 1996 through 2010. An interesting finding is the fact that percentage adoption of ICT for teaching before 1990 (innovators) are comparatively higher than the standardized distribution by about 2.1%. Results also show ICT adoption trend for teaching increased at an exponential rate over time. For instance, the frequency score before 1990 increased from 2.1% to 39% by 2005. Despite this increasing trend, the cumulative adoption over this period is comparatively the least of the four adoption patterns at 60.6%.

Adoption for research: Frequencies and percentages of adoption pattern of year ICT or computer was first used for research are highest for early majority at 58 (36.7%) and late majority at 53 (33.5%) compared to the other three adoption models. Both scores are comparable to Rogers' (2003, 1995) and the standardized normal distribution. In comparison to the three adoption patterns, the cumulative adoption for research is the largest at 93% by 2005; from the initial 2.1% before 1990. Substantial 41% adoption rate is computed between 2001 and the first quarter of 2010 (see Table 5).

Undeniably, differential adoption thresholds are observed in all four models. It is important to note the total number that responded to first purchase of computers, ICTs for general use and research are more than the respondents for teaching. In addition, innovators who used ICT for general tasks before the 1990 (27) are about twice the number of those who used ICT for research (13), and nine times of those who used it for teaching (3) at the same period. For instance, by 2005, almost 97% of academic staff were using ICT for general tasks such as emails, presentations and word processing, compared to 89 (63%) for teaching, and 147 (93%) for research. Almost 89 (57%) respondents purchased computers between the 2001 and 2010, and 108 (76%) adopted ICT for teaching by the same period. In contrast, only 5.6% had used ICT for teaching by 1995. However, the number for teaching increased substantially to almost 63% by 2005, and these results are consistent with similar studies that showed significant increase in computer and ICT adoption rates for pedagogy and research in higher education (e.g. Kirkup & Kirkwood, 2005; Oyelaran-Oyeyinka & Adeya, 2004; Rossi, Russo & Succi, 2007). Results are illustrated in Figure 14.

Figure 14. ICT Adoption Patterns of Computer Purchase, General Use, Teaching, and Research

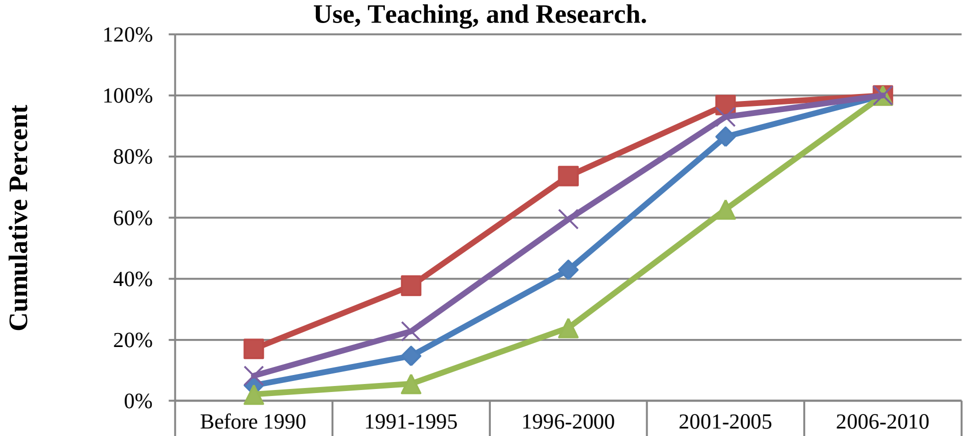


	Innovators (Before 1990)	Early adopters (1991-1995)	Early majority (1996-2000)	Late majority (2001-2005)	Laggards (2006-2010)
Computer Purchase	5.1	14.7	23.1	43.6	13.5
General use	17.0	20.8	35.8	23.3	3.1
Teaching	2.1	3.5	18.3	38.7	37.3
Research	8.2	14.6	36.7	33.5	7.0

Adopter Categories Over Time

Note: Computed from survey data

Figure 15. Cumulative ICT Adoption Patterns of Computer Purchase, General Use, Teaching, and Research.



	Before 1990	1991-1995	1996-2000	2001-2005	2006-2010
Computer purchase	5%	15%	43%	87%	100%
General use	17%	38%	74%	97%	100%
Teaching	2%	6%	24%	63%	100%
Research	8%	23%	60%	93%	100%

Time

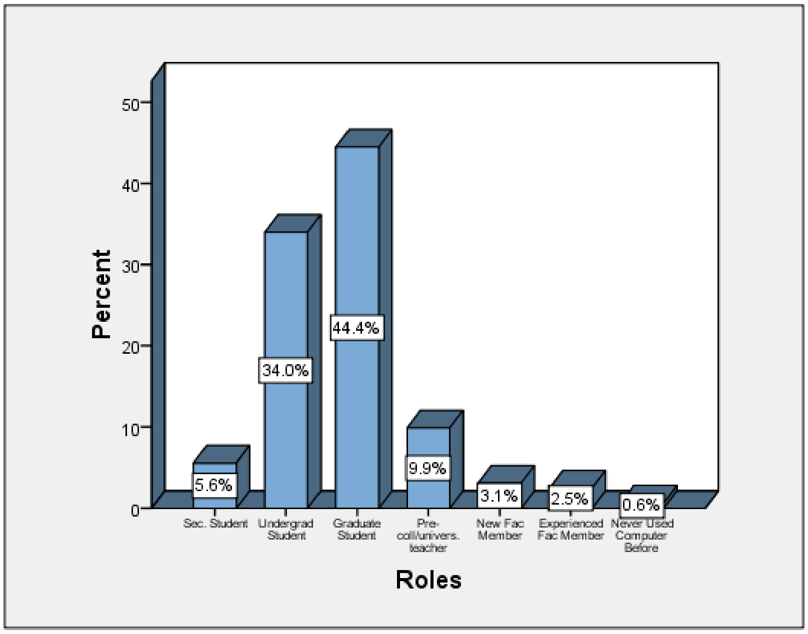
Note: Computed from survey data

Figure 15 illustrates the four cumulative percentages of the ICT adoption patterns over time, which are found to be consistent with Rogers' (2003, 1995) Sigmoid-shaped cumulative adoption model. ICT adoption for general use peaked in the 2000s and plateau after 2005. In contrast, ICT adoption for teaching seems to be increasing exponentially after 2000 with a slow start before 1990. The pattern of adoption by research is characterized by sharp increase in the 1990s and peaked in the mid-2000s. Information and communication technology use for all these tasks are, however, still evolving and characterized by player mobility, personal choice, and types of operations.

Patterns of computer access and use: Further questions were asked to explore ICT adoption patterns and applications. Results indicate teachers use ICT to engage in multi-tasks such as teaching, research, collaboration, grading, and assessment of students from home and on-campus. On the average, approximately 63% of the participants use computers at home, while about 76% use them on campus for professional engagements. Computers have become part of daily life, and this observation is not surprising that professionals would extend work hours at home. However, scores on campus and home are widely dispersed with standard deviation scores at 28.5 and 20.7 respectively.

Again, of 160 participants, 158 (99%) reported they own personal computers, while a negligible proportion of 2 participants (1.3%) indicated they did not at the time of survey. In addition, 75% have ready access to computers including teaching and research software on campus, and 24% did not. The majority of 149 (91%) had exclusive access to ICT/computer technology for professional tasks on campus. The exclusive category defines whether computer was shared or not shared with others in the same office or department. Of 163 respondents, 35.6% (70) personally do purchase teaching and research software for use, while the majority (55.2%) does not purchase any of these items. Those who did not explained that these items are costly and unaffordable since they are all imports.

Figure 16. Roles in Which Computer Was First Used for Professional Practice

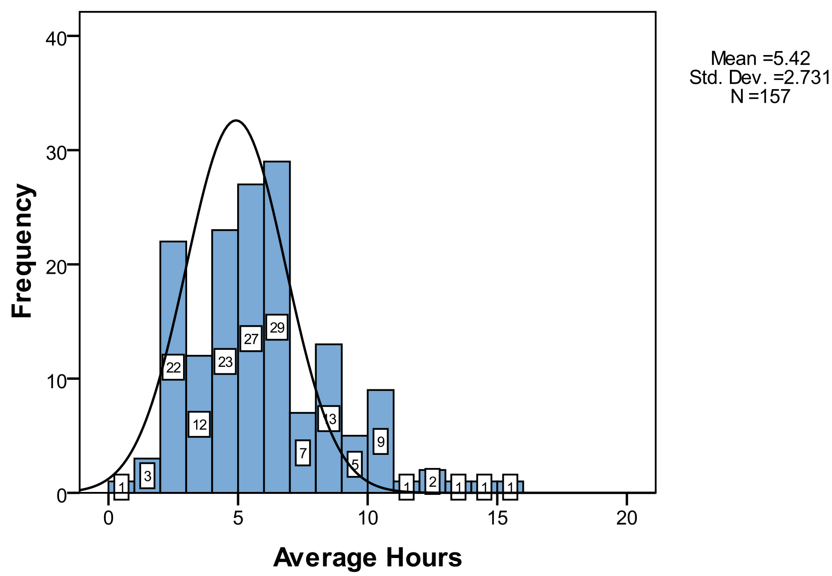


Note: Computed from survey data. Sec. Students = secondary students, Fac = faculty.

Figure 16 presents percentage responses to the roles in which the teaching staff first used computers or ICT for professional practices on campus. The majority (84%) self-reported they used computers as students, and the distribution is as follows: 72 representing 44% used ICT/computers for the first time as graduate students, 55 (34%) as undergraduate students, and 6% as secondary (high) school students. Fifteen percent used ICT for teaching for the first time as teachers in pre-college and university levels, and a negligible percent (0.6%) reported they had never used computers at the time of survey.

Figure 17 shows the distribution of average hours spent on the computer per day. This variable is hypothesized as one of the most influential factors on ICT/computer performance impact. On the average, the staff commits about 5 hours per day on the computer for professional tasks, personal engagements or both with a low minimum of zero hours to a highest of 15 hours per day. Approximately 70% spend 5 to 7 hours per day on ICT and computer technology. In addition, nearly 27% formally teach or have taught computer science or ICT-related subjects at pre-high school, high school, undergraduate, graduate levels or in some combinations. However, the majority responded “no” or “not applicable” to teaching or had ever taught ICT or related subjects.

Figure 17. Average Hours Spent on ICT/Computer Per Day



Evidence of Mean Differences in ICT Performance Levels

The information and communication technology performance assessment instrument (ICTPAI) yielded high internal consistency reliability. The Cronbach’s alpha on standardized items was computed at 97.9% and construct validity at 99% significance level ($p < .01$; N=163) on 21 performance tasks. Results of the six ICT performance subscales also yielded high value estimates of a minimum 88.8% to a highest 95.5%, and were found to be consistent with the total performance scores. For example, the reliability scores for *Technology operations and concepts* was computed at 92.3% (N=163), *Planning and designing learning environment* at 92.1% (N=159), *Teaching, learning and curriculum design* at 95.5% (N=159)), *Assessment and evaluation* at 93.6 percent (N=160), *Productivity and professional practice* at 88.8 percent (N=161), and *Social, ethical, legal, and human issues* at 92.5 percent (N=159), all at the $p < .01$.

Table 6 presents the descriptive statistics of the ICT performance factor and levels. The overall performance mean score is computed at 80.18 and widely dispersed at a standard deviation of 22.65. Lowest mean score is calculated for social, ethical, legal and human issues (SELH) at 13.25 and is the most widely dispersed. In contrast, technical operations and concepts (TOC) is close at a standard deviation of 3.65 with the highest mean score at 12.72. All other mean scores operate from approximately 12 to 14 and standard deviation within 3.65 to 4.41. Total responses varied from 159 to 164.

Table 6

Statistics of ICT Performance Factor and Levels (ICTPFL)

	ICT Performance Scores		
Performance Variables	Mean	SD	N
Overall Performance level	80.18	22.65	164
Technology operations and concepts (TOC)	13.96	3.65	163
Planning and designing learning environment and Experiences (PDLEE)	12.84	3.97	159
Teaching, learning and curriculum design (TLC)	12.72	4.32	159
Assessment and evaluation (AE)	15.20	5.00	160
Productivity and professional practice (PPP)	12.77	3.92	161
Social, ethical, legal, and human issues (SELH)	13.25	4.81	159

Note: Data from computed from ICT study survey. Maximum possible score for overall performance = 128; TOC = 20; PDLE = 20; TLC = 20; AE = 24; PPP = 20; SELH = 24.

Table 7

Statistics of Gender, Age, Professional Status, Academic Discipline, and Six ICT Performance Factor Levels

		Six ICT Performance Categories											
		Technology Operations and Concepts		Planning and Designing Learning Environment		Teaching, Learning and Curriculum		Assessment and Evaluation		Productivity and Professional Practice		Social, Ethical, Legal, & Human Issues	
Independent Variables	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gender (N = 160													
Female	26	13.81	2.80	12.42	3.61	12.42	3.61	15.15	4.50	12.69	3.59	13.31	3.93
Male	134	14.04	3.80	12.95	4.42	12.79	4.42	15.16	5.14	12.81	3.97	13.22	4.96
Age (N = 158)													
≥ 30 years	9	16.67	1.94	15.44	5.07	14.67	5.07	17.00	4.5	15.22	2.99	15.44	4.69
31-40 years	38	15.00	3.50	14.05	3.86	14.05	3.86	16.95	4.37	13.61	3.58	14.29	4.85
41-50 years	60	14.00	3.36	12.87	3.97	13.07	3.97	15.60	4.88	13.30	3.69	13.77	4.43
51-60 years	44	13.05	3.85	11.73	4.19	11.66	4.19	13.73	4.84	11.73	3.79	12.07	4.75
60+ years	7	10.86	4.45	9.57	1.96	6.29	1.96	7.43	3.36	6.86	2.85	6.71	.95
Professional Status (N = 160)													
Professor	3	14.67	4.58	14.67	5.13	10.67	5.13	12.00	5.20	11.33	4.73	13.00	5.20
Associate Professor	11	13.18	4.51	13.00	4.05	12.82	4.05	14.91	5.39	13.00	5.08	13.73	4.82
Senior Lecturer	36	14.19	4.27	13.00	4.54	12.33	4.54	14.86	6.86	12.78	3.98	13.25	5.80
Lecturer	102	14.09	3.43	12.84	4.21	13.15	4.21	15.48	4.77	12.94	3.84	13.42	4.49
TAs/RAs	7	13.29	3.15	12.14	3.98	10.14	3.98	14.14	4.60	11.57	2.07	10.86	3.24
Research Fellows	1	10		8.00		8.00		12.00		8.00		6.00	
Academic Discipline (N = 157)													
Agric	20	12.85	3.62	11.20	3.19	11.80	3.19	12.00	5.20	11.33	4.73	13.00	5.20
A.S.H	50	13.68	3.25	12.08	4.04	12.16	4.04	14.91	5.34	13.00	5.08	13.73	4.82
Business & Management	27	13.59	3.52	13.26	4.30	12.48	4.30	14.86	5.87	12.76	3.98	13.25	5.80
Sc. Med. Nur	22	14.64	3.46	12.95	4.35	11.95	4.35	15.48	4.78	12.94	3.84	13.42	4.49
Engineering	14	16.93	2.81	16.21	2.47	17.50	2.47	14.14	4.60	11.57	2.07	10.87	3.24
Comp. Sc	5	17.60	3.36	16.60	4.22	16.60	4.22	12.00		8.00		6.00	
Education	19	12.58	4.11	11.26	4.42	11.26	4.42	15.16	5.04	12.79	3.90	13.24	4.80

Note: Computed from survey data; TAs/RAs = teaching and research assistants; A.S.H = Arts/Social Science/Humanities; Sc.Med.Nur = Science/Medicine/Nursing; Comp. Sc = Computer Science.

While MANOVA was used to analyze significant differences in the group means of the six performance factor levels, a simultaneous multiple regression applied in the estimation of combined personal characteristics and ICT adoption patterns on total performance impact. Results of these multivariate analyses are presented next. Table 7 shows the summary of the descriptive statistics of the ICT performance factor levels by gender, age, professional status, and academic discipline.

Gender: Gender effects are indicated in the results. Males, in general, showed higher mean scores for 5 out of the 6 ICT performance factor levels with the highest mean recorded for assessment and evaluation at 15.2 followed by technology operations and concepts at 14.0. Females; however, perform better than males in social, ethical, legal, and human (SELH) issues with a modest mean score of 13 out of 24 maximum. Although, it seems males performed relatively better, the differences in the mean scores for males and females are negligible, indicating no substantial difference between the two. For instance, the mean score for assessment and evaluation is 15.15 for females compared with that of males at 15.16.

Age: Mean scores for ages 30 years and below were consistently highest for all 6 sub performance levels; from a minimum 14.7 for planning and developing the learning environment to a maximum 17 on assessment and evaluation. However, mean scores across all six categories are inversely related to age, suggesting decreasing performance levels with increasing age of the academic staff. For instance, the mean score for the technology operations and concepts is decreased from 16.7 for age 30 years old and below to 15 for ages 31-40 years, 14 for ages 41-50 years, 13 for ages 51 to 60 years, and 11 for ages 60+ years. Similar trends are observed in all other ages and performance levels in this estimation.

Professional Status: With regard to professional status, the professor variable produced two highest mean scores on technology concepts and operations, plus planning and developing the learning environment at 14.7 apiece. Associate professors scored highest in two other levels: Productivity and professional practice at a mean of 13 and social, ethical, legal, and human issues at almost 14 on the average. Lecturers performed best in the two other performance levels with mean scores of 13 for teaching, learning and curriculum, and 15.5 for assessment and evaluation. Results suggest no substantial differentiation of ICT performance based on perceived social or academic ranks.

Academic discipline: Mean scores are varied across academic disciplines with almost each discipline scoring highest in one or two ICT performance task levels, except for Agriculture. For example, Computer Science scored highest on technical operations and concepts at 17.6 on the average and 16.6 for planning and developing learning environment and experiences (PDLEE). Engineering dominated for PDLEE at a mean score of 17.5, while Science, Medicine, and Nursing performed highest in assessment and evaluation at 15.5. Besides, the mean scores were highest for Arts, Social Science and Humanities on social, ethical, legal, and human issues (SELH) at 13.7, in addition to, productivity and professional practice at 13.0.

In summary, the mean scores differed for groups formed by the independent variables (gender, age, professional status, and academic discipline) on the dependent variables (six ICT performance factor levels); hence, the hypothesis that all mean scores for the group are equal is rejected for this estimation.

Rejecting the a priori hypothesis of equal differences meant a post hoc test for significance of group differences in magnitude. Results of MANOVA and ANOVA indicated by each univariate test of Wilks' lamda (λ) F ratios are summarized in Table 8. Gender and professional status were eliminated for this estimation due to initial nonsignificant results. Results show the mean differences on age and academic discipline and the six performance factor levels are varied and positive, from a minimum score of .58 to a maximum of 6.86.

Table 8

Multivariate and Univariate Statistics of Variance of Age, Academic Discipline, and Performance Factor Levels

		ANOVA (Dependent Variables)					
Independent Variables	*MANOVA*	Technical Operations and Concepts	Planning and Developing Learning Environment	Teaching, Learning and Curriculum	Assessment and Evaluation	Productivity, Professional and Practice	Social, Ethical, Legal and Human Issues
Age	F(4, 153)	F(4, 153)	F(4, 153)	F(4, 153)	F(4, 153)	F(4, 153)	F(4, 153)
	1.84***	4.24***	4.30***	6.95	7.68	7.40	5.54
Eta-squared	.069	.10	.10	.15	.17	.16	.13
Academic Discipline	F(6, 150)	F(6, 150)	F(6, 150)	F(6, 150)	F(6, 150)	F(6, 150)	F(6, 150)
	1.74***	3.74***	4.14***	5.07***	3.35***	3.81***	4.15***
Eta-squared	.068	.13	.14	.17	.12	.13	.14

Note: F ratios are Wilks' approximation of Fs; ***p < .01; MANOVA = multivariate analysis of variance; ANOVA = univariate analysis of variance.

Statistically significant variability in mean differences is detected for technical operations and concepts at F(4, 153) = 4.24 and for PDLEE at F(4, 153) = 4.30 on age at p < .01 suggesting dominating performance by males on these two items over females. In contrast, mean differences were significant on all six levels of ICT performance for academic discipline at p < .01. Again, the results indicate teaching, learning and curriculum (TLC) is significantly highest at F(6, 150) = 5.07 compared with assessment and evaluation at F(6, 150) = 3.35 for academic discipline factors. In general, the a priori prediction that the mean scores of the six ICT performance factor levels will differ significantly by differences in age is strong and partially supported by 2 out of 6 factors; however, prediction on mean differences in academic discipline on all six ICT performance are strong and totally supported (6 out of 6).

The Eta-squared (η^2) is calculated within a range 10 to 17 percent for age and 11 to 17 percent for academic discipline, which means overall variance (effect + error) is accounted for by the margins within these ranges for each contrast variable indicated. Eta-squared measures the strength of association between the dependent and independent variables for significant ANOVA effects, and is described as medium on each contrast of age and academic discipline in the ANOVA estimates (see Table 8).

Evidence of the Impact of Personal Characteristics and ICT Adopter Categories on Performance (T-FIIPHE)

Given that performance is a function of variations in personal characteristics and ICT adoption categories, four simultaneous multiple linear regressions were run. Personal characteristics were represented by age, gender, and total years of teaching experience, professional status, and academic discipline. ICT adoption categories were represented by innovators, early adopters, early majority, late majority, and laggards in the four models of:

1. Computer purchase
2. General use
3. Teaching
4. Research

Also considered in the equation is the average number of hours spent using ICT or computer technology per day. Two results are presented in each case: a) correlation matrix and descriptive statistics in Appendices G, H, I, and J, and b) multiple regressions outcomes in Tables 9, 10, 11 and 12. Reported in each MRA table are the partial regression coefficients (βi's), unstandardized (B) scores, standard error (SEB), *t* and *F* values that report significant testing and cell mean differences. Each MRA is reported separately.

***Pearson correlations of the MRAs*:** Using the correlation matrix presented in Appendix G as a model, all MRA results are explained relative to negative and positive correlates. Negative independent values are explained as inverse relationships with the dependent variables. For instance, the negative correlations in MRA1 indicated by total years of teaching, professors, and senior lecturers (-.135, -.032 and -.054 respectively) imply negative relationship with ICT performance. The age variable implies growing older could result in possible lowered ICT performance or its rejection and vice versa. Similar inverse relationships apply to all variables with negative signs. The first MRA is represented by all variables indicated plus adopter category of computer purchase in the estimation.

Positive correlations imply increased or enhanced performance for the indicated independent variable(s). For example, correlations for Engineering and Computer Science are positively (.312 and .226 respectively) correlated with ICT performance, and imply possible increased ICT utilization and performance of teaching faculty who enter these academic disciplines compared to others such as Education. However, that is not to suggest teachers in other disciplines cannot learn to use the ICT tools effectively for professional practices. Similar positive relationships apply to all variables with positive signs (Appendix H, I and J).

Performance impact: Moderate to large statistical significant ICT performance impact are reported for a set of six predictor variables comprising age, average number of hours spent on ICT per day, Engineering, and Computer Science at $p < .01$ (99% significance level), and lecturers and early adopters at p < .05 (95% significance level) in MRA 1. Partial regression coefficient (β) for age is -.36 (36%) while average number of hours spent on ICT or computer technology is.29 (29%), meaning, age and average number hours spent on ICT per day predicted significant and large ICT performance impact. Table 9 presents the regression results of MRA1.

Table 9

Multiple Regression Results for Gender, Age, Teaching Experience, Average Number of Hours Spent on Computer Per Day, Professional Status, Academic Discipline, and Computer Purchase Adoption Pattern on ICT Performance (MRA1)

Independent Variable	*B*	*SEB*	*β*	*t*
Constant	79.09	12.19		6.491
Personal Characteristics				
Gender	7.01	4.34	.12	1.62
Age	-.86	.26	-.360***	-3.36
Years of teaching experience	.28	.34	.10	.84
Average number of hours spent on ICT/computer per day	2.31	.63	.291***	3.66
Professional Status				
Professors	14.55	14.72	.09	.99
Associate Professors	18.89	11.40	.20	1.66
Senior Lecturers	13.69	8.93	.26	1.53
Lecturers	15.69	7.85	.342**	2.00
Academic Discipline				
Agriculture	2.74	5.62	.04	.49
Business & Management	-.70	4.92	-.01	-.142
Science/Medicine/Nursing	.94	5.08	.01	.185
Engineering	19.49	5.91	.262***	3.30
Computer Science	26.46	9.24	.220***	2.86
Education	7.95	5.50	.22	1.45
ICT Adoption by Computer Purchase				
Innovators	15.18	9.21	.12	1.65
Early adopters	16.26	6.57	.261**	2.47
Early majority	4.63	5.81	.09	.80
Late majority	3.56	5.16	.08	.69
Durbin-Watson Test	1.944			
Max. VIF ≤ 6.262				

Note: Computed from survey data. Dependent variable = performance (4-Advanced, 3-Intermediate, 2-Basic. 1-Unable); N = 145; R^2 = .403; Adjusted R^2 = .318; F = (18, 126) = 4.74; **p < .05; ***p < .01. Arts/Social Science/Humanities was highly correlated with Education; hence, was eliminated for the model of best fit. VIF = Variance Inflation Factor.

Result is interpreted for age as a 36% proportional change in ICT performance due to a proportional unit change in age levels (e.g., from the level 31-40 years old to 30 years or below) on the margin. This regression coefficient results are not suggestive of causality of change in ICT performance impact by these variables. Contrasting the result of age, a proportional change of 29% in ICT performance is estimated by additional one percent change in average number of hours spent on the ICT/computer per day with all other factors fixed. For the adopter variables, only early adopters (1991-1995) predicted positive and statistically significant change in ICT performance, $\beta = .26$ at 95% significant level ($p < .05$) holding all other conditions fixed. In other words, early adopter is associated with a 26% change in performance for each unit increase in ICT adopter level, when all other factors are fixed. Contrary to prediction on this estimate, age and lecturer factors are significant estimators of performance impact. Also results of average number of hours spent on ICT or computer technology per day and early adopter variables on ICT performance strongly support the a priori prediction.

The beta (β) score or standardized regression coefficient explains the degree of strength of the independent variable and can be negative or positive; the higher the beta value, the greater the impact of dependent variable on the independent variable. The proportion of the variance R^2 in this model is .403, which implies approximately 40% of the variability in ICT performance is explained by the combined influence of age, average number of hours spent on ICT/computer per day, lecturers, Engineering, Computer Science, and early adopters by computer purchase, holding other factors fixed. No correlated error term problems and multicollinearity were detected (Durbin-Watson = 1.944; max VIF $\leq$ 6.262). The Variance Inflation Factor (VIF) provides an index of the amount that the variance of each regression coefficient is increased relative to a situation in which all of the predictor variables are uncorrelated (Cohen, et al., 2003).

Table 10

Multiple Regression Results for Gender, Age, Teaching Experience, Average Number of Hours Spent on Computer per Day, Professional Status, Academic Discipline, and General Use Adoption Pattern on Performance (MRA2)

Variable	*B*	*SEB*	*β*	*t*
Constant	77.996	12.638		6.17
Personal Characteristics				
Gender	7.557	4.544	.130	1.66
Age	-.706	.253	-.295**	-2.80
Years of Teaching experience	.109	.352	.038	.310
Average number of hours spent on ICT/computer per day	2.523	.650	.317***	3.88
Professional Status				
Professor	15.585	15.155	.101	1.03
Associate Professor	25.019	11.881	.244**	2.11
Senior Lecturer	15.578	9.323	.304	1.67
Lecturer	14.225	8.303	.312	1.7
Academic Discipline				
Agriculture	.373	5.820	.005	.06
Business and Management	-1.488	4.927	-.026	-.30
Science/Medicine/Nursing	1.392	5.142	.023	.27
Engineering	20.426	6.098	.275***	3.35
Computer Science	25.521	9.333	.212**	2.73
Education	6.496	5.684	.095	1.14
ICT Adoption by General Use				
Innovators	8.653	5.628	.147	1.54
Early adopters	-.025	4.502	.000	-.01
Late majority	-.876	4.345	-.017	-.20
Laggards	-10.429	12.057	-.068	-.87
Durbin-Watson Test	1.891			
Max. VIF ≤ 5.782				

Note: Computed from survey data. Dependent variable = performance (4-Advanced, 3-Intermediate, 2-Basic. 1-Unable) N = 146; $R^2 = .368$; F = (18, 128) = 4.149; **p < .05; ***p < .01. Arts/Social Science/ Humanities and early majority were eliminated from the final equation of best fit. VIF = Variance Inflation Factor.

Table 10 summarizes the MRA2 results where the adopter category is represented by ICT for general use. Results show ICT performance impact is accounted for by a combination of age, average number of hours spent on computer per day, associate professor, Engineering, and Computer Science at p < .05 and p < .01 levels holding other factors constant. For example, estimated standardized coefficients of average hours spent on ICT or computer technology per day is significant and largest (β = .317; p < .01), which explains a proportional 30% change in ICT performance due to a proportional change in one unit of average number of hours spent on computer per day, all other factors fixed. Again, the coefficient of age is negative and statistically significant, while scores on adopter categories are mixed and nonsignificant.

Table 11

Multiple Regression Results for Gender, Age, Teaching Experience, Average Number of Hours Spent on Computer per Day, Professional Status, Academic Discipline, and Teaching Adoption Pattern on Performance (MRA3)

Variable	*B*	*SEB*	*β*	*t*
Constant	116.737	16.305		7.160
Personal Characteristics				
Gender	4.941	4.479	.086	1.103
Age	-.831	.251	-.363***	-3.307
Years of teaching experience	-.025	.349	-.010	-.072
Average number of hours spent on ICT/computer per day	1.399	.664	.182**	2.108
Professional Status				
Professor	8.828	14.514	.062	.608
Associate professor	12.020	12.380	.128	.971
Senior lecturer	11.459	9.667	.236	1.185
Lecturer	7.630	8.895	.174	.858
Academic Discipline				
Business and Management	-3.413	4.874	-.060	-.700
Science/Medicine/Nursing	2.396	4.921	.041	.487
Engineering	17.799	5.661	.260***	3.144
Computer Science	19.787	8.935	.179**	2.215
Education	5.619	5.919	.082	.949
ICT Adoption for Teaching				
Early adopters	-1.074	5.469	-.017	-.196
Early majority	-6.162	8.399	-.116	-.734
Late majority	-16.721	8.007	-.385**	-2.088
Laggards	-22.763	8.235	-.522***	-2.764
Durbin-Watson	1.949			
Max. VIF ≤ 6.782				

Note: Computed from survey data. Dependent variable = performance (4-Advanced, 3-Intermediate, 2-Basic. 1-Unable); N = 132; R^2 = .412; F (17; 114) = 4.693; ** p < .05; *** p < .001. Excluded variables for this estimate by default in SPSS are Agriculture, Arts/Social Science/Humanities, and Innovators. VIF = Variance Inflation Factor.

ICT performance variance is explained by the set of these five predictor variables: Age, average hours spent on ICT/ computer per day, associate professor, Engineering, and Computer Science is significant and large at 37% (R^2 = .368). The a priori prediction is contradicted by the scores of innovator, early adopters and age, but supports that of

Computer Science and Engineering. There was no correlated error term problems or detected multicollinearity in the model of best fit (Durbin-Watson = 1.891; max VIF ≤ 6.782).

Table 11 presents the MRA3 result of which the ICT adoption pattern is represented by teaching. Again, ICT performance impact is significant on five explanatory variables comprising age (β = -.363), average number of hours spent on ICT/computer per day (β = .182), Engineering (β = .260), Computer Science (.179), late majority (β = .385), and laggards (β = -.522) at $p < .05$, holding all other factors equal. Surprisingly, only these two adopter variables (late majority and laggards) were significant in predicting ICT performance impact in the adopter category. Laggard (2005-2010) is the explanatory variable that played a major role in the overall proportional change in ICT performance at a significant predictor value of 52% followed by late majority adopter category (2001-2005), at 39% and age at 36% holding all else constant. Four professional status variables (professor, associate professor, senior lecturer, and lecturer) are positive and nonsignificant. Years of teaching experience is negative and nonsignificant. Compared to MRA1 and MRA2, average hours spent on the computer per day is the least of the significant predictors with an estimated 18% regression coefficient. Computer Science and late majority are significant at $p < .05$ level, while other significant predictors are estimated at $p < .01$ significance level.

Coefficient of determination is large at nearly 41 percent (R^2 = .412), which implies that a substantial performance impact is explained by the six-set explanatory variables, holding all other variables fixed. Excluded variables for this estimate by default are Agriculture, Arts/Social Science/Humanities, and innovators. There were neither error term problem nor multicollinearity issues in the model of best fit, which is indicated by Durbin-Watson test scores and VIF estimates (Durbin-Watson = 1.949; max VIF ≤ 6.782).

Table 12

Multiple Regression Results for Gender, Age, Teaching Experience, Average Number of Hours Spent of Computer per Day, Professional Status, Academic Discipline, and Research Adoption Pattern on Performance (MRA4)

Variable	*B*	*SEB*	*β*	*t*
Constant	80.103	12.611		6.352
Personal Characteristics				
Gender	7.285	4.410	.123	1.652
Age	-.726	.262	-.304***	-2.767
Years of teaching experience	.170	.356	.061	.478
Average number of hours spent on ICT/day	2.595	.637	.325***	4.073
Professional Status				
Professor	9.093	15.271	.059	.595
Associate Professor	12.934	11.962	.126	1.081
Senior Lecturer	12.174	9.505	.237	1.281
Lecturer	12.565	8.262	.274	1.521
Academic Discipline				
Agriculture	.387	6.533	.006	.059
Arts/Social/Humanities	.229	4.890	.005	.047
Science/Medicine Nursing	3.953	5.985	.063	.661
Engineering	21.211	6.600	.284***	3.214
Computer Science	28.851	9.477	.239***	3.044
Education	5.187	6.244	.078	.831
ICT Adoption for Research				
Innovators	15.715	7.822	.181**	2.009
Early adopters	4.115	5.067	.066	.812
Late majority	-1.969	3.734	-.043	-.527
Laggards	-6.222	7.422	-.068	-.838
Durbin-Watson	1.881			
Max. VIF ≤ 6.715				

Note: Computed from survey data. Dependent variable = performance (4-Advanced, 3-Intermediate, 2-Basic. 1-Unable) N = 146; R^2 = .393; F(18, 127) = 4.559; **p < .05; ***p < .01. Business Management and Early majority were excluded in the final equation due to high correlation with Education and Late majority respectively.VIF = Variance Inflation Factor.

The MRA4 result is presented in Table 12. All independent variables are repeated in the estimation except for ICT adoption pattern, which is represented by research. Results show a set of five variables age, average number of hours spent on ICT/computer per day, Engineering, Computer Science, and innovators predicted moderately to large significant impact on ICT performance compared to a set of six in MRA3 at p < .05. Independently, average number of hours spent on the ICT/computer technology per day accounted for large performance impact of 32% and is the highest contributor in this category of explanatory variables, followed by age at 30%. Engineering and Computer Science predicted positive significant impact of 28% and 24% respectively. Innovator is the only variable in the adopter category to predict positive and significant impact at 18%, controlling for all other variables.

Again, all professional status and teaching experience variables are positive and nonsignificant. Except for innovator in the research adopter categories, all others are mixed and nonsignificant. Overall variance explained by this set of five independent variables is large at 39% ($R^2 = .393$); $F(18, 127) = 4.559$ at $p < .05$ holding all else fixed. The a priori hypothesis for innovator and average number of hours spent on the computer per day is supported in contrast to that of age, Computer Science and Engineering. Business Management and early adopters were excluded in the final equation due to high correlation with Education and late majority. There were no error term problems and multicollinearity issues detected with the model of best fit (Durbin-Watson = 1.881; max VIF ≤ 6.715).

Summary: Across all 4 MRAs, the regression coefficients of gender are positive and nonsignificant at $p < .05$. Age is consistently significant and negatively associated with ICT performance. Years of teaching experience is positive and non significant in the estimation where ICT adoption is represented by computer purchase and general use; however, it is negative and nonsignificant for ICT adoption by teaching and research. Partial regression coefficients for professional status are positive and nonsignificant except for lecturers in the estimation where adopter category is represented by computer purchase and for associate professors where adopter category is characterized by general use. All t-statistics confirm greater relationships between the performance and the predictor variables indicated.

Mixed and consistent results are reported for academic discipline variables. Excluding Engineering and Computer Science, all variables are positive and non significant or mixed with positive and negative regression coefficients. Though not reported in the MRA summary tables, the computed coefficient *R* in all four MRA models suggested very strong positive relationships between the outcome variable, ICT performance, and the sets of explanatory variables. For example, *R* = .672 for research; .635 for purchase; .642 for teaching, and .602 for general use at the 99% significance level ($p < .01$). In general R values in this study are consistent with that of Jegede, et al (2007) who studied the relationships between ICT competence and attitude among Nigerian teachers in higher education. Reportedly, the R value was estimated at .686 and R^2 at .470 at the 95% significance level. Independent variables that are not indicated in the MRA models but specified in the equations were excluded by default in SPSS to maintain maximum acceptable significant levels. Significant predictors in the four multiple regressions is summarized in Table 13.

Table 13

Summary of Comparative Significant Predictor Variables on ICT Performance Impact

Predictor Variables	*Degree of Significance*			
	MRA1 (Computer Purchase)	*MRA (General Use)*	*MRA3 (Teaching)*	*MRA4 (Research)*
Age	-.360***	-.295**	-.363***	-.304***
Average number of hours spent on ICT/computer per day	.291***	.317***	.182**	.325***
Lecturers	.342**			
Associate Professor		.244**		
Engineering	.262***	.275***	.260***	.284***
Computer Science	.220***	.212**	.179**	.239***
Early adopters	.261**			
Late majority			-.385**	
Laggards			-.522***	
Innovators				.181**

Note: Summarized from survey data: Dependent variable = Performance; **p < .05; ***p < .01.

Reasons Accounting for ICT Adoption

Open-ended qualitative data of reasoning as reported for ICT adoption and integration in higher education by the respondents were subjected to componential analysis and reported under student learning, teaching and research.

ICT for Student Learning

Table 14 presents four inductive thematic categories of ICT for students learning with key terms and sample responses under: a) easy access to computer and learning resources, b) labor and time saving, c) intercultural and global experience, and d) distractions. Students were reported to access and retrieve learning materials from the internet easily and quickly to support inadequate print media such as textbooks in the classroom. Computer ownership and Internet access allow students to be productive and rational in their presentations and research projects. In addition, ICT provides the medium for intercultural and global experiences. Student network and access open courseware such as that of Massachusetts Institute of Technology (MIT) in the United States. Learning has become more participatory and interactive with ICT, and students can construct their own understanding and be innovative with the new learning experience.

In contrast, students are reported to engaging in objectionable activities such as watching movies and playing music at the least opportune times, while others social network and send emails during class sessions. Some participants reported students search the Internet for solutions and are, therefore, less intuitive and productive. Plagiarism is in ascendancy and students are unable to filter sources of information for quality and reliability. Others reported students have become mechanical learners. They copy from the Internet and answers provided to questions are without logic and critical thoughts.

Table 14

Inductive Thematic Reasoning Categories for ICT Integration for Student Learning

Category	*Thematic Category*	*Key Terms*	*Sample Reponses*
ICT for Student Learning	Easy access to computers and learning resources	Computer ownership	Many students own laptops and personal computers and can find answers by the click of the mouse. Others are eager to own computers since they can access Internet for free on campus.
		Internet access	Students have easy access to the Internet with free wireless access within certain radii. Adapting ICT to diverse learning environment requires functional support systems; however, this is not the case in this university.
		Learning resources	Quick access and retrieval of learning resources from the Internet. Diverse sources of information to supplement classroom materials.
		Learning	ICT has changed the way students learn over the past decade for better. Learning is more interactive and participatory. Students can easily construct learning experiences with innovative ideas.
		Productivity	Students are less productive and cannot solve problems since they are always searching the Internet for solutions.
		Rationality	Learning is mechanical. Students answer questions without logical and critical thinking because they copy from the Internet. Students lack ingenuity.
		Textbooks	Students seem to loathe textbooks and other print media; however, these materials have their inherent maturity.
	Labor and time saving	Time	ICT application saves students time in accessing and retrieving information.
			ICT keeps students current on diverse topics and subject matter.
		Labor	ICT prevents the drudgery of working through problems. Students can simulate situations for better solutions.
	Intercultural and global experience	Networking	ICT provides the platform to network across cultures and national boundaries.
		Courseware	Global access to courseware including that of Massachusetts Institute of Technology (MIT) in the United States.
	Distractions	Social network and Websites	Distractions from social sites such as *Facebook*, emailing, watching video or listening to music whilst classes are in session.
		Plagiarism	ICT use encourages plagiarism. Students copy materials without acknowledgment.

Note: Compiled from survey data.

Table 15

Inductive Thematic Reasoning Categories for ICT Integration for Teaching

Category	*Thematic Category*	*Key Terms*	*Sample Reponses*
ICT for Teaching	Course planning and development	Time and energy spent	Reduces energy and time used in preparing teaching materials. However, less time is used for class presentations and discussions.
		Course customization	Very creative, innovative and imaginative in customizing my material and delivery.
		Open courseware	Open courseware makes available specialized information such as slides and other techniques that cannot be accessed and researched, typically, in a country like Ghana for teaching. Teaching is better and effective.
	Course Delivery and Pedagogical Strategies	PowerPoint presentations	By using PowerPoint presentation, we can cover more topics than before. It is possible to build and update notes in PPT without having to start all over again.
		Relevant links	Hyperlinks in presentation help to access relevant websites for teaching and learning. The Internet is a good source and aid for teaching and learning. Students can be directed to other Web resources to augment face-to-face interactions.
		Project and task-based activities	Task-based activities from the Internet can be adapted to enhance students' oral and written skills in my French class. Projects and assignments are given and received via online. Students collaborate to work on projects online. *Moodle* CMS is very helpful
		Time and labor	Facilitates teaching and reduces time of delivery. I am able to create my own materials and, therefore have more control over the materials used in the lecture room. Teaching is less stressful.
		Diversity, teaching and learning style	Students of current generation are more technology literate than previously. They are becoming accustomed to immediate connections with people and information around the globe. Their learning style is changing rapidly in response to available technology. As a result teaching methodologies must be adjusted to meet the needs of the changing student.
			ICT offers different and better approaches to teaching, especially, teaching large class sizes; large number of students can be reached at the same time.
		Communication	ICT helps to improve communication between students and colleagues. Most teaching materials are sent to students via email attachments.
	Distance learning	Learners at a distance	Off campus students access various assignments, references, etc via ICTs. For example, two of them are in the northern part of Ghana; Tamale and Bolgatanga. One is in the Volta Region, another in Accra. Our projects are online-based.
	Multimedia Integration	Teaching improved	ICT helps to improve conceptual understanding of science through simulations. It improves data-handling skills and information gathering. I am able to hold students' attention when I integrate multimedia in my lesson.
		Simulations and complex diagrams	Complex diagrams, tables and pictures can be prepared in advance of class time. You create and own your materials and can reuse them.
		Active participation	I am able to encourage active participation through multimedia applications such as case studies, audio and video; hence, the class is active, interactive and interesting
	Drawbacks	Compatibility	Many lecturers did not "grow up" on computers and are not so comfortable to use them in the presence of students. Students are, however, very helpful when called to help. However, inconsistent power supply is very frustrating, especially, when the lights go off while you are teaching. You feel very disorganized, so you do not teach with a computer at all.
		Cost	Cost of laptops is prohibitive; many lecturers cannot afford them. If we have laptops, we could practice using them more. Facilities are not available for use and even where they are available they are very costly to procure.
		Less meticulous	You are tempted to rush through your lesson, therefore, tends to make me less meticulous.
		Inaccessibility	Computer assisted teaching (and learning) is only possible with a functional ICT set-up. At the moment the university does not have one. Particularly difficult on this campus is the inability to access computerized library for e-borrowing of books. Everything is still manual.

Note: Compiled from survey data

ICT for Teaching

Inductive themes of reasons for ICT application for teaching are categorized in Table 15. Five principal themes with corresponding key terms and sample responses are reported under: a) course planning and development, b) course delivery and pedagogical strategies, c) distance learning, d) multimedia integration, and e) drawbacks.

Findings show mixed reactions to time saved. While some faculty suggested ICT applications save time and energy used in preparing materials for teaching, others argued more time is required to prepare teaching materials and not for the actual presentations. Other participants suggested they are more creative with lesson plans and course delivery systems. Globalized open courseware such as that of MIT makes available specialized information and teaching slides, which can be accessed and researched for relevance. While majority of the faculty expressed improvement in presentations and ability to integrate multimedia for more interesting and interactive practices, others were frustrated with slow Internet connectivity and inadequate resources such as multimedia classrooms to support ICT use.

ICT for research

Thematic reasoning of ICT for research is presented in Table 16. Categories of major themes are reported under a) information retrieval and data management, b) collaborative research, and c) publications. Teachers found ICT more useful for research due to easy and quick access to journals, periodicals, and other required information from electronic libraries and the Internet. Indicative, they also engage in collaborative research with colleagues in Ghana and abroad. Publication and submission of manuscripts are quicker via the Internet.

In sum, careful review and analysis of the qualitative data provided very rich, insightful and comprehensive view of the pros and cons of ICT for effective student learning, teaching, and research. Emerging general patterns across the universities are quite consistent, but varied based on individual mission, complexity and availability of capital infrastructure to support these pedagogical and professional engagements. Though many teachers are enthusiastic, others expressed frustrations with inadequate support and lack of clear focus regarding ICT for learning and course management systems.

Table 16

Inductive Thematic Reasoning Categories for ICT Integration for Research

Category	*Thematic Category*	*Key Terms*	*Sample Reponses*
ICT for Research	Information retrieval and Data management	Researchable fields	ICT helps academic staff to explore potential areas of research and learning projects. Information can be easily filtered for accuracy.
		EBooks and E-journals	Massive research resources, data and information can be retrieved through ICT or the Internet such as online journals and eBooks.
		Online Library resources.	Through ICT, many library resources and databases such as EMERALD and EBSCO could be explored for research purposes. ICT is a great resource for faculty.
		Literature reviews	ICT has helped to redefine how research is conducted. Pre-research literature review is quick and prevents re-inventing the wheel.
		Research Software	Programs such as EndNote help in organizing bibliography and references easily and fast.
	Collaborative research	Co-research and authorship	ICT helps in reaching out to colleagues both at home and abroad. Has facilitated co-authorship and proprietary.
		Conference, seminars and forum	Online conferences and seminars are conducted through WEBINARS and WEBCASTS.
		Timely research	Research can be conducted in good time. Literature search is made easy with the myriad search engines. Data can be processed: analyzed very easily and timely. Various statistical packages are available to support the process.
	Publication	Grants and Scholarships	Unlike previous, publication is now faster. It is easy to access funds for scholarly work and research without too much paper work.
			ICT does not support research in this university, though a great deal of research is now carried out online. The university is unable to supply all the lecturers with needed computers. We are stuck.

Note: Compiled from survey data.

Incentives for ICT Integration in Higher Education

Table 17 summarizes statistics of incentives to ICT integration in higher education, the responses to research question 7. Items include social prestige, economic, and features of ICT innovation such as relative advantage compatibility, complexity, trialability, and observability as espoused by Rogers (2005, 1995). Other factors explored are personal gratification, time saved, and previous experience with ICT tools and devices among others.

Respondents self-reported on a 5-point Likert scale structured items of *5-Very Important to 1-Not Very Important*. Computed internal consistency reliability coefficient of the full instrument scale based on Cronbach's alpha standardized items is high at approximately 82% (.821) and significant construct validity ($p < 0.001$) level. Out of 164, the majority (*f*=147; 91%) of the academic staff reported compatibility of ICT to professional goals, needs, and requirements on combined *very important* and *important* incentive to ICT integration in higher education. Only six (4.9%) thought otherwise. Counts are also highest for previous knowledge in ICT (*f*=137; 85%), adaptable ICT benefits (*f*=132; 85%), visibility of ICT benefits (*f*=131; 81%), easy access to ICT on campus (*f*=130; 81%), ability to cope with ICT (*f*=128; 80%), and easy to experiment with ICT (*f*=120; 74%). Comparatively, social prestige (*f*=74; 46%) and personal gratification (*f*=53; 33%) are the least important factors indicated in this survey.

In general, 12 out of 13 items are reported important. They include ICT innovation features such as compatibility, complexities, visibility of benefits, trialability, easy to experiment with, and relative advantage. Responses are comparable and supports Rogers' (2005, 1995) identified features of technology innovation. Respondents found ICT as an alternative to conventional face-to-face interactions.

Table 17

Incentives Mitigating ICT Integration in Higher Education

		ICT Incentive Instrument Scale (ICTIIS)														
		Very Important			Important			Neutral			Not Important			Not Very Important		
Indicators	N	F	%	C%	*f*	%	C%	*f*	%	C%	*f*	%	C%	*f*	%	C%
Economic incentives.	160	32	20	100	60	37.5	80	35	21.9	42.5	22	13.8	20.6	11	6.9	6.9
Better alternative to conventional face-to-face interaction.	162	50	30.9	100	69	42.6	69.1	25	15.4	26.5	12	7.4	11.1	6	3.7	3.7
Spends less time to prepare for class.	162	39	24.1	100	71	43.8	75.9	25	15.4	32.1	24	14.8	16.7	3	1.9	1.9
Social prestige.	162	14	8.6	100	37	22.8	91.4	37	22.8	68.5	54	33.3	45.7	20	12.3	12.3
Personal gratification.	162	29	17.7	100	53	32.7	82.1	27	16.7	49.4	38	23.5	32.7	15	9.3	9.3
Previous knowledge and experience in ICT.	161	59	36.6	100	78	48.4	63.4	15	9.3	14.9	7	4.3	5.6	2	1.2	1.2
Compatibility with ICT for professional goals, needs and requirement.	162	66	40.7	100	81	50.0	59.3	9	5.6	9.3	4	2.5	3.7	2	1.2	1.2
Ability to cope with ICT complexities.	161	51	31.7	100	77	47.8	68.3	22	13.7	20.5	9	5.6	6.8	2	1.2	1.2
Easy to experiment with ICT/computer technology.	162	33	20.4	100	87	53.7	79.6	33	20.4	25.9	8	4.9	5.6	1	0.6	0.6
External support from colleagues and University ICT supporting staff.	161	39	24.2	100	76	47.2	75.8	29	18.0	28.6	11	6.8	10.6	6	3.7	3.7
Visibility of ICT benefits.	162	50	30.9	100	81	50.0	69.1	26	16.0	19.1	1	0.6	0.6	4	2.5	2.5
Adaptable ICT benefits.	162	43	26.5	100	89	54.9	73.5	20	12.3	18.5	6	3.7	3.7	4	2.5	2.5
Easy access to ICT on campus.	161	68	42.2	100	62	38.5	57.8	22	13.7	19.3	6	3.7	5.6	3	1.9	1.9

Note: Computed from survey data. Incentive Scale = 5-very important, 4-important, 3-neutral, 2-not important, 1- not very important; N = total respondents; *f*= frequency; % = percent; C% = cumulative percent.

Barriers to ICT Integration in Higher Education

Barriers or challenges to ICT integration in higher education were examined with a set of 16 self-checked items and the results are summed in Table 18. Five major barriers rated as having a *great deal or much* impact on ICT integration are inadequate computer peripherals (*f*=133; 82%), unreliable telecommunication and network connectivity (*f*=128;

79%), high student-to-computer ratio (*f*=127; 79%), high teacher-to-computer ratio (*f*=106; 66%), and inadequate financial support from the university (*f*=106; 65%). Unreliable

Table 18

Barriers to ICT Use in Higher Education

	ICT Challenges Instrument Scale (ICTCIS)															
	A Great Deal				Much			Somewhat			Little			Never		
Indicator	N	*f*	%	C%	*f*	%	C%	*f*	%	C%	F	%	C%	*f*	%	C%
Tight time schedule.	162	14	8.6	100	31	19.1	91.4	47	29.0	72.2	45	27.8	43.2	25	25.4	25.4
Unsure of how to integrate ICT.	159	21	13.2	100	43	27.0	86.8	58	36.5	59.7	24	15.1	23.3	13	8.2	8.2
High student-to-computer ratio.	161	91	56.5	100	36	22.4	43.5	26	16.1	21.1	6	3.7	5.0	2	1.2	1.2
High teacher-to-computer ratio.	161	59	36.6	100	37	23.0	63.4	35	21.7	40.4	17	10.6	18.6	13	8.1	8.1
Inadequate computer peripherals.	162	96	59.3	100	37	22.8	40.7	21	13.0	17.9	6	3.7	4.9	2	1.2	1.2
Curriculum makes no provision for ICT integration	160	26	16.4	100	34	21.4	83.6	36	22.6	62.3	36	22.6	39.6	27	17.0	17.0
Unstable and dysfunctional hardware.	159	37	23.1	100	45	28.1	76.9	50	31.3	48.8	21	13.1	17.5	7	4.4	4.4
Cost of ICT is expensive on-campus for students.	160	17	10.6	100	29	18.1	89.4	51	31.9	71.3	46	28.8	39.4	17	10.6	10.6
Cost of ICT is expensive off - campus for students.	140	43	30.7	100	28	20.0	69.3	37	26.4	49.3	27	19.3	22.9	5	3.6	3.6
Inadequate university financial support.	162	60	37	100	46	28.4	63.0	42	25.9	34.6	8	4.9	4.9	6	3.7	3.7
Unreliable network connectivity.	162	87	53.7	100	41	25.3	46.3	20	12.3	21.0	10	6.2	8.6	4	2.5	2.5
ICT is irrelevant to courses I teach.	160	5	3.0	100	5	3.0	3.1	15	9.4	93.8	19	11.9	84.4	116	72.5	72.5
Inadequate technical support.	158	21	13.3	100	41	25.9	86.7	56	35.4	60.8	26	16.5	25.3	14	8.9	8.9
Unfamiliar with converging ICT and online instructional design.	160	12	7.5	100	38	23.8	92.5	55	34.4	68.8	33	20.6	34.4	22	13.8	13.8
ICT is intimidating to novice teaching faculty.	159	15	9.4	100	27	17.0	90.6	53	33.3	73.6	37	23.3	40.3	27	17.0	17.0
Inadequate professional training	160	32	20.0	100	47	29.4	80.0	51	31.9	50.6	17	10.6	18.8	13	8.1	8.1

Note: Computed from survey data. Respondents ratings from 5-A Great Deal, 4-Much, 3-Somewhat, 2-Little, and 1-Never; N = Total respondents; *f*= Frequency; % = Percent; C% = Cumulative percent.

telecommunication and network connections are consistent with findings reported earlier on reasons faculty integrate ICT in higher education. Equally, 79 (49%) rated inadequate professional training as having a *great deal* and *much impact* on ICT integration for pedagogy and curriculum. Combined 82 respondents (52%) rated unstable and dysfunctional hardware *as a great deal* or *much* impact, and the majority (f=135; 84%) did find ICT relevant to the courses they teach.

Almost one-third of the respondents (f=52) reported they are unfamiliar with the convergence of ICT and online instructional design; however, they rated this item as having *a great deal* and *much impact* on ICT use in higher education. Fifty-five reported a "Somehow" response on this item. Mixed and almost split rating is indicated for whether the curriculum makes no provision for ICT integration. For example, 63 participants (39%) rated no provision for ICT integration on conventional practices as *little* or *never*, while 60 (38%) selected a *great deal* or *much* impact.

Taking the middle ground, the items ranked highest on "somewhat" are inadequate support (f = 56; 41%), unsure of how to integrate ICT (f = 58; 36%), unfamiliar with the convergence of ICT and online instruction design (f=55; 34%), and unstable and dysfunctional hardware (f = 50; 31%). Interestingly, time is not a debilitating factor.

Interview Results

Qualitative and quantitative methods complement each other in validating behavioral patterns as well as providing consistent viewpoints when similar questions are used to study the same phenomena; hence, interviews were conducted across the universities for patterns and themes. Results of structured questions on specific computer proficiencies are summarized in Table 19 and interpreted under computer operating systems, computer applications, pedagogy-related and instructional software and courseware, communication, and similar applications.

Computer Operating Systems

The majority of the interviewees are proficient with Windows Operating Systems rather than MS-DOS, Macintosh, LINUX/VARIANTS, and UNIX/VARIANTS. For example, the majority use Windows XP (100%), Windows Vista (85%), and Windows 7 (8%) at the time of survey. Few LINUX users explained their preferences by the fact that the system is "philosophical", open-sourced, faster, cheaper or free compared to Windows. For Windows operators, the reasons cited include user-friendly and compatibility with most available software. Respondents explained there are help options, books and available documentations online to support Windows users. Yet, others have no preferences, suggesting "anything that works is good".

Computer Applications

Between 9 and 13 have advanced or intermediate proficiencies. In contrast, only one is advanced in computer applications for music composition, and this finding is atypical and expected. Preferences for these applications ranged from research, teaching, and management of personal and professional databases such as students' reports, examinations, and budgeting, among others.

Table 19

Specific Computer Technology Proficiencies

		Computer Proficiency Levels											
		Advanced			Intermediate			Basic			Unable		
	N	*f*	%	C%	F	%	C%	*f*	%	C%	*f*	%	C%
Computer Operating System													
MS-DOS	13	4	30.8	100				4	30.8	69.2	5	38.5	38.5
Macintosh	13	1	7.7	100				3	23.1	92.3	9	69.2	69.2
UNUX/VARIANTS	13	1	7.7	100				1	7.7	92.3	11	84.6	84.6
LINUX/VARIANTS	13	1	7.7	100	2	15.4	92.3				10	76.9	76.9
Windows 95	12	7	58.3	100	2	16.7	41.7				3	25.0	25.0
Windows 98	13	7	53.8	100	4	30.8	46.2				2	15.4	15.4
Windows 2000	13	8	61.5	100	3	23.1	38.5				2	15.4	15.4
Windows XP	13	9	69.2	100	4	30.8	30.8						
Windows VISTA	13	8	61.5	100	3	23.1	38.5				2	15.4	15.4
Windows 7	12	1	7.7	100							12	92.3	92.3
Computer Applications													
Word processing	12	9	69.2	100	1	8.3	25.0	1	8.3	16.7	1	8.3	8.3
Text editing	13	9	69.2	100	1	7.7	30.8				3	23.1	23.1
Desktop publishing	13	2	15.4	100	6	46.2	84.6	3	23.1	38.5	2	15.4	15.4
Database management	13	4	30.8	100	7	53.8	69.2	1	7.7	15.4	1	7.7	7.7
Spreadsheet	13	5	38.5	100	7	53.8	61.5				1	7.7	7.7
Graphs and Charts	12	4	33.3	100	4	33.3	66.7	3	25.0	33.3	1	7.7	8.3
Statistical package	13	2	15.4	100	7	53.8	84.6	3	23.1	30.8	1	7.7	7.7
Music composition	13	1	7.7	100				4	30.8	92.3	8	61.5	61.5
Software Application													
Presentation package	13	11	84.6	100	1	7.7	15.4				1	7.7	7.7
Drawing programs	12	4	33.3	100	6	50.0	66.7	1	7.7	16.7	1	7.7	8.3
Clip Art	12	5	41.7	100	6	50.0	58.3				1	7.7	8.3
Communication													
Email	12	11	91.7	100	1	7.7	8.3						
Newsgroup	12	3	25.0	100	3	25.0	75.0	3	25.0	50.0	3	25.0	25.0
Listserv	12	2	16.7	100	1	7.7	8.3	5	41.7	75.0	4	33.3	33.3
File Transfer Protocol	12	6	50.0	100	3	25.0	50.0	1	7.7	25.0	2	16.7	16.7
Internet	12	11	91.7	100	1	7.7	8.3						
E-library and Database	12	4	33.3	100	7	58.3	66.7	1	7.7	8.3			
Multimedia Applications (Audio/Visual)	11	4	36.4	100	5	45.5	63.6				2	18.2	18.2
Bookmark	12	5	41.7	100	5	41.7	58.3				2	16.7	16.7
Favorites	13	6	46.2	100	4	30.8	53.8				3	23.1	23.1
Social Network (e.g. Blogs/Facebook/Twitter)	12	2	16.7	100	4	33.3	83.3				6	50.0	50.0
Instructional and Courseware													
Tutorial	13	2	15.4	100	3	23.1	84.6	3	23.1	61.5	5	38.5	38.5
Drill and Practice	12				3	25.0	100	3	25.0	75.0	6	50.0	50.0
Simulation	13				1	7.7	100	7	53.8	92.3	5	38.5	38.5
Games	11				2	16.7	100	2	16.7	83.3	7	58.3	66.7
Video Conferencing	12	1	7.7	100	4	33.3	91.7	4	33.3	58.3	3	25.0	25.0
Teleconferencing	12	2	16.7	100	3	25.0	83.3				7	58.3	58.3
Streaming video	10				1	10.0	100	1	10.0	90.0	8	80.0	80.0
Assessment and Grading	13	3	23.1	100	4	30.8	76.9	3	23.1	46.2	3	23.1	23.1
Other applications													
Saving documents	13	9	69.2	100	2	15.4	30.8	1	7.7	15.4	1	7.7	7.7
Video production	12	1	8.3	100	7	58.3	91.7				4	33.3	33.3
Virtual reality (Avatar, Second Life, etc)	13	1	7.7	100				1	7.7	92.3	11	84.6	84.6
Webpage creation	12				4	33.3	100	4	33.3	66.7	4	33.3	33.3

Note: Computed from survey data.

Software Applications

Under, software applications, all, except for one respondent, reported proficiency in using presentation package, especially, *PowerPoint (PPT)*. For example, a participant from GIMPA reports:

> I use CMAP in addition to the presentation package, such as PPT. However, I do not use drawing programs and *Clip Arts* very frequently. I use PPT for teaching. You know, lecture rooms have been set up for daily use in this university for presentations, and I use them, all the time, I mean daily.

Communication

Communication technology is a major factor in ICT integration. The result on advanced and intermediate proficiency in electronic mail is estimated at100%; the Internet at 92%, and E-library and database access at 92%. Computed frequency on Bookmark is 10 (83%) and Favorites, 10 (77%) for combined advanced and intermediate proficiencies. *Newsgroups* and *Listserv* are the least rated and infrequently used communication methods. Nine out of 13 (82%) reported they have advanced and intermediate proficiencies in multimedia applications such as audios and videos. Proficiency and usage of social network such as blogs, *Facebook*, and *Twitter* is split (50-50%) between advanced and intermediate on one hand, and unable on the other. Reasons provided for using these tools ranged from communicating with colleagues, friends, publication journals, in addition to, sending and receiving students' assignments via email attachments.

Instruction and Courseware

Majority of the respondents are less proficient in using the computer for tutorial, drill and practice, simulation, games, videoconferencing, teleconferencing, and streaming videos. Between 1 and 8 participants indicated they have either *basic* proficiency or are unable to use these applications for pedagogical and other professional practices (see Table 19). Also, between 7 and 12 self-reported both *basic* and *unable* on most of the instruction and courseware applications. For example, 8 participants have basic (3) and unable proficiencies (5) in *tutorial*, and 12 out of 13 on *basic* (7) and *unable* (5) proficiencies in using simulation as an instructional tool. Mixed and almost equally distributed results are reported for assessment and grading across advanced, intermediate, basic, and unable proficiency levels.

Mixed reactions are indicated for the purpose of using ICT in the classroom. Those who use instructional courseware explained they interface lectures in audio and visual modes for effective and enhanced presentations. On regular bases, they appraise these applications to keep up with evolving technology. Typically, streaming videos and simulations are used to explain concepts and scenes that were difficult to comprehend in abstract forms. Others suggested they did utilize non animated media such as still pictures and slides, while very few indicated they never use these applications. Case studies are suggested as one of the online instructional techniques used in course or lesson delivery and presentations, in addition to, indicated items in the survey.

Other Applications

Of 13 participants, 12 could save files, and one is unable. Eight could produce instructional videos and 4 could not; 2 have different proficiency levels in developing virtual reality such as *Avatar* and *Second Life*, while 11 are unable. Explaining what these programs are used for, a respondent asserted he often used virtual reality for cartographic visualization, while those in the intermediate zone, produced videos for class presentation supported with simulations and case studies. One, however, suggested he did not, but had the interest, while another suggested “instructors come with innovative cases, and not to produce video”.

Final part of the 30 minutes interview comprised stating and explaining; a) general perception of ICT policy in higher education with regard to roles and performances of teaching faculty, and b) four major challenges to using ICT in the classroom.

Emerged inductive general perceptions themes are age factor, functionality, distance learning, and pro-innovation bias. For example, relative to age, many of the interviewees argued the younger faculty is passionate about technology applications; however, older colleagues seem to struggle with the idea and practice, which is consistent with earlier findings in this study. Others suggested ICT has the potential to enrich teaching, learning and research experiences; though, the policy has not been vigorously pursued due to lack of political will, capital infrastructure, and funding, among others. Again, the question of pro-innovation bias came up in the discussion. Some faculty believes the idea that all members will adopt ICT and related-computer technology is misplaced since innovation entails more functionality. Others recommended monitoring and evaluation of ICT goals, strategies and implementation for valued judgment.

With regard to major challenges, again, the four that resonated in the interview apart from capital infrastructural development, lack of funding, and slow internet connectivity are inadequate computers, lecture theaters, professional training, and technophobia. Findings are consistent with earlier reports; however, some respondents suggested the degree of severity of the challenges is contextual and depends on university in quest. For example, while UCC is experiencing slow Internet access, KNUST has major problems with electricity power outage. GIMPA is doing best with Internet access and consistent electricity supply; however, there is the need to provide high-speed interconnections for better Internet access and distribution. Inductive general perceptions are summarized in Table 20.

Table 20

Inductive Thematic General Perceptions of ICT integration in Higher Education

Category	*Thematic Category*	*Key Terms*	*Sample Reponses*
General perceptions of ICT in higher education	Age-related	Young versus old faculty	Problems with age differences and ICT use. For example, 40% of senior members want to use ICT, but they cannot because of lack of training and technical support; 20% are younger, eager and are very good at using ICT.
	Functionality	Pedagogy and research strategies	ICT enhances teaching, research, and learning at public-funded institutions in Ghana. In fact, ICT has changed our teaching methods through the use of overhead projectors and PPT presentations.
		Pedagogy and administrative	We are in the ICT world, therefore, computer is relevant for teaching, and administrative work; otherwise we would be left behind. Information is disseminated quickly, and we can interact and do business quickly online.
		Distance learning	With ICT, we can reach out to students far and near. Though, we still meet face-to-face with distance learners and continuing students.
		Policy versus practice	I think ICT policy has not been pursued ambitiously enough. The policy is a wishful one with no commitment of funds to support its implementation. More lip service is paid to this program than what is practically possible. There is lack of political will, with no seriousness attached to its implementation. In my opinion, there is limited GDP commitment to science programs in general.
	Pro-innovation bias	Assumption versus support	The assumption that we are in the ICT/Computer age and that everyone can use the computer is misplaced. The use of the computer for learning and teaching is more involving than for social meetings. Special efforts must be made to tech new entrants …both students and lecturers the basic learning and teaching application of ICT/Computers. Students must be supplied computers on admission, and the cost must be worked out into their fees and paid over time. Computers for teaching must be provided for by the institutions.
	Evaluation	Goals and strategies	Well, it seems the policy is still lacking vigorous implementation and clear cut achievement goals in terms of critical evaluation and monitoring.
Major challenges	Internet connectivity	Slow and interruptive	On paper, previous and current governments appreciate how ICT should be embraced in higher education; however, in practice, the implementation leaves much to be desired. Slow networking and Internet connectivity prevent serious ICT use in the classroom and for pedagogy.
	Capital infrastructure	Inadequate computers	Inaccessible computers. Some of the lecturers do not have personal computers. Integrating ICT in higher education greatly enhances teaching and transfer of knowledge. However, in my opinion, we are not doing enough to providing the necessary infrastructure and support.
		Inadequate lecture theaters	The demand to use ICT for distance learning is there; with the AVU, however, there are inadequate lecture theaters, not well-equipped with needed materials and multimedia, thus, preventing the realization of this dream. Lecturers are very much interested, but the resources are just not there. If the teachers cannot access and use these innovations, students would not be able to access and use them as well.
	Lack of funding	Self-sufficiency	This university is self-financing, and probably can afford. But lack of funding and infrastructure can constrain the use of ICT in other universities.
		Slow integration and process	The integration process is very slow, with lots of challenges in the universities.
	Technophobia		Most teachers are computer phobic and novices. In this university, we are required to use PPT, but I cannot say the same for the other universities.
Recommendations	Professional training	Faculty	I would recommend continuous training in ICT skills for non-ICT faculty members and supporting staff.

Note: Compiled from survey data and inform

General Comments: Summary

In addition to reasons, incentives, and challenges reported, respondents reiterated the importance of multimedia fixtures in the classrooms and lecture theaters. Inadequate facilities thwart integrating ICT initiatives in public universities and institutions, the curriculum and effective course delivery. Classrooms are swiveled for different subjects; therefore, making it extremely impractical for individual teachers to set up multimedia spaces for specific subjects. “Simply, the set up in this university is not supportive.., and there is lack of leadership support”, suggested a participant.

Other major factors include inadequate computers and laboratories to support the exponential increase in student population. Cost of personal computers is prohibitive for most teaching faculty. Other computer peripherals such as projectors copiers, and fax machines are unavailable or centrally shared due to lack of funds. A participant commented: “What we have is only a central pool which constantly breaks down because of extreme pressure on them”. Perennial slow and erratic Internet connectivity in UCC was explained by limited but high cost of bandwidth. Constant electric power outage results in continuous breakdown of hardware, which is reported as very exasperating.

In addition, there is lack of technical support systems such as repairs and maintenance. Computers are found to be infected always with viruses when USBs and CD-ROMs are used, particularly, after students’ presentations. Licensed teaching, research and security or safety software is unavailable and computers are not frequently updated. Technical services are not well advanced, and servers work inefficiently. Problems with novice ICT supporting staff, as well as inadequate feedback systems to improve practices were reiterated throughout the interviews and discussions. Participants from a particular university are appalled by lack of leadership commitment, professional development, and clear focus of ICT for pedagogy by all teaching staff.

Conversely, the ICT administrators and coordinators interviewed report difficulty in getting teachers to attend training and workshops to update their knowledge and skills in ICT. Many of the lecturers are found to possess no pedagogical training for imparting knowledge in the university; hence, it is difficult in considering alternative teaching strategies. In addition, some teachers display conservatism and skepticism about ICT use and benefits in the classroom. Those in favor of ICT integration for pedagogy thought conservatism and skepticism are an anemic duo doomed to failure and rejection of ICT adoption in their departments and entire university. Changes in attitude are recommended for individuals who are content with the status quo and oppose the efforts of others. Others recommended augmenting present practice with open-source and Web 2.0 or 3.0 tools and resources. For example, comments below resonance as very interesting recommendations:

> ICT is costly and expensive; therefore, I would recommend *OpenSource* for the system. It is short sighted not to see and go for the *OpenSource*. You just have to download for training purposes, and it is most workable in the system, otherwise forget it. There is no funding for commercial products.

Another suggested

> As a common platform for students to work on their own; I am using *Moodle* on trial basis for levels 100 and 200 (undergraduates) on a pilot basis for the department and so far it is working alright.

While some participants recommended change in attitude and professional development programs for faculty, others proposed continuous training for the non-ICT faculty members whose services are indispensable to supporting the general effectiveness of ICT policies in the universities and higher education. According to a participant, GIMPA is at the stage of deciding on modalities for distance learning and online teaching, which will intend decide financial support and the way forward for better and effective ICT practices.

In summary, this chapter has presented the results as evidenced from the survey; from descriptive analysis to MANOVA, to MRA, and interviews. In general, demographic information seem to be consistent with any conventional institute of higher learning. Positive computer attitude was indicated. Four ICT adoption patterns are reported and compared for computer purchase, general use, teaching, and research relative to Rogers' (2003, 1995) categorization. The academic staff performed moderately on ICT as a pedagogical tool; however, there are significant differences in the mean scores across the six-level ICT performance factor based on differences in age and academic discipline. No significant differences were indicated for differences in gender and professional status factors. Consistently, age, average number of hours spent per day on ICT/computer, Engineering and Computer Science predicted significant ICT performance impact at the 99% and 95% significance levels. Varied results were indicated for adopter categories and professional status. Reasons for adopting and utilizing ICT in the universities, as well as incentives and challenges are summarized and reported. Discussion of findings and recommendations are further explicated in Chapter 5.

CHAPTER 5

Discussion, Conclusion and Recommendations

The good old days are gone; approached with intelligence and zest, the days of the future will be better. If the future is an adventure, it is adventure because of technology. The cost of civilization is the fact that we can make wrong choices because of the alternatives technology presents. The reward of civilization is the freedom provided by technology and the opportunity to make the right choices.

James Finn

This chapter discusses results of the distinctive but complementary roles of mixed methodology employed. In general, outcomes are expectative, revealing, and corroborative to similar empirical studies. Contribution to theory and knowledge is articulated followed by demographic information and ICT or computer attitudes. Findings of information and communication technology adoption patterns support Rogers (2003) theoretical and practical expositions, but vary in the categorization of adopters, particularly, that of laggards. Performance levels are discussed within the context of ICT adoption for pedagogy, learning and research. Next is inductive thematic reasoning, incentives, and challenges to ICT integration in higher education, and specific computer proficiencies of the academic staff. Concluding comments focus on summary and limitations of the study, recommendations and future directions.

Contribution to Theory and Knowledge

All instruments used in this study are reliable, valid and consistent with the indicative measures. First, the ICT/Computer Attitude Scale (ICTCAS) and each of the four attitudinal constructs showed high inter-rater reliability, internal consistency with tests of Cronbach's alpha. The overall ICTCAS was computed at 87% at construct validity, $p < 0.001$.

Cronbach's alpha scores of the four constructs are between 74 to 95%, and are comparable with Selwyn (1997), Cázares (2010) and Jegede et al. (2007). By these results, the utility of the instrument for measuring faculty ICT/computer attitude is supported.

Second, retained and modified items of the 2000 ISTE-NETS-T performance standards applied as the Information and Communication Technology Performance Assessment Instrument (ICTPAI) yielded high internal consistency reliability at overall Cronbach's alpha score of 96%. Scores of the six subscales were computed between 89% and 98% and are above .70 to .90 ($p < 0.001$) range suggesting good measures (Cohen, et al. 2003; Morgan, Leech, Gloeckner, & Barret, 2004). Validity and reliability of the ISTE-NETS-T Standards (2000 version) is found consistent with the primary purpose of this study.

Third, internal consistency reliability coefficients of incentive instrument scale based on standardized items is high at approximately 82% (.821) Cronbach's (α) at 99% significance level ($p = 0.001$), and construct validity ($p < 0.001$). Reliability statistics for the full instruments on challenges to ICT integration was equally high at internal consistency of .871 (87%) Cronbach's alpha (α) based on standardized items at $p < 0.001$. The Inter-rated validity scores ranged between 86% and 88% (.860 and .878).

Research Questions Answered

ICT adopter characteristic: Demography of the teaching staff was found to exhibit typical pattern in any conventional university. All three universities were adequately represented in the study; however, comparative lowest return rate of administered questionnaires by KNUST affected its representation proportionally and was short by about 12%. Notwithstanding, all three institutions were adequately represented in subject area. In addition, the mean age and the standard deviation suggests the sample is about normally distributed since with a typical case of standardized normal distribution, 95% of the cases would lie between 25 and 65 years with a standard deviation of 10. In this study, average age was calculated at 45 years with a range of 23 to 66 years old, and standard deviation of approximately 10.

Gender is adequately represented with estimated female to male ratio of 1:5 compared to estimated 1:7 from available complete list of the lecturers in the three universities. Women constitute about 51 percent in Ghana and have always been inadequately represented as they progress beyond high school. Comparably, the ratio is higher than that of Nigeria and Kenya universities, which are estimated at 1:3 and 1:2 respectively in a study to examine gender disparity in ICT adoption and usage (Oyelaran-Oyeyinka & Adeya, 2004). High on agenda in Ghana are various policies and programs to promote gender equity. With recent increasing trend of female enrollment in post-secondary and universities (estimated at 35% to 66% female to male ratio in the 2007/2008 academic year (NCTE, 2009)), one would expect more females to enter the teaching profession to impact the university system with their own unique persona in the nearest future.

The majority of the academic staff is represented by senior lecturers and lecturers in the study (87%). Almost 97% are employed on full-time basis. The majority have taught between 2 to 5 years, which implies increase in employment over the last few years, possible retirement of older teachers, or attrition from the teaching profession in higher education. However, almost 40% have extensive experience and have taught for between 6 to 20 years suggesting relatively stable positions in the universities. Experience in teaching at the university or college level was an important factor in this study and was examined as a function of knowledge, skill, practice, and maturity over time. It was assumed the more experienced the better or superior the performance.

The academic staff was reasonably distributed relative to major subject areas. Major academic disciplines were aggregated into a) Agriculture, b) Arts, Social Science, and Humanities, c) Business and Management, d) Science, Medical and Nursing, e) Engineering, f) Computer Science, and g) Education. Self-reported specific majors spanned from Accounting to Zoology and are found to be consistent with any typical conventional university type. Further examination indicated the majority of the academic staff is engaged in teaching both undergraduates and graduates. Average number of students per teaching staff per semester was found to be rather large and varied; with a range of 3 to 700 students, a mean score of 192, and standard deviation of 151. Number of students supervised ranged from 40 to 60 per academic year with a median of 10 and mean score of approximately 12.

Compared to the 2007/2008 statistics of the National Council for Tertiary Education (NCTE, 2009), student to teacher ratio in public universities is estimated at 38:1, with a minimum of 12:1 in the Medical Sciences and 61:1 for Education. In spite of these figures, the class sizes are found to be relatively large for meaningful practice and supervision irrespective of type of academic discipline, course or degree level, especially, in situations where there are inadequate classroom facilities and resources to commensurate the increase. Empirical studies over the years have found significant improvement in student achievement as a result of combined reduction in class sizes and teachers’ ability to deal with individual student’s academic needs, supported with effective teaching techniques and needed resources (e.g. Nye, Hedges, Konstantopoulos, 2000; Rivkin, Hanushek, & Kain, 2005). Class sizes are, nonetheless, a function of economic factors, of which reduction tends to favor higher income earning societies rather than the disadvantaged. With about 700 students in a class, it is possible many may “swim” or “sink”, whether at the basic or higher education levels.

Teaching Faculty ICT/Computer Attitude (TFICTCA)

This study models that of Selwyn’s (1997) computer attitude, which was based on Ajzen's (2005, 1988) theory of planned behavior. Among others, the theory suggests an object leads to forming an attitude about the object, which in turn leads to the behavioral intentions regarding the object. Therefore, it is hypothesized that computer behavior and use is influenced by behavioral beliefs, which is dependent on attitude towards the behavior, and the behavioral intentions. Intention is defined as a person’s readiness or immediate antecedence to perform a given behavior. Hence, computer attitude is defined as a function of computer behavior and potential performance.

Subjecting computer attitude scores to percentiles, a score below the 25^{th} percentile is interpreted as a relative negative attitude towards ICT/computer technology and above the 75^{th} percentile as relative positive attitude towards ICT/computer technology. Thus, with the scores indicated in Table 2 and 3, it can be concluded the teaching staff has relatively high positive attitude towards computer technology. Comparatively, Selwyn (1997) interpreted a 32 score at the 25^{th} percentile in a study to test 288 students computer attitude in the United Kingdom as a relative negative attitude and a score of 51 in the 75th percentile as relative positive attitude. Total scores were computed in the range of 0 to 84 for individuals.

Affective component**:** Mean score of affective component is calculated at 22 (91%) and was the highest of the four computer constructs, suggesting minimal technophobia. Technophobia defines fear of advanced technology such as computers (APA Online Dictionary Reference, n.d.; Online Webster’s Dictionary, 2010). The positive affective factor for the computer could be due to the majority of the academic staff’s increased access, general knowledge and skill set in ICT, which are requirements for adoption and utilization. For example, Yaghi and Abu-Saba (1998) attributed computer anxiety of teachers, primarily, to lack of knowledge about computers rather than against computer use. In that study, computer anxiety was reduced when the teachers used the computers for educational tasks. Affective construct such as perceived fear and hesitation or discomfort towards computers could be associated with decrease use and avoidance. For example, Weiner, Freedheim, Stricker and Widiger (2003) argued fear and anxiety could dominate one's cognitive process to the point of interfering with daily functioning.

In a similar study, Saadé and Kira (2009) reported self-efficacy as a strong significant mediating influence in reducing anxieties towards learning management system utilization. As students [users] anxiety increased, the perception of ease of using the learning management systems decreased and vice versa. Self-efficacy was determined by students' levels of anxiety. Reduced anxiety and increased experience improved performance indirectly by increasing levels of self-efficacy. According to Cázares (2010) proficiency in certain information technologies encourages or increases the belief and self-efficacy of managing more complex technologies.

***Usefulness component*:** Responding positively to computer usefulness means the academic staff found the innovation adaptable, helpful, productive, and imaginative in relation to their work and vice versa. The mean scores of the usefulness factor was calculated at 17.10 out of 20 (86%) and found relatively high, positive, and closer to the actual mean score of the overall computer attitude (17.71). Usefulness was the second highest predictor of computer attitude next to the affective factor,. The score is comparable, but slightly higher to Yashau's (2006) computed average score of 19 out of 24 (79%) of teachers attitude towards pedagogical usefulness of computers. He described this score as a more positive attitude towards enhancing teaching and learning process and above average.

Also consistent with these findings is that of Karahanna, et al (1999) who reported perceived usefulness (mean score = 5.63) as the only belief underlying both attitude toward adopting and continuing use of Windows technology innovation. Hsu, Wang and Chiu (2009) found both perceived usefulness and perceived ease of use to have positively influence MBA students' intentions to use statistical software. They reported statistically significant and negative impact of anxiety on perceived usefulness, perceived ease of use and behavioral intentions. Negative impact suggests an inverse relationship between these variables. In this current study, perceived usefulness of ICT innovation implies visible quality, utility, and applicability. The usefulness factor is related positively with computer attitude, and is consistent with Rogers' (2003) assertion that perceived usefulness of technology innovation could positively influence its adoption and utilization.

***Control component*:** Again, this assessment is based on planned behavioral theory (Ajzen, 2005). The theory states behavioral control is determined by the total set of accessible control beliefs, which implies beliefs about the presence of a factor or factors may facilitate or impede performance of the behavior; and the strength of each control belief is weighted by the perceived power of the control factors, which when aggregated reflect the extent of the actual behavioral control. Actual behavioral control describes the extent of users' ability, skills, resources, and other required prerequisites to perform a given action or behavior (Ajzen, 2005, 1988).

The control component, therefore, described the ability to teach oneself about ICT, and *absolutely* manage and troubleshoot some computer problems, or otherwise, seek needed assistance in completing these tasks. The means score of the control component was relatively high, but the lowest at 15.9 (79%) among the four attitudinal constructs. However, the evidence is not to be interpreted as lack of control. Possible causes for the lowest score could be partly explained by extreme scores of incapable few respondents to exercise control due to inadequate ICT skill sets to perform the stated actions in the questionnaire.

Second, the word “absolute” (item 27; Appendix D) was found inapt by some respondents. Arguably, respondents had to disagree with the statements if they had no absolute control and should not be controversial; however, absolute could be changed to “adequate” in future studies for this item if it matters that much to influence the results.

Third, there were inconsistencies in the responses to items 28 and 29 (see Appendix D) which were asked to validate internal consistency of the responses. Nonetheless, the findings supports Chin’s (n.d.) less positive attitude towards the control factor, and contrasts Jegede’s (2007) dominating perceived control component of attitude in predicting ICT competence. In any case, actual control is found useful in predicting actual behavior (Ajzen, 2005) and computer attitude (Selwyn, 1997) such as computer use and performance.

***Behavior component*:** The behavior component assessed regular use and possible avoidance of computers. Behavioral attitude construct was estimated at a mean score of 16.06 out of 20 (80%) with a relatively high standard deviation (5.81), which could be assigned to a wider margin between respondents’ levels of computer experience and usage. Comparatively, Karahanna, et al. (1999) reported a mean score of 6.78 for the behavioral intentions and 4.44 for potential adopters. The authors interpreted the former as users’ intention to continue using Windows, and the latter as above neutral point, which implied a stronger relationship between attitude and behavioral intentions for users than for potential adopters of Windows technology or innovation. Karahanna, et al (1999) studied combined innovation diffusion adoption and attitudes theories by determining differences in pre-adoption and post-adoption beliefs and attitudes in a financial institution.

Schwarzer (1996) suggested behavioral change is required when old behavioral routines become inefficient to serve their purposes or when they become incompatible with new goals. Ajzen, (2005) asserted a behavioral belief is the subjective probability that the behavior will produce a given outcome. Perceived behavioral control is people's perception of their ability to perform a given behavior. Successful performance of the behavior, therefore, depends not only on favorable intentions, but also on sufficient level of behavioral control. In this study, the composite set of attitudes are antecedes and assumed to strongly influence ICT adoption, continued adoption, utilization, and performance of the subjects studied in higher education.

Summary**:** The teaching faculty exhibited overall positive ICT/computer attitude, which is directly related to affective, usefulness, control, and behavioral factors. Differences were observed in the four levels of the computer attitude. For example, perceived affective and usefulness components are reported as dominating factors in estimating the overall ICT/computer attitude of the academic staff, and supports the findings of Chin (n.d..). Adoption of ICT innovation is, also, found to be highly subjective to people's attitudes (Erumban & de Jong, 2006; Karahanna, et al, 1999). Consistent with this study is that of Jegede and Josiah's (2005) who estimated the mean score of computer attitude of teachers in a Nigeria College of Education at 79.0 and described it as moderately "good" and little dispersed using the Selywyn-Soh's Computer Attitude Scale (CAS). In contrast, Jegede, Dibu-Ojerinde and IIori (2007) found perceived control and affective components dominating in predicting ICT competence. Morris and Venkatesh (2000); however, found younger workers' technology usage decisions to be influenced by attitude toward using the technology; that of older workers were strongly influenced by subjective norm and perceived behavioral control with subjective norm declining over time. Subjective norm was defined as perceived social pressure from peers and superiors to perform or not to perform the behavior.

Attitude towards ICT was designed with descriptive factors such as productive, imaginative, useful, problem solving, and interactive among others. In practice, computer attitude results could provide the basis for diagnosis and management of identified problems including fear or anxiety, utility, control and self-efficacy. Overcoming technophobia and developing a change or favorable attitude could result in better ICT adoption and integration through exercising control and connecting emotionally with ICT/computer technology. Attitudes affect the way people interact with and use their environs and have been examined as potential predictors of information and computer technology behaviors (Chin, n.d.; Karahanna, et al, 1999; Selwyn, 1997). Theoretical understanding of the dynamics of human-computer-interactions could help in assigning supportive computer-related learning environments based on subjective human behaviors such as attitude and self-efficacy.

Patterns of ICT Adoption

A greater insight into the micro level adoption behaviors of the teaching faculty was achieved by disaggregating the units of innovativeness into a set of defined groups with the intent to identify potential gaps in adopter categories. Five adopter groups based on Rogers (2003) standardized percentages were defined as innovators, early adopters, early majority, late majority, and laggards, which are discussed under four adoption models indicated by computer purchase, general use or purpose, teaching, and research.

General purpose or use defines activities such as presentations, word processing, communication through emailing, and similar daily engagements without necessarily using the medium for teaching or research. ICT adoption for teaching defines ability to impact knowledge through collaborative engagement with students for meaningful learning and achievement. For research, it means careful systematic investigation of a phenomenon, engagement in a qualitative inquiry or both with the purpose of improving knowledge, understanding, and/or practice. Differences were found in the four adopter thresholds and are consistent with that of Rogers' (2003) and Jacobsen' (1998) but differs in categorization.

***Innovators*:** Innovators in the study are defined by ICT adopters before 1990. Adoption for general purpose was estimated at 17% compared to that of research at 8%, computer purchase at 5%, and teaching at 2%. Except for teaching, the percentage scores of this group are considerably higher compared to 2.5% of Rogers' standardized normal distribution. For instance, general use score exceeded the "normality" by a substantial 14.5%. Innovativeness at this period could be supported by the fact that ICT has been deployed and developed in Ghana for almost three decades in education (ICT4AD, 2003; Rogers, 1998). Described as venturesome with the capacity to deviate normatively (Rogers, 2003), this group seems to fit well with Rogers' general categorization of innovators, which is indicated by their ability to challenge themselves in computer technology studies and substantially control financial resources to afford computers or pay for access in Internet cafés at this early stages of ICT deployment.

Possibly, innovators are tagged to global trends and adopted ICT as new faculty or student at the inception of the computer programs in education, before 1990. A respondent who used mainframe computers as a student in the1970s prompted the principal investigator to change the period from 1985 to 1970 for him to respond to the online survey of the current study. Apparently, a restriction had been placed on the study's survey for a period between 1985 and 2010 to represent ICT/computer technology adoption era in education in Ghana.

Dankwa (n.d.) reporting on the *SchoolNet* project in Ghana asserted email was popularized in Ghana in the 1980s and the Internet by late 1995. Before this period, most schools and the Ministry of Education relied on manual typewriters for data processing, storage and other administrative functions; however, computers had been adopted in other ministerial sectors such as health, finance, industry, communication, and business. Early innovativeness could also be attributed to returnee academics from abroad coupled with deployment of ICTs in many urban public high schools and institutions of higher learning.

***Early adopters*:** Adoption rate for teaching was minimal at approximately 4% compared to adoption by computer purchase (15%), for research (15%), and for general use (21%) between 1991 and 1995 suggesting modest and gradual increase in adoption rates for these practices. Slow adoption of ICT for teaching at this period could be attributed to inadequate resources and infrastructure coupled with lack of expertise and focus. Teachers were experimenting with ICT and related devices for teaching. The period was characterized by learning about ICT rather than learning and teaching through or with ICT. Confirming Dankwa's assertion, Quaynor, Tevie and Bulley (1997) reported the Internet was popularized in 1994 when Network Computer Services (NCS) began testing Internet Protocol (IP) services. Full connectivity was achieved in Ghana and West Africa by 1997.

Adoption was highest for general use and lowest for teaching; however, scores of research and by computer purchase were comparable to that of the standardized normal distribution. Rogers' standardized composition of the early adopters is estimated at 16% and is defined, among others, by their leadership qualities and ability to trigger the critical mass. This group is sought after by change agents in the innovation diffusion process based on their ability to accelerate the process (Rogers (2003, 1995). This assertion could explain the trend and characteristics of these cohorts in Ghana.

Before 1995, the Kyoto Computer Gakum of Japan had implemented the International Development of Computer Education (IDCE) program to provide public access to computer technology in countries where computers were inadequate or non-existing including Ghana, Thailand, Poland, Kenya, Peru, and Zimbabwe (Kyoto Computer Gakum, 2004). In addition to supplying computers to schools and institutions, students from the Massachusetts Institute of Technology (MIT) in the United States partnered with host countries to provide intensive course for selected teachers with a follow up training in Kyoto, Japan. Implications of this program to the innovation-adoption-diffusion process was to have these teachers return to their home countries after the program to implement computer education and programs in their schools and for the general public; thus, behaving as catalysts, opinion leaders and role models in the diffusion process. The program commenced in Ghana in 1991, and by 1996 the National Center for Youth Education had been built to further expand the project with the support of these trainers-of-trainees. Rogers, (2003, p. 283) asserted these are the "individuals to check with" before adopting an idea in the innovation-diffusion process. The idea is consistent with the finding of this study and seems plausible in the Ghanaian context.

***Early majority*:** The period between 1996 and 2000 experienced another modest increase in ICT adoption for teaching (18%) and by computer purchase (23%); however, more academic staff adopted ICT for research (37%) and general use (36%). The latter two are comparable and slightly higher to the "normal" by nearly 2 percent.

Increasing trend of adoption at this period could be due to continued expansion of ICT in education. For example, by 1996, the *SchoolNet* project had distributed substantial number of computers to high schools in Ghana and embarked on related programs of training technical persons. The Ghana WorLD program continued the expansion in 1997 to cover more high schools and trained over 300 teachers and 9,000 students. Influx of computers for educational purposes increased in the late 1990s when import duties on these items were waived, thus increasing their adoption by purchase and use (Dankwa, n.d.).

By the same period, public universities, KNUST, UCC, GIMPA, and the University of Ghana (UG) had established information and communication technology resources to pilot the African Virtual University (AVU) project of the World Bank through the Ministry of Education (KNUTS-KVCIT Policy, 2010). The University of Cape Coast partnered with external institutional such as the University Systems of Georgia to train teaching faculty in Instructional Technology (IT) for basic education (ALO, 2003). Potentially, all these indicators at this period influenced ICT adoption and utilization by the early majority. Early majority adopters of ICT are described as individuals with deliberate willingness to adopt the innovation. Epitomizing this scenario is the case where IT trainers-of-trainees from the university established IT training centers for students and teachers with potential multiplier effects in primary and secondary schools. Early majority often interact with peers for effect.

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[1]The SchoolNet is a not-for-profit project pioneered by Dr. Gideon Chona, a Professor of Computer Science at Zurich University in Ghana high schools.

[2]WorLD Ghana is a program of the World Bank's World Links for Development (WorLD) to expand computer literacy in schools.

Through this interconnectedness and interpersonal networking, they might have communicated better to influence peers and other people into adopting the information and communication technology in education.

Late majority**:** By 2005, most of the academic staff was utilizing the ICT medium for general use (97%) and research (93%). This cumulative high adoption rates might have resulted from increased access to ICT and associated-devices in the universities. For example, distribution of ICT adopters by computer purchase exceeded the standard normal by almost 10 percent, and was lower for general use by the same margin. Adoption for both teaching and research were within “normal” with teaching showing highest score of 38.7%. Adoption by computer purchase increased from nearly 20% by 1995 to 86% by 2005, suggesting possible increase in income levels or the need and importance placed by the teaching staff in holding computers for personal and professional tasks.

General increase in ICT adoption rate at this period, also, could be due to overall widespread information and communication as a result of global knowledge-economy and access through the World Wide Web. For example, by mid 2000, the government in collaboration with other external agencies had provided more training and support for ICT integration in education (Martey, 2004). Most of the universities had expanded ICT centers including that in the libraries to correspond to growing student population on the various campuses. Improved access to electronic databases for research purposes and general use could be attributed to expansion of ICT facilities in general, and the national ICT policy has been redrafted in 2007 to commensurate expansion in all ministerial sectors in Ghana.

Expansion of ICT facilities is supported in the various universities. For example, subject to changes in its finances, the University of Cape Coast had established in its ICT implementation plan to include what it calls minimum needs of the various departments, faculties, and units. The university planned to provide reliable Local Area Network (LAN), train senior members of staff to publish electronically, and refurbish obsolete computers and peripherals by 2005 (UCC ICT Policy, 2002). UCC decided to put up for sale computers at subsidized price to staff and students to appropriate its outreach program of ICT integration in the university and community by 2006. Thus, if the plan was carried through, the general increasing access and purchasing of computers could be attributed, in part, to this policy.

In retrospect, while UCC proposed vigorous pursuit of ICTs vision and mission, the financial conditionality to implementing the programs enumerated is disconcerting, and could imply inadequate commitment to this course of action and level of prioritization. Evidently, very few resourced ICT teaching laboratories and multimedia classrooms exist to effectively and productively support the policy compared to other capital infrastructural developments in the university.

***Laggards*:** Between 2006 and first quarter of 2010, 53 (37%) academic staff had adopted and was utilizing ICT for teaching compared to 21 (14%) adoption by computer purchase suggesting substantial increase in adoption rate for teaching by this group compared to the normative trend of 16%. This trend of adoption and utilization exemplifies possible continuous improvement and learning through observed practices and benefits derived from using the ICT medium. Though laggards are typically described as traditional and last to adopt an innovation, all indications in this study suggest otherwise, Adoption of an innovation, among others, is a function of personality traits, contexts and availability of supporting mechanisms. Since ICT is very dynamic with player mobility via employment of new and young faculty and retirement of older faculty, it seems intellectually unfair to catalog this cohort as traditional and locals. ICT and computer technology adoption is age-related and the description of laggards does not fit this typical classification in the current study. More studies would be required for accurate and consistent categorization of this group.

Pro-innovation implication and adopters' personal characteristics are disregarded in diffusion research (Nasierowski, 2010; Rogers, 2003). For example, Nasierowski argued "countries that are classified as laggards in innovation, do in fact spend less, but do it in efficient ways" (p. 45). He proposed research in this area of innovativeness to highlight best pro-innovative policies. Rogers (2003), on the other hand, argued that though pro-innovation bias is identified as a problem, it is overlooked by diffusion researchers and not much is done to remedy the situation. Ignoring pro-innovation bias has intellectual implications, and some implications for laggards are; first, not everybody adopts an innovation (Rogers, 2003). Second, innovation is not radically diffused (Kirkup & Kirkwood, 2005), third, an innovation can be reinvented or rejected. Fourth, context and socio-cultural differences play major roles in adoption of innovation, and fifth personal attributes contribute to influence the innovation-adoption-diffusion process among similar factors. These influencing factors tend to support the idea that "several indicators of innovativeness that are used are difficult to measure and their values are impacted by the context" (Nasierowski, p. 45). Oversimplification of innovation-diffusion process has both practical and theoretical implications; hence more studies are recommended to include other influencing variables and possible re-categorization of laggards, in particular.

Summary: Markedly, the four adoption patterns differed in stages of adoption over time; however, the rate of adoption and diffusion is gradual and not drastic, supporting the findings of Kirkup and Kirkwood's (2005). Cumulatively, ICT adoption rates increased over time for research, computer purchase and general use. Comparative lowest adoption rate of ICT for teaching and successive steady increase over the years suggest ICT and computer technology had not drastically changed the way academic staff teaches in higher education in Ghana, but the results are hopeful with supporting human and capital investment.

For example, trends in educational technology and Internet access studies in the United States public schools and classrooms between 1994 and 2000 indicated gradual increase aided by allocation of funds through the Education-rate (E-rate) program established in 1996 (NCES, 2001). By 1994 only 3% of instructional rooms had computers and were connected to the Internet. Gradually, this figure increased to 77% in 2000 up from 64% in 1999. Differences in computer and Internet access were attributed to differences in characteristics of less or well-endowed schools.

The current study shows the staff is not resistant to change, but change management can be challenging. Modest changes have occurred; computer and Internet access with connections types such as integrated services digital network (ISDN), wireless, and cable connections are available for individual and institutional use; the difference is the stability of the utilities, purpose and degree of utilization, which are a function of priority and institutional type. Programs such as *The Teaching and Learning Innovation Fund* (TALIF) and analogous programs in higher learning institutions need to be evaluated for valued judgment. TALIF is a joint development project between Ghana Education Sector Project (EdSeP) and the World Bank to augment teaching, learning and extension of knowledge to a wider community in Ghana. Findings are very revealing, and recognizing differences in the rate of ICT adoption can direct future investment and practices in the universities.

Adoption Pattern Expanded

***Computer access*:** While 99% own personal computers, 91% have exclusive access to computers for professional tasks, and almost 75% have ready access to computers plus teaching and research software on campus. About 15% of the staff shares computers with others. By logic, if 99% own personal computers, it means almost all the staff, except for one percent has exclusive and ready access to computers. However, inconsistencies and potential gaps are observed between the numbers that own personal computers (99%) and those who personally purchased computers, teaching and research software (36%) suggesting possible misunderstanding of ownership and purchasing of computers, possible low investment in software for teaching and learning on institutional and personal levels, or computers are donated to individuals. Also, it implies inadequate specific subject software use, rarely used software in the university, or combinations of these factors. Literature reports low investment in subject-specific software infrastructure in greater number of countries, except for mathematics (Quale, 2003).

Arguably, lower scores for ready access to computers and software for teaching and research could be attributed to purchasing only computers for teaching and research and not the software. However, additional comments provided to support this assertion contrasts this argument. Those who did not purchase computers and software suggested these items are costly and unaffordable since they are not produced in the country. Notwithstanding, both computer ownership and access have increased substantially over the years, thus, supporting trends in similar studies (Jegede & Josiah, 2001; Kirkup & Kirkwood; 2005; NCES, 2001).

Access and computer ownership do not necessarily designate its effective use in the classroom. Neither is this study focused on how many computers one possesses, but given that the respondents have ready access to these tools, the question is what important changes could ensue as the teachers adopt and utilize these media and equipment? With improvement in practice, can they reach out to potential college students at a distance? What type of electronic databases would be accessible to influence quality research and publications? If the attrition rate of students in public universities is not a major problem in Ghana, the admission rate is. Qualified applicants admitted to the universities are estimated at below 6% (NCTE, 2009).

***Computer use*:** In-depth examination into the ICT adoption patterns indicated the majority of the teaching staff was using computers both at home (63%) and on campus (75%) for professional engagements. Academic staff commits approximately 5 to 7 hours a day to using ICT with 15 hours maximum compared to an average of 3 to 5 hours per day by 45 percent of university faculty in two universities in Canada (Jacobsen, 1998). Hypothetically, the more the academic staff practice with ICT, the better the performance and control. According to Vince Lombardi (n.d.), "practice does not make perfect, only perfect makes practice, and the difference between a successful person and others is not lack of strength, not lack of knowledge, but rather lack of will", implying given enough time to perfect practice, *all* students can conceivably attain mastery of a learning task (Bloom, 1981; Carroll, 1967) including teachers as potential ICT learners and users.

In sum, academic staff who finds ICT rewarding and purposeful will be disposed to spending more time in learning and using the medium for personal and professional goals. In contrast, those frustrated by its application will self-defensibly reduce the time spent on ICT or refuse to adopt this innovation. In general, ICT adoption rate is moderately high for research, computer purchase, and general use, but lowest for pedagogical engagement.

Differences in ICT performance levels: How big is it?

The purpose of this analysis was to determine differences and the strength in the means of the six ICT performance factor levels by the differences in the personal attributes. Out of a total maximum score of 128 on the overall ICT performance assessment (based on ISTE-NETS-T performance standards), the academic staff's total mean score is estimated at 80.2 (63%) suggesting moderate preparation and performance towards ICT integration for pedagogical engagements. Each of the subscales measured different performance task and the results are average. For example, computed averages are moderately high for technical operation and concepts at 70%, planning and developing the learning environment at 67%, and teaching, learning and curriculum, as well as productivity and professional practice are split at 64% apiece. Assessment and evaluation is calculated at 63%, while social, ethical, legal, and human issues factor is lowest at 55% (see Table 6). Each of the levels is described and concluded with the test of significance.

***Technology operations and concepts (TOC)*:** In sum, the mean score for TOC was slightly higher for males (14.04) than females (13.81), but showed no substantial difference. However, younger faculty of age 30 years and below scored highest at 16.7 out of 20 compared with all other ages in this class. Also, compared to other covariates of professional status, professors performed best with a mean score of nearly 15 out of 20 and standard deviation of .58. More expected, Computer Science and Engineering dominated in the category of academic discipline at mean scores of 17.60 and 16.93 out of 20 respectively.

Performing on TOC implies demonstrated knowledge and skill in concepts and operations related to technology as well as potential growth to keep current with ICT and computer-related technology in education. TOC is the benchmark to basic proficiencies in computer knowledge, applications, and connectivity. It assessed the ability to instruct and command the computers to perform the needed tasks through recognition of functions and computer vocabulary. Once participants are clear on these basic terms and functions, it is assumed they would explore ICT potentials for better utilization. According to Bitter and Pierson (2005), a reasonable place to begin with computer and technology literacy is to gain an understanding of the machine's history. The relative highest mean score of Computer Science and Engineering could be assigned to familiarity and indulgence in computers and related-technology. Younger faculty may be described as technology "*savoir-faire*" in the digitized world and more engaging in computers than their older counterparts.

***Planning and designing the learning environment and experiences (PDLEE)*:** PDLE assessed purposeful application of ICT principles to augmenting instructional strategies and meeting different learning needs with technology. Males performed better than females on PDLE, which could be due to comfort levels and experience. Younger faculty age 30 years and below, again, performed best with scores declining with age progression. Similarly, Computer Science and Engineering scored high on this item in the academic discipline category, while professors dominated the performance in the professional status category with mean scores declining sequentially from associate professor to senior lecturers, lecturers, and teaching and research assistants.

Overall performance on PDLEE is; however, average (14 out of 20), which could be assigned to variations in the structure and prioritization of the ICT-based courseware or instruction by individuals, the institution, or both. Nevertheless, prioritization of ICT-based courseware or instruction by individuals is a direct function of the teaching staff's expertise, pedagogical preference and teaching philosophy. Whereas some would like to plan for future consequences and achievement of purpose, others would rather deemphasize planning compared to other pedagogical techniques. After all, designing ICT learning environment differs contextually from conventional classroom practice and teaching; hence, it requires some degree of thought and practical investment. Many may be bewildered by the interface change and unfamiliarity with required technology tools for the new learning environment.

For instance, a study conducted by Morris, Xu and Finnegan (2005) to examine roles of faculty in teaching asynchronous undergraduate courses in the University of Georgia reported dramatic varied opinions about faculty roles and responsibilities, and between novice and experienced instructors. Discrepancies were indicated between enacted and described roles; thus, leaving many questions unanswered to fully understand and develop required pedagogy of teaching in a virtual environment. Hawkins (2001-2002) also argued that while much has changed by the advances of sciences, technology, and education, students learning methods and teachers teaching strategies have remained unchanged. However, many teachers have found a way of planning and grouping their students to allow access to computers for project and task-based learning in developing countries such as Ghana, which could be assigned to systematic design and implementation.

Purposeful planning and designing the learning environment and experiences help in identifying, locating and evaluating technology resources in the university. It represents an operating model which allows one to stay on course for desired outcome. Planning could increase success in resource utilization and help in defining roles and responsibilities of both faculty and students. Efficient and effective planning and development of the learning environment could offer faculty and students' the experience in diverse learning environments, and is considered a valuable utility for multi functions such as interactive multimedia applications and learner-centered learning. According to (Gharajedaghi, 2006),

> Designers seek to choose rather that predict the future. They try to understand rational, emotional, and cultural dimensions of choice and to produce a design that satisfies a multitude of functions. The design methodology requires that designers learn how to use what they already know, learn how to realize what they do not know, and learn what they need to know (p. 23).

***Teaching, learning and the curriculum (TLC)*:** TLC dealt with instruction contents, learner-centered activities, and development of students' higher-order level thinking skills. In addition, it prioritized management of general learning process in an ICT or technology-based learning environment and the curriculum (ISTE, 2000). The assessment of this item assumed that teachers implement curriculum plans by selecting complementary methods and techniques of technology in the classroom. Performing, therefore, in TLC implied examination, prioritization, facilitation, and moderation of technology enhanced experiences.

Overall mean score on TLC is computed at a modest 64%. Domination trends were repeated for gender, age, Engineering and Computer Science; however, lecturers' performance was highest in the academic ranks compared to professors, senior lecturers and teaching or research assistants. Moderate results could be ascribed to the fact that ICT is largely taught as a subject in the school curriculum in all three universities and inadequately explored as a teaching tool in other subject areas. These findings seem consistent with that of Plomp, et al in the mid-1990s when computers were introduced in many school as subjects rather than used to augment teaching wholly or in blended forms. Results also corroborate Anderson's (2003) assertion that major issues of ICT implementation in education are related to the ability to achieve new curriculum goals through new pedagogical practices. Learning through and with ICT such as that observed in other global studies (Plomp, at al., 2003) have not been realized fully in Ghana; however, individual and isolated cases were observed in the classroom. Bases for this average performance are discussed later in this chapter under reasons, motivations and challenges to ICT integration. Instructors all over the globe are adding to their portfolio new pedagogical practices due to inevitable changes associated with emerging educational technology, and Ghana should not be an exception.

Consistent with observed practices in this current study is, also, that of Hawkins (2001-2002) who reported most curricula in developing world schools are rigid and overloaded, thus leaving little space for innovative classroom practices. Subjects that are not tested in the curriculum are regarded unimportant. Observed practices at UCC required all undergraduate students to take ICT as core subjects; however, students were reported to be adamant because they are not-graded. Reportedly, many graduate as computer illiterates, which suggest gaps between policy statement and practice. The 2003 ICT4AD requires all graduates from Ghana universities to be ICT competent by 2015. What are the possibilities when ICT integration for teaching, learning and the curriculum is emphasized?

Assessment and evaluation (AE): Performing on assessment and evaluation implied faculty's application of technology for appraising students' learning of subject matter using the various available AE technology platforms and portfolios in the universities, and other sources where applicable.

A general trend in performance is observed for gender and age as indicated in previous mean scores; however, senior lecturers dominated the performance in AE in the academic ranking, while professors, teaching and research assistants scored relatively lowest on the average. Sciences, Medical and Nursing as well as Education produced the highest mean scores in the academic discipline category. The overall performance was little above average at 63%, suggesting moderate expertise and practice in AE. Lower scores for research and teaching assistants are possible, because, typically, they do not assess and evaluate students; however, the same cannot be said for other professional statuses. Ergonomics of Sciences, Medicine and Nursing could explain their relative better performance in AE since as part of their professional practice, they are perceived to be meticulous in appraising situations, concepts and students compared to other subjects and disciplines.

Comparative studies across different universities by NSSE (2009) indicated 75% of faculty found student assessment around their campuses either *quite a bit* or *very much* involved. Perception of involvement was consistent across several faculty characteristics, including gender, race, and rank. Nearly three-quarters of assistant and full-time professors thought their institutions were highly involved in assessment efforts. However, perceptions differed by disciplinary area with a greater percentage of Business faculty (81%) scoring high in institutional involvement compared with their colleagues in the Social Sciences (70%).

Continuous evaluation with technology through collecting, analyzing, and interpreting data in support of students learning and achievement was emphasized with AE items. For example, designing rubrics for students is found to guide the learning process and help students focus on current and future requirements (Jackson & Larkin, 2002 in Bitter & Pierson, 2005). Though a plethora of assessment and evaluation tool-boxes and kits are available and could be accessed via the Internet to help the teacher in assessing, grading and reporting, it is doubtful whether the relevance of these opportunities are adequately explored to influence teaching and learning in Ghana through digitized media.

Productivity and professional practice (PPP): Basic productivity applications in this study assessed proficiencies in word processing, spreadsheet and database management or office suites (composite application software). For example, for teaching purposes, features of *Word Processing* could apply in editing or reviewing students work and providing feedback. In addition, specific proficiencies were explored and the results are discussed later in this chapter.

Dominating scores are repeated for males and age 30 years and below; however, associate professors, Arts, Social Science and Humanities, and Sciences, Medicine and Nursing scored best, suggesting the emphasis placed on this category for professional tasks by this group of academics. Productivity and professional practices differentiated experts from novice practitioners due to influencing factors such as level of ICT adoption and performance. Basic productivity applications are readily available for access and relatively easy to use (Bitter & Pierson, 2005), but require individual learning efforts. By default, most computers applications such as Windows have "help" and tutorial options to guide learning of these applications for diverse tasks.

Five distinct developmental stages are described by Bitter and Pierson (2005 based on Ringstaff & Dwyer's (1997)) through which teachers new to technology progress in pursuit of technology integration for professional practice. First is the *entry stage*, which is plagued with myriad challenges, and teachers seem to ignore the bigger picture of effective instructional agenda. Second is the *adaptation stage*, which is characterized by a more proactive deportment towards the challenges and learning with students to use the hardware and software. In the third and *adoption stage*, teachers make technology work for instructional and administrative duties. Fourth, is the *invention stage* and is associated with breaking-out of the typical teacher-controlled classroom routines. Teachers communicate with peers and students, and facilitate authentic project-based students' activities. In the final and fifth stage, teachers take control in playing roles as facilitators, consultants, academic advisors, and course developers (Kook, 1997 cited in Bitter & Pierson, 2005).

Consistent with personal development, the teaching faculty who want to integrate ICT in the curricula and courseware need to evaluate their productivity and professional levels relative to pedagogical goals, strategies and available resources. PPP is more of individual appraisal than collective or institutional responsibility. In addition, technology integration is not a preserve for only science and technology teachers in higher education. It is multidisciplinary and involves conscious decision making on faculty or departmental levels regarding how resources should apply to support student learning and achievements. The future holds more technological tools and opportunities for pedagogical practices, and no faculty or students should be left out of the equation.

***Social, ethical, legal and human issues (SELH)*:** SELH is the sixth of the ICT performance factor levels, and assessed issues with equitable access and use of technology resources including that of assistive technology for disadvantaged learners, privacy, security, and netiquette among others (ISTE, 2000).

Overall, performance in SELH is the lowest of the six at 55%, suggesting possible disregard for these issues. Trends in mean scores for age factor remained the same, which is quite surprising since one would expect older faculty to be more concerned about social, legal and ethical issues on the Internet and other technology-related environments. However, associate professors scored highest compared to other professional status variables. Arts, Social Science and Humanities dominated in the academic discipline category, possibly due to their affinity for human related issues and subjects. In contrast to the earlier scores, females performed better on SELH than males, and could be explained by the former’s degree of prioritization and ability to promote social, ethical, legal and human issues on the Internet and technology-resourced environment.

For example, Smith (1997) reported significant differences in men and women business education students' evaluation scores of socially classified behaviors in favor of women. The findings, however, differed and favored men regarding scores on ethical issues related to legal or company policy. The mean score on the social items for females was calculated at 30.36 compared with males at 27.67, which tend to suggest females have higher expectations for ethical behaviors related to social and interpersonal issues than their male counterparts. On the other hand, males are more concerned with legal issues than social.

Another study conducted to test existence and nature of the relationship between ethical factors and illegal software use in government and private sectors by Akman and Mishra (2009) reported negative correlated information technology ethics with software use in government and private sector organizations. The results were explained by the different interpretations of the unethical behavior in the use of software by the information technology professionals' in these two sectors. Significant correlation was also found between the code of ethics and attitude of the professionals towards unethical use of software in these two contexts; government and private sector organizations. The authors reported that, though, the government sector professionals were aware of licenses, yet, they were lenient towards the illegal use compared to those in the private sector.

Underperformance in the current study seems to corroborate the disregard for establishment of ethical rules for information and communication technology. However, the Internet, for example, operates in an unregulated environment where both apt and inapt materials could be accessed. Greater precaution on these issues is recommended for academic integrity and personal protection. Pervasiveness of computer technology requires utmost management and maintenance of security systems to prevent fraud, misuse and abuse, viruses and spam, plagiarism, privacy, and general security. Decisive prioritization of these issues in academic settings is critical for preventing future costs and fines if disputes arise. For example, illegal use of software means failure to comply with any legal and contractual agreements such as those under copyright law (Prasad & Mahajan, 2003).

Summary: Describing the mean scores of the six ICT performance factor levels indicated that teachers performed moderately best with the TOC component and lowest on the SELH factor. Younger faculty is embracing computers, information and communication technology and the Internet better than their older counterparts. Lowest scores for PDLEE, TLC, PPP and AE could be explained by nominal integration of course and learning management systems in the universities at all levels; colleges, departments and faculties due to inadequate multimedia classrooms and lecture theaters. A participant reported:

> Seventy percent of teaching staff had been trained when ICT was just emerging. ICT seems cumbersome to the older lecturers. This is underscored by lack of hardware, software and training to influence the development of instructional programs. Younger lecturers seem to me eager to adopt ICT, but their enthusiasm can wear off if facilities and training would not be forthcoming in the near future.

Though, the 70% score is anecdotal and unsubstantiated in this study, the assertion could be valid based on general perceptions and observed practices in the universities as corroborated by another participant next.

> Generally, lecture theatres are not equipped with multimedia projectors. Departments have at best two multimedia projectors that teachers can sign for if available. Majority of lecturers do not own laptops because they are too expensive, and that limits ICT preparations for lectures. However, lecturers with laptops and are able to present by PowerPoint to enthuse their students; if lectures engage in the use of ICT to improve presentations, it could positively impact both lecturers and student learning.

Evidence of Significant Mean Difference

Mean differences in the ICT performance factor levels (dependent variables) and differences in age and academic discipline (independent variables were tested. Results of this post hoc test indicate all mean values were significantly different for the six ICT performance factors and academic discipline; contrasting the a priori hypothesis of no mean differences.

More specific, mixed scores were recorded across academic discipline, which seemed consistent with the area of specialization. Results of Engineering and Computer Science support the a priori hypotheses, which are indicated by the strong relationships with the six ICT performance factor levels. Strong and positive relationship is shown between technical operations and concepts and Computer Science on one hand and between planning and developing the learning environment and Engineering on the other (see Table 7).

Results of age factor are mixed and significantly different on only two ICT performance factor levels. More specific, age 30 years and below scored comparably better on all six levels than all other age categories. The strength of the relationship is significant for: a) technical operations and concepts (TOC), and b) planning and developing the learning environment (PDLEE), suggesting differentiation in emphasis, levels of cognition and expertise. For instance, Hawthorn (2000) asserted when it comes to applying computers, older adults have different needs and concerns compared to younger adults. Differences in results could be attributed to natural physical and cognitive changes that come with aging, which according to Hawthorn, tends to become more noticeable at about 45 years. Physical changes could result from decline in vision, hearing, memory, and psychomotor coordination, spatial abilities, and reduced attention span. Gender and professional status were dropped in the post hoc analysis for nonsignificant mean differences at $p < .05$.

Evidence of ICT Performance Impact

Different from ANOVA that tested significant mean differences in the six performance levels, MRA was applied in the estimation of impact of age, professional status, academic discipline, years of teaching experience, average number of hours spent on ICT/computer per day, and ICT adoption patterns on performance. Four MRAs and the contribution of each independent variable are discussed, beginning with a brief recall of the results (see Table 13).

With the MRA where adoption pattern was represented by computer purchase (Table 9), a six-set predictor variables consisting of age, average number of hours spent of ICT/computer per day, Engineering, Computer Science, lecturers, and early adopters are found positive and statistically significant on ICT performance. All other factors controlled, age accounted for a large significant 36% of ICT performance impact at the 99% significance level ($p < .01$). The negative sign on age confirms an inverse relationship with performance; the lower the age, the higher the performance. The a priori hypotheses are supported for average number of hours spent on the computer per day, Engineering, Computer Science, and early adopters. However, age and lecturer factors failed to support expectations.

In comparison with the first MRA, the second adoption model in the equation was also represented by ICT for general use or purpose. Together, a set of five explanatory variables of age, average number of hours spent on ICT/computer per day, associate professor, Engineering, and Computer Science contributed significantly to ICT performance impact, controlling for all others factors. General ICT use assessed communication such as emails, typical editing of documents, file transfer protocol (FTP), and presentations. Total variability (R^2) explained by the combination of this set of factors is moderate at .368 (37%).

Independently, average number of hours spent on ICT/computers per day contributed the highest proportional ICT performance impact of 32% at $p < .01$. Mixed results are reported on the adoption variables of general use; none is statistically significant. Again, age is negatively related to performance and the highest significant contributor in this group; all other four predictor variables are positive. A priori hypotheses failed to support the results of age and associate professor factors; however, that of average number of hours spent on ICT per day, Engineering and Computer Science are supported. Comparing covariates of professional status, associate professor produced the major significant performance impact compared to lecturers, senior lecturers, professors, and teaching and research assistants.

ICT adoption pattern was represented by teaching in the third MRA. Similar to the first estimation, a set of five independent variables comprising age, average number of hours spent on ICT/computers per day, Engineering, Computer Science, late majority, and laggards contributed significant impact on performance. Except for Engineering, Computer Science, and average number of hours spent on ICT per day, all other three significant predictors show negative regression coefficients (β), suggesting inverse relationships of these factors on ICT performance. Coefficients of professional status variables are all positive and nonsignificant. Surprisingly and independently, laggard contributed highest to ICT performance impact at estimated 52%, holding all other conditions fixed.

Results, again, raise questions about the characterization of laggards and pro-innovation bias. What are the possible cause(s) for this high performance? What personal profiles contributed to differentiate laggards from the classical traditional descriptions? What differentiated them from others in the adopter categories? Further studies are recommended to establish these findings. In this estimate, predictions of average number of hours spent daily on ICT, Engineering, and Computer Science are supported, while results of age, late majority and laggards failed to support the a priori expectations that these factors do not impact ICT performance significantly. The R^2 was estimated at a large 41%.

Fourth, and in the final MRA estimate, ICT adoption variable was represented by research. A set of five predictor factors were found statistically significant on ICT performance. Again, these are age, average number of hours spent on ICT/computer per day, Engineering, and Computer Science. However, innovators were the sole predictor variable in the adoption category compared with early adopters, early majority, late majority, and laggards. The highest significant predictor, however, is average number of hours spent daily on ICT at 33%. The R^2 that explained the variance in ICT performance impact by the set of five factors is .393 (39%). Following earlier hypothetic trends, the a priori prediction for age is not supported, while all other significant predictors in this category are supported.

Estimating ICT performance impact provided insightful results at the micro level in response to research question 6. All variables have the expected signs with some showing stronger support than others. For example, gender variables are positive and non significant in all MRAs, and do not differ significantly between male and female staff in all estimates where gender factor is indicated. Findings corroborate Oyelaran-Oyeyinka and Adeya (2004) who found no significant gender disparity in Internet use in ICT studies in Kenya and Nigeria universities. However, other documented evidence support male dominance in technology and science in higher education in most parts of the world (Bitter & Pierson, 2005; NCTE, 2009; SIGIS, 2002). For example, enrollment of female to male ratio in the sciences is nearly 1:4 in public universities in Ghana for the 2007/8 academic year (NCTE, 2009). Equity issues are vital for inclusive education such as that of ICTs and computer technologies.

Increasing participation of both females and males students in computer technology classes across disciplines could strengthen their self-confidence and continued performance. Despite worldwide male dominance in computers, there seems to be noticeable emerging increase of females in areas such as programming, system analysis, and designing WebPages (SIGIS, 2002).

All results are consistently negative and significant with respect to age in all four multiple regression analyses, and are comparable to Bartel and Lichtenberg's in as far back as 1987. Partially, it contrasts that of Oyelaran-Oyeyinka and Adeya's (2004) who found age to be positively correlated and significant for ICT use in higher education; but consistent with the greater performers of faculty younger than 40 years old. Results could be explained by different needs and concerns of older faculty compared to younger counterparts. Each may apply these devices for different purposes. Insufficient knowledge of ICT features in order to explore its potential benefits could account for the average performance.

In converse, higher performance of younger faculty could explain better exposure and indulgence than older faculty who may be conservative and technophobic. Many above age 50 years might have completed their first degrees long before computers were pioneered in education. Limited exposure to new and evolving information and communication technology can result in total rejection by older teaching staff whose perceptions about efficacy of ICT in education may be suspicious. In addition, basic physiological processes associated with senescence discussed previously could complicate and differentiate performance at different age levels. Since ICT performance depreciates with age, senior and older staff would have to work extra hours to increase their knowledge base in order to compete favorably in a global technology-oriented education and market place. Support relating to improved visual appraisal and assistive technology is recommended. Equally, innovative learning institutions striving to accelerate ICT adoption and performance can increase employment of younger faculty to balance expertise and provide professional development for all. Understanding the structure and effects of demography such as age may help in differentiating resources and channels of ICT growth and development in education.

One would expect a positive association of expertise and performance; however, estimation of total years of teaching experience failed to contribute significantly to ICT performance impact, supporting results of Oliver's (2002) and contrasting that of Morris, et al. (2005). While Morris, et al reported wide variations between novice and expert teachers perceived and enacted roles in teaching asynchronous undergraduate courses, Oliver found no significant difference between performance of novice teachers with formal no formal training in computer use for teaching. Differences in the current results could be attributed to inadequate experience in connecting instruction and online course management systems and ICT devices; whether synchronous or asynchronous. With inadequate knowledge in pedagogical techniques and fair adjustment to teaching large class sizes, it becomes even more complicated for both novice and expert teachers to explore alternative strategies such as integrating technology for meaningful and quality practice.

Expertise is a function of time and purposeful practice, which are in turn dependent on attitude and behaviors such as commitment and productivity. Average number of hours spent in using ICT and computer technology per day factor is found consistently positive and significant across all four estimated MRAs and supports the a priori predictions. Time factor is consistent with achievement and performance (Bloom, 1980; Carroll, 1989; 1963), which meant spending more time on the ICT medium to constantly update skills and knowledge by the faculty members could improve performance. Teaching experience was assumed to impact ICT adoption and performance in three very distinctive, but complementary ways in this study. First, new teachers have to adjust towards a period of learning the art of teaching in higher education. Second, novice teachers unaccustomed to teaching large classes may have to adjust to the overwhelming experience within the first couple of years. Third, both novice and experienced teachers have to learn ICT nuances and make adoption decisions or stay conventional. Overall score on teaching experience is; however, weak and nonsignificant, implying no explicit difference between ICT performance and teaching experience.

Professional status variable showed partial support for the hypothesized relationship with ICT performance and results are mixed results. Overall, only lecturers and associate professor variables are positive and significant in two MRAs where teaching and research are indicated in the adoption models. Contrary, Jegede and Josiah (2005) found no significant effect of professional status and subject discipline on computer attitudes. In the current study, professional status is assumed to be associated with maintenance of social prestige, academic power, and structure, which could in turn differentiate ICT performance impact. However, findings indicate otherwise, suggesting these factors, together with economic incentives and recognition did not play a significant role in ICT adoption and utilization to proportionally influence performance by academic ranks. According to Finnegan and Hyle (2009) progressing through the academic ranks does not support movement from one level of expertise to the next.

Consistently, Computer Science and Engineering variables produced significant and positive results across academic discipline while all other covariates are mixed and nonsignificant. ICT and related computer technology is applied in teaching and students' achievement across multi-subjects and different curriculum (see Bitter & Pierson, 2005), and should not be perceived as a preserve of only science and technology-related subjects. For example, in a study to assess computer usage by academic staff in Singapore, Chin (n.d.) found the Department of Physical Education dominating in computer attitude scores compared with moderate performance of Science and Mathematics. Contrary, the interaction of subject discipline and professional status of College of Education teachers in Nigeria was nonsignificant (Jegede & Josiah, 2005). The Humanities and non-related sciences did not have the same computer attitude as the Sciences because ICT was perceived by the former as science and machines.

Adopter categories produced mixed results. For example, early adopter is positive and significant for computer purchase in MRA1; mixed negative, positive and nonsignificant results are reported in MRA2, negative and significant for late majority and laggards in MRA3, and significant and positive innovator results in MRA4. The results corroborate differentiation of innovativeness of Rogers (2003, 1995); but fail to support the classical descriptions due to age differentiation, type of innovation, context, and performance. For example, late majority and laggards are found to be pro-innovators and high performers. This characteristic contradicts the typical classification, where laggards are described as traditional and locals with limited capacity and opinion.

In retrospect, the tendency to categorize personality into defined universal indicators can be complex due to the contextual influence. For the reason that a set of ICT adoption and innovative indicators change over time, it is difficult to attribute increase in performance from one level of adopter category to another. Plausible explanation to these results is situational, which means adoption for the different tasks was dependent on what was prevailing at the time. For example, laggards preformed best based on existing contextual elements such as access to ICT pedagogical resources including software, computers and the Internet. Access to these resources could be non-existing or limited in previous years.

One important implication of these findings for practice is ICT adoption for course or learning management system. While the majority of educational institutions in developed countries use both commercial and open-source course and learning management systems such as *Blackboard*™ or *WebCT*™ or some other platforms to meet general and specific needs, isolated cases were observed in Ghana on pilot bases. For instance, a lecturer in the French Department, University of Cape is pilot testing an OpenSource called *Moodle* as a course management system with levels 100 and 200 undergraduate students with modest success. At KNUST, the Human Anatomy Department led by a female senior staff is collaborating with a University in Utah in the United States to provide teaching software and integrated learning systems to Medical students. Singularly, these individualized efforts are commendable, but they could be supported and expanded. If proved successful, they could be replicated in other departments and faculties to augment specific needs and requirements, especially, in situations where inadequate finances constrain acquisition of commercial resources for effective implementation.

In summary, ICT plan in higher education in Ghana is inherently designed in terms of teaching, learning and research; however, the rhetoric exceeds implementation and performance. No fully established open-source or commercial course management system was observed in any of the institutions studied. Reasons articulated for these phenomena are presented next.

Reasons Accounting for ICT Adoption in Higher Education

Rationale and performance are discrete variables, yet, they are complementary in sustaining the ICT thrust. Singularly, the volume of the report generated on this item is enormous (42 pages) suggesting the importance of indicated factors to academe. Self-narrated inductive thematic reasoning for ICT adoption is differentiated under student learning, teaching and research.

Learning: Five inductive themes of: a) ownership of laptops and Internet access, b) learning resources and information, c) better communication, d) adapting to different learning platforms, and e) interruptions or drawbacks from social network were deduced.

With regard to students' learning, respondents reiterated increased access to unlimited knowledge and information on any subject and topic by students carrying laptops to class. By this act, learning is made easier, interesting, and participatory. Students corroborate facts with quick access to quality information when properly directed to good sources of e-books and other referenced materials. Quick access to quality information on the Internet is particularly vital in a context where many printed books are dated and inaccessible. Better communication such as improved written and verbal expressions is reported. One faculty explained:

> With basic ICT use, students assignments are no longer hand written, but typed and that has eased and improved marking and their expressions. Learning is made possible no matter where students find themselves.

Others commented on how students are developing problem-solving skills and adapting to different global learning platforms. Particular reference was made to the global courseware and open programs of the Massachusetts Institute of Technology (MIT) where students keep current with colleagues and subject matter. Reportedly, today's students are "better-off" with the ICT medium because of innumerable opportunities via Internet and computer technology.

Some faculty reported a rapid shift in students learning styles in response to emerging technology, and recommended alternative teaching methodologies and adjustments to meeting the needs of these evolving phenomena. Such statements call for further studies to explore potentials of ICT and related computer technology in education to corroborate Kozma's (2006, 1994a, 1994b). For instance, good practices in teaching undergraduate students writing is reported to correspond with higher student engagement and deeper approaches of educational goals (NSSE, 2009). The question is which practices and alternative teaching methodologies are "good" and by what means are they evaluated?

On the contrary, faculty described students of today as disingenuous and "lazy" learners with the potential to digest trivial information from the Internet without discriminating scholarly work from non-scholarly. Some are found to plagiarize with little understanding, which tends to stifle independent thoughts and logical presentations. Students are observed to depend largely on photocopied materials to supplement limited resources.

Teaching**:** Five principal themes on ICT for teaching are: a) alternative course delivery methodology, b) improved pedagogical strategies, c) improved development of course and reusable materials, d) multimedia integration, and e) labor and time saving.

Reportedly, applying ICT in course delivery is labor and time saving for the reason that simulations, complex diagrams, tables, and pictures can be easily and efficiently developed in advance for effective class presentations. In other words, engaging with the ICT medium reduces writing constantly on the chalkboard and allows for more time on explanations and class discussions. In addition, personal teaching materials can be easily developed, updated, recreated, modified, protected, used, and reused, which seem to identify with the concept of reusable learning objects in instructional design. According to Douglas (2001), reusable learning objects emerged as a paradigm shift in instructional systems with a promise to bring to education the similar improvements in productivity relative to that in software development. This concept could be explored for its effect in higher education.

Also reported to encourage student participation, deeper teaching, and varied learning experience is the hyperlinks to online and Internet resources to augment lecture notes, Integrating multimedia such as videos, animations, and pictures is engaging and promotes interactivity. Capabilities of ICT can be extended for facilitating the teaching of large class sizes. Faculty reported they are able to cover more materials in class sessions with PowerPoint presentations; thus reducing lecture time in favor of more interactivity. However, respondents argued extra time is required in lesson preparation a priori, which supports the assertion by White and Weight (2000) of inadequate time and more pressure for course and lesson delivery for online lectures. Results regarding time saved support that of DiBiase (2000) and contradict Visser's (2000). Improved pedagogical and social strategies in education confirm others such as Bonk and Dennen (2003), Maor (2003) and Morris, Xu and Finnegan (2005). Constrained by time and workload, some faculty members reported they never use ICT for course delivery.

Research: Three major developments reported on ICT for research are: a) information dissemination, b) collaborative research, and c) publication. Participants reported being kept current on research and subject matter with electronic information and databases such as EBSCO[3] and NetLibrary[4]. Relevant research and literature are easily accessed and reviewed via e-library, e-journals and e-books. Accordingly, the teaching faculty is able to collaborate effortlessly and punctually with colleagues at home and abroad to research, write and publish through ICTs. They find these developments effective alternative for self and professional development. Hence in debating ICT in higher education, it is important to emphasize changes that are occurring in traditional roles of the teacher, processes of teaching and research, and other professional tasks for improved practices and long term sustainability.

Changes in communication through WEBINARS[5], online forum, and video conferencing are reported to save time and reduce drudgery of dealing with voluminous paper work. Despite these evolutionary roles and practices, not all staff reported equal access to communication tools due to individual motivation and competency as well as contextual differences. Two contrasting views on this issue are:

> A few of us who have overall access attest to the paramount of these ICT/computer technology tools for research; however, the majority of faculty members are denied in terms of costs and computer literacy.

A second commented:

> Absolutely not, ICT for research in this university is unavailable..., non-existence, especially, for literature review and searching current methodologies.

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[3]EBSCO is a service provider of e-journal, e-book and e-journal package and print subscriptions. Also provided are e-resource management tools, full-text and secondary databases, and related services for all types of libraries and research organizations.

[4]NetLibrary® is part of the EBSCO Publishing Family of Products

[5]Webinar is a neologism to describing a specific type of web conference. Typically, it is one-way communication: from the speaker to the audience with limited audience interaction. In contrast, a Webcast is interactive and involves broadcasting over the Internet using streaming media.

The latter comment seems extreme; since all the universities have partially digitized their library system and none of them has absolutely no ICT implemented. However, it also expresses frustrations associated with inadequate support systems and lack of communication; possibly among ICT coordinators, librarians, faculty, and students. Issues raised are: What technology resource centers exist to support teaching and research needs of faculty and students? Why would faculty report non existence of ICT for research on campus?

Contextual differences in performance and access depend on leadership, managerial and technical support. General practices in the three research sites revealed a system of uncoordinated ICT practices and inadequate support for faculty interested in integrating technology in the classroom. ICT centers are either commercialized with limited student access (2 hours browsing/access period per day in some cases), wireless access to the Internet within very limited radii called “hot spots”, or via general services to the community through campus ICT centers. Services are constantly interrupted by sporadic electric power supply, limited bandwidths and slow Internet access. With an unstructured credit system in Ghana, some of the participants found purchasing books and research materials online complicated and frustrating, but not for journal subscriptions.

Lack of university authority, leadership and clear focus on ICT for teaching are among major blockades reported by the ICT coordinators. Reports indicate most ICT centers are coordinated by full-time faculty members, thus preventing the workers and student access to their full services. Lack of leadership in school-level ICT policy is reported by Anderson and Dexter (2001) and Law, Yuen, Ki and Lee (1999) as a factor with considerable differences in pedagogical improvement in teaching and students learning. For example, the

African Virtual University projects are in the process of demise due to lack of clear focus, inadequate funding and leadership support. Moreover, professional development programs are not linked with ICT for research, classroom practices and integrated learning or course management systems. Though, all lecturers at GIMPA are directed to incorporate *PowerPoint* in presentations, much more is needed to support pedagogical, social, technical, and managerial functions. Core practices in distance and continuing learning would be realized with strong commitment to ICT policy statements. With such compounding problems, one is tempted to conclude the MoESS ICT policies are too ambitious, imitated and rhetorical. There is inadequate needs analysis and evaluation to situate challenges and remedies of ICT integration for pedagogy in their proper contexts.

While commercial course management systems (CMS) are costly and unaffordable to developing economies, a collection of *OpenSource* system can be explored and piloted at departmental and faculty levels and evaluated for their effects. OpenSource systems comprise programs or software freely distributed and redistributed with access to the source code, and licensing does not restrict other software distributed along with the licensed one. Examples of open source programs available for experimental purposes on customized or massed application bases in education are *Moodle* (course management system), *OpenOffice.org* (productivity suite), and *Project.net* (project portfolio management), and many others designed to enhance presentations and research. According to Prahalad (2010, p. 32)

> Most executives believe it’s tough to identify breakthrough opportunities. However, several are pretty obvious…Next practices are all about innovation: Imagining what the future will look like; identifying mega-opportunities that will arise and building capabilities to capitalize on them... Executive is constrained not by resources, but by their imagination.

In summary, participants articulated well ICT use for students learning, teaching, and research; however, what is found missing is the fine connective tissues of instruction, curriculum and ICT. Isolated practices through individual initiatives can be supported, evaluated for their effects, and institutionalized if found effective and successful. With only 6% of potential students admitted, it is imperative for public universities in Ghana to explore alternative but quality educational possibilities to increase enrollment in order to improve human capital resources and knowledge-based economy and society. Motivators of faculty's ICT adoption and integration for professional practice are presented next.

Incentives to ICT Adoption

ICT adoption was assumed to depend partly on its features and faculty personality traits such as social prestige and previous knowledge. Five top-rated very important and important incentives to ICT adoption are compatibility (91%), previous knowledge (85%), adaptability (85%), visibility of benefits (81%), and easy access to ICT (81%). Least important factors, but relatively highly ranked are social prestige and personal gratification. Results of social prestige and personal gratification support earlier discussions of nonsignificant mean differences in professional status and ICT performance factor levels. Nearly all 13 factors in Table 17 are considered important or very important including that of the five attributes of innovation (see Figure 1), which are consistent with that of Rogers' (2005). A minimum of 9 out of 37 items are; however, rated neutral.

Results imply the academic staff finds these indicators relevant and consistent with their professional goals, needs and requirements and could explain the increase in ICT adoption rates. According to Nasierowski (2010), discussions about enhancement of innovativeness is current; however, it has not resulted in practically useful conclusions on the search for innovation problem solving, which makes it particularly important to explore innovative indicators and link them to innovative matters and improvements in performance. ICT benefits and other items rated important could be explored as complementarities in advancing the ICT agenda in higher education.

Barriers to ICT Adoption and Implementation

Challenges to ICT adoption and integration are grouped into four areas. These are a) lack of professional development (training and support), b) inadequate technological infrastructure, c) inadequate provision of ICT in curriculum and instruction (time schedule, provision in the curriculum, relevance to course, and familiarity with course management system or learning management system (CSM/LMS), and d) and inadequate finance (cost to accessing ICT and university support). This is not to downplay other factors indicated as potential challenges since all factors combine to impact effective ICT integration.

More specifically, challenges related to technological infrastructure comprise inadequate computer peripherals, unreliable telecommunication and network connectivity, high student to computer ratio, and high teachers to computer ratio. Recall only 36% of the academic staff purchase computers plus research and teaching software on campus, and 82% ranked inadequate computer peripherals as influencing factors in ICT use in higher education. While GIMPA seems to be coping relatively best, UCC is constrained by limited bandwidth and slow connectivity. KNUST is plagued by incessant electricity interruptions averaging three times a day and lasting between 1 and 3 hours. High speed Internet connectivity and constant electricity supply could reduce most barriers indicated.

Inadequate infrastructure is supported as a major hurdle to implementing ICT plans and policies in developing countries (Assié Lumumba, 2008; ICT4AD, 2003; Martey, 2004;

Park & Moser, 2007). In addition to technological infrastructure, a qualitative study by the Massachusetts Institute of Technology Learning International Network Consortium (MIT LINC) in higher education in the 14 countries of Algeria, China, France, Gaza, Israel, Jordan, Kenya, Lesotho, Malaysia, Mexico, Pakistan, Switzerland, Syria, and the United States, reported pedagogical, financial, managerial, and cultural factors as major challenges to providing quality education in these countries. ICT for pedagogy was an extremely difficult challenge.

Though this study was conducted in Ghana, results and contexts are consistent with findings of similar studies around the globe. The difference is the degree of impact and institutional strategies to meet defined goals. If university executives are to look, monitor, and evaluate they will find solutions abound, which implies a shift in thinking, from what is visible in the original innovation imitation, to what makes the innovation successful (Shenkar, 2010).

Specific Computer Proficiency

Any successful professional development intervention would depend on participants' proficiency levels, attitudes and behaviors. To advance the connection between competencies and performance, specific computer proficiencies were examined through directional interviews. Results show participants are very acquainted with the basic computer operating system and cited diverse reasons for its adoption. Open Sources such as LINUX and UNIX VARIANTS are useful because they are regarded as relatively cheaper, accessible and reliable; whereas, WINDOWS operating systems are found more user-friendly, compatible with most systems, and provide functional support with help options. Most members are familiar with computer applications such as word processing, text editing, spreadsheet, and database management. All participants (84%), except for one are proficient in using a presentation package such as PowerPoint. Other programs such as avatar, second life and webpage creation and development are rated basic or unable; though, many could save documents and produce educational videos.

Most frequently used communication tool is email (100%); while social network such as List-serve and Newsgroup are rarely used. Social networks, however, are becoming very popular for personal, organizational and institutional use for diverse reasons and purposes. *WordPress*, *Facebook*, *Twitter* and *LinkedIn* are among the popular social sites. LinkedIn, for instance, is a blog-based community with the aim of keeping professionals connected and for developing personal portfolios. *Delicious* is a social bookmarking website and *Facebook*, a social utility and blog-based platform for both personal and organizational networking. For lack of empirical evidence, Molenda and Bichelmeyer (2005 in Januszweski and Molenda, 2008) suggested nearly 90% of all instructors in higher education exchange emails with students, about 60% communicate with students through *List-serves*, 40% use digital presentation, 20% engage students in online discussion forum, and 10-20% provide online simulation or laboratory experiments.

Despite the high proficiency levels of the academic staff across the different platforms, very few possess the basic skills required for using ICT or computer technology for instructional and course delivery such as drill and practice, simulation, tutorial, and video conferencing, which partially explains their inability to merge ICT and online teaching. Teaching staff is familiar with learning and course management systems (CMS) because many received their graduate degrees abroad in CMS operated educational contexts. Others are currently or have been engaged in professional development programs and courses offered in virtual and electronic environments. Many experienced online CMS for the first time as students and not as university or college teachers. The missing link is the ability to shift roles and transform from student roles to teaching by planning and designing the learning environment for technology-based teaching.

General comments: Besides factors discussed previously, lack of ICT monitoring and feedback systems, difficulty in setting up multimedia space for specific departments due to student population explosion and limited classroom spaces, and lack of technical support and maintenance were expressed. Exacerbating the situation are the differences in infrastructure and areas of prioritization. More emphasis is placed on teaching and learning ICT than on learning and teaching with or through ICT in the universities. Reportedly, some university authorities question authenticity of e-learning and online degrees; an issue scheduled for discussion at academic senate at the time of visit. While, they may be expressing genuine sentiments, it also suggests conservatism and orthodoxy. Both factors have the potential to stifle growth and continued development of ICT for learning, teaching and awarding degrees via online distance education. Recall, almost 94% potential candidates are waiting to enter public institutions of higher learning; private ones are costly for the average Ghanaian family.

Supporting this findings is that of Park and Moser (2008) who reported “the expanded use of ICT in developing countries and its further development is not only impeded by financial limitations or due to lack of expertise but also by traditional mindset regarding teaching and learning” (p. 203). Most profound challenges reported by ICT coordinators are apathy, inadequate top level management support, and lack of clear focus on how ICT should run to support teaching and the new educational paradigm. Administration is reported to still circulate sheets of hard-copied information by couriers to schedule meetings. Reportedly, faculty is apathetic to professional development training programs, which is consistent with reports by Anderson (2003) and Plomp, et al (2003) in similar studies around the globe.

While some departments are redefining their agenda with the aim of promoting distance learning via ICT, others are investing in relevant equipment such as printers, projectors, and copiers. Lecturers interested in pursuing ICT for teaching are supported with diverse incentives by some departments. Leadership and other human and non-human support are demanded to keep the African Virtual University buoyant since it has the potential to serve more students in real time. Various recommendations to improve performances were also offered by the faculty. For example, computer literacy was recommended as a condition for appointing new faculty. In lieu of that, adequate training for all teaching faculty on how to integrate ICT into teaching and the curriculum is proposed.

According to a participant, "*If for nothing at all, faculty should have the basic skills of how to convert their lecture notes into PowerPoint presentations*", which suggests strong opinions about the need for professional development programs and continuous training. Refurbishing lecture theatres and access to laptop by every faculty member for course delivery and scholarly presentations are proposed. Others suggested commitment of university authorities into providing adequate computers to staff and students, in addition to, fully-digitized libraries and multipurpose laboratories to facilitate teaching and learning and match up with exponential increase in student population. Younger faculty complained about general skepticism of senior faculty about the efficacy of ICT skills in teaching and learning in their departments, and recommended a change in attitude. Continuous training in ICT is recommended for both non-ICT faculty and supporting staff to improve skills and reduce frustrations associated with lack of expertise. Education is independent of technology and pedagogy, and vice versa. There can be no excellence in teaching, learning and research with ICT without measurable performance indicators and outcomes.

Conclusion

This study focused on providing a comprehensive view of ICT integration in higher education in a developing country from the perspective of one of those impacted by its utilization. It examined computer attitudes, and the impact of personal characteristics together with information and communication technology adoption patterns on performance of teaching faculty. The research was constructed within the theoretical framework of Selwyn's Computer Attitude (1997), Rogers' Innovation-Diffusion (2003. 1995), and the ISTE Performance Standards (ISTE, 2000)

A cross-sectional research design was employed in surveying three public universities and randomly sampled multidiscipline academic staff in Ghana, West Africa. Mixed methods of qualitative and quantitative instruments were employed in collecting data and information. Independent variables measured were computer attitude with levels of affective, behavioral, control, and usefulness constructs. Personal characteristics were represented by age, gender, academic discipline, professional status, and average number of hours spent on ICT or computer technology per day, plus years of teaching experience. Academic discipline comprised an aggregate of seven departments: a) Agriculture, b) Arts, Humanities and Social Studies, c) Business, d) Computer Science, e) Education, f) Engineering, and g) Science, Medicine and Nursing. Levels of professional status factors consisted of professors, associate professors, senior lecturers, lecturers, and teaching and research assistants. Four ICT adoption patterns of computer purchase, general use, teaching, and research with five levels of innovators, early adopters, early majority, and laggards were measured. The dependent variable was ICT performance comprising: a) technology operations and concepts, b) planning and designing the learning environment, c) teaching, learning and curriculum design, d) assessments and evaluation, e) productivity and professional practice, and f) social, ethical, legal, and human issues.

Pooled data were analyzed with MS Excel 2007 and SPSS 17.0/18.0 and involved reliability, descriptive and multivariate analyses. Multivariate analysis of variance (MANOVA) provided evidence of mean differences between age, gender, academic discipline, professional status, and six ICT performance factor levels, while multiple regression analysis (MRA) was applied in the estimation of modular tracks. Structured and unstructured interviews were analyzed for thematic patterns and triangulation. Complementary factors included specific computer applications.

Findings of the study show that all instruments designed and modified to assess and measure defined parameters are valid and robust. Inter-rater and internal consistency reliabilities are high and above 70% (between 74 and 95%). For example, Cronbach's alpha (α) scores of computer attitude are found consistent with the original (Selwyn, 1997) and that of similar studies (Cázares, 2010; Jegede, et al, 2007). Each of the other instruments provided reliability indices for estimating ICT adoption patterns, performance, and other control factors indicted, implying the instruments can be used as standalone index or composite indices for similar studies and parameters specified.

Results of teaching staff's demography are reminiscent of a typical pattern in any conventional university or institute of higher learning. Patterns of ranks, gender ratio, academic discipline, and levels of achievement of subject matter expertise are consistent and relevant to performing effective pedagogical and research functions. Exceptional large class sizes are major concern for meaningful class management, effective pedagogy and supervision of students' projects. Potential adverse effects are inefficiencies due to high student to teacher ratio and inadequate lecture theaters or classrooms to support the teaching-learning process and students' achievement. Demography does matter for technical change and innovation adoption. It is essential for understanding direct relationships with personal teaching and learning philosophy, expertise, and meeting specific and alternative requirements and needs of both students and the teaching staff. Information provided an avenue for understanding the inferential relationships with others such as inherent intrinsic and extrinsic factors to ICT adoption, utilization, and performance.

Results on ICT or computer attitude support existing evidence of overall scores and that of the four indicators, but vary with similar studies on perceived affective and usefulness constructs (see Cázares, 2010; Chin, n.d; Jegede, et al., 2007; Selwyn, 1997). Affective and usefulness constructs dominated in predicting ICT or computer attitude. Control component was the least dominant factor. Results could form the basis for diagnosis and management of problems associated with ICT acceptance and utilization. Relevance of these antecedent factors for practice is the ability to overcome technophobia and develop favorable attitudes towards ICT and computers for better adoption and integration. For example, understanding the dynamics of human-computer-interactions could help in designing supportive computer-related learning environments and interventions based on subjective human behaviors such as attitude (affective, usefulness, behavioral and control), aptitude, motivation, and self-efficacy. Being aware of the results could possibly change attitude and empower the teachers to develop skills required to survive in high-tech society and education community. Further research to categorize variations in computer attitude scores and other variables such as gender, age, academic status, and subject areas is proposed.

Differential thresholds are reported for four adoption models of computer purchase, general use, teaching, and research. Results show ICT adoption by computer purchase peaked between 2000 and 2005 at nearly 44% compared to teaching at 39%, research at 34% and general use at 23%. However, cumulative adoption percentages over the same period are highest for general use (97%), followed by research (93%), computer purchase (86%), and teaching (63%). Initial adoption of ICT and computer technology before 1990 was for general use such as presentations, word processing, communication via emails and similar functions. Adoption for research and teaching increased modestly over time with the latter lagging by the first quarter of 2010. General use is declining with increasing application of ICT for professional practice. ICT adoption was further explained by number of hours spent on the computer per day and types of application. On the whole, the teaching faculty is moderately situated in the furtherance of ICT applications for pedagogy and online teaching. Patterns of adoption support Rogers (2003. 1995), but differ in categorization. For example, late majority and laggards are significantly differentiated from the classical categorization by their innovativeness and high performance. Further study is proposed for validation.

Multivariate analysis of variance (MANOVA) showed significant differences in mean scores of the six ICT performance factor levels, a) technology operations and concepts, b) planning and designing the learning environment, c) teaching, learning and curriculum design, d) assessments and evaluation, e) productivity and professional practice, and f) social, ethical, legal and human issues due to differences in age and academic discipline. For example, mean scores were unequal across all six performance factor levels on differences in academic discipline in support of the a priori hypotheses; however, age variables were significantly different for only two out of the six performance factor levels indicated by technical operations and concepts (TOC), and planning and developing the learning environment (PDLEE). A priori hypothesis is partially supported. Eta-squared score ranged between 10 and 17% at $F(4; 153)$ for age; and 11 and 17% at $F(6; 150)$ for academic discipline at $p < .01$.

Research required all indicated variables be explored for possible relationships and strength in the MRA estimations. Age was inversely correlated with ICT performance implying declining performance with age progression. Independently, age was consistently large and significant on all four regression models and accounted for between 30 and 36% ICT performance impact at $p < .01$. Younger faculty performed relatively best and could serve as catalyst for growth and development of ICT integration in higher education. Professional development programs are recommended to support older faculty performance.

Average number of hours spent on ICT per day factor is positive, large and significant and accounted for between 29 and 32% of ICT performance impact, holding all other factors constant. In converse, mixed results were estimated for professional status variables with lecturers accounting for medium statistically significant performance impact at 34% in MRA1, and associate professors at 24% in MRA2 at $p < .05$, holding other variables fixed.

Computer Science and Engineering predicted statistically significant impact on performance in all four MRAs; from a 17% to medium 28% compared to other covariates such as Education. Results are expected since these subjects involve ICT related courses, curriculum and devices. Learning and course management systems could commence from these disciplines and departments and replicated serially in others with performance indicators and outcomes, tracking strategies, and evaluation plans.

Mixed results are reported for ICT adoption patterns. For example, regression coefficient for early adopters is computed at 26% in MRA1 where the adoption pattern is represented by computer purchase. Late majority and laggards are estimated at large significant performance impact at 39% and 52% in MRA3 respectively, where ICT adoption is represented by teaching, and innovators at 18% in MRA4 at $p < .05$ and .01. ICT adoption category is represented by research in MRA4. All independent variables considered, laggards predicted the highest statistically significant ICT performance impact. Characterizing this cohort as “local and traditional” with limited opinion (Rogers, 2003) is not supported in this study.

Complex milieu of prospects and drawbacks are reported. For example, public universities are continuously challenged with ICT capital infrastructure such as limited bandwidth and slow Internet access, plus sporadic telecommunication and electricity power supply. Primarily, they depend on central government subventions for most of their development agenda. Electricity power is supplied via the national grid. Though GIMPA has financial autonomy it is a public institution with a degree of dependency on the central government. Solving problems associated with this major capital infrastructure would substantially and positively influence ICT access at all levels.

Inadequate multimedia classrooms and lecture theaters to support pedagogical practices are indicated. No quality ICT-related professional training and development programs exist for continued advancement. Micro level performance indicators show very wide disparities in ICT for professional practice between experts and novices, young and old faculty, academic ranks, and across subject disciplines. ICT seems to be a preserve for Computer Science and Engineering academic staff.

The teaching faculty is moderately prepared, and needs self-directed learning and institutional support to develop the distinctive set of ICT-related skills. Such skills should include basic computer applications, content management, online instruction design, and courseware development in order to perform effective pedagogical, managerial, social and technical functions through and with ICT media.

All research sites have well designed ICT policies. Excellent core and elective science and technology-related subjects such as information and technology systems, programming, computer science, and information management systems are offered in the universities. However, teaching and learning through ICT is less emphasized, which is consistent with global practices in the 1990s when ICT was primarily studied as a subject (Anderson, 2003; Plomp, et al, 2003). With ICT access and continuous practice, the teaching faculty can develop required competencies for improved performance. Professional development programs could foster sustained change in individual knowledge, skills and attitude towards educational technology, design of technology-based learning experiences and curriculum, and research. Further studies are required to explore relationships between ICT-related professional development programs, teachers learning and performance, and student achievements.

Improving professional competencies and performances are moderating factors for autonomy, confidence and self-efficacy. Though skilled in conventional teaching and subject matter, sufficient attention to technology application for pedagogical purpose is required to maintain online discourse due to the demands and requirements of educational technology

(Spector & de la Teja, 2001) and distance education. “The game is evolving..., and increasingly we are finding out that our independent variables are no longer independent and that the neat and simple construct that served us so beautifully in the past is no longer effective” (Gharajedaghi, 2006, p. 13).

Recommendations

Higher education across the globe is increasingly relying on ICT and related-educational technology such as course management systems for pedagogy and managerial functions. Based on evidence from the study, the following recommendations are made under micro, macro and mega levels for possible improvement in practices and policies. Suggestions are not for radical change, but for gradual management of micro successes and existing structures to achieving overarching goals of integrating ICT to improve the teaching and learning process. All players have to collaborate for desired change and impact.

Micro Level: Teaching Faculty

Academic staff in all three universities exhibited positive ICT/computer attitude and is reasonably poised to perform or engage in learning how to incorporate the capabilities of the ICT media in teaching, learning and research. While few can perform expertly as ICT resourced-based teachers, many are still novices with low to no proficiencies. Very few are taking individual initiatives to navigate the ambiguities of connecting ICT-based learning management systems in the classroom, curriculum and at departmental levels. For effective design of integrated ICT-related instruction, curriculum, and course management systems, the following are proposed besides individual efforts: a) learning communities, b) ICT-based professional development programs, and c) technology-based teaching and research consulting.

Learning communities: The scholarship of teaching and learning requires faculty to view teaching as an intellectually challenging scholarly work that should be studied, discussed, shared with colleagues, and reviewed not only by students, but by peers (NSSE, 2009). Learning communities or communities of practice should be made part of the services at the various senior staff club houses for collaborative teaching and learning practice. Small groups of individuals can meet regularly to explore and update their knowledge and skills in ICT media and strategies to restructure the curriculum and share ideas on current research and publications. Mode of interaction can be physical and face-to-face, technological through electronic social networking communication media or in combinations of physical and technological.

A community of practice (COP) is a very valuable practice for educational innovation and is reported as one of the promising models to supporting the performance of tutors or teachers in a computer technology-based learning environment (Nett, 2008). Support from faculty from the sciences, engineering and computer technology-related departments could benefit others in application and development of multimedia such as animations, graphics, and simulations to enrich academic and personal practices. Findings in this study indicate that younger faculty is more technology savoir-faire; hence, their services could be employed as part of the learning community initiatives. Making learning ICT part of the senior club services could provide the needed privacy and convenient environment for all types of learners.

Professional development programs: ICT use for teaching and learning is complex, multidimensional and requires support in diverse ways, because, “the response to demand for education cannot be reduced to issues of simple access to technology” (Assié-Lumumba, 2003b; p 375). Increasing demand for higher education requires better alternatives to conventional practice through effective and customized professional development. Collegial attention to technology-related pedagogy is inadequate. Faculty recommended orientation and continuous support for novice and older faculty in order to access available ICT resources and media in the universities. Providing high-quality professional development could positively influence teachers' knowledge and skills, in addition to, supporting their ability to explore digitized resources, alternative pedagogical strategies, and emerging educational practices.

Through the ICT centers, structured and walk-in professional development programs on ICT related topics, instructional media and resources, and online courses with hands-on-experience could be organized for those interested in going this route. Rigid professional development schedules are not workable considering faculty schedules and workloads. Those interested could be supported, motivated and compensated with incentives such as personal computers, laptops and hand-held projectors for continuous usage and improvement in performance. Hand-held and mobile ICT peripherals are, particularly, important and applicable in situations where classrooms are shared between subjects and departments.

ICT-based learning and research consulting: Challenges to integrating ICT in higher education are multifaceted in Ghana; from inability to access official university email address to inadequate capital infrastructural investment. For example, most teaching faculty uses unofficial email addresses for official communication due to inefficient maintenance of university-based webmail databases and websites. Students in these higher institutions of learning predominantly depend on dated print-media and photocopies to supplement conventional classroom lecture. Intermittent electricity supply and slow Internet access is thwarting teachers' motivation and professional growth in technology-based practices. Access to online research and publication databases are limited. For example, only two electronic databases: EBSCO and EMERALD were listed by faculty in this study.

Consequently, ICT-based learning and research consulting is proposed to provide a variety of services through the different transitioning phases. Digitized libraries could help keep faculty current on emerging research issues, trends and design methodology, analysis and reporting since myriad Internet sources, resources and databases abound to support faculty research initiatives (see Provenzo, 2005). Consulting with instructional technology and design professionals can situate teachers in proper positions to design and develop relevant technology-based curriculum and instruction based on contextual merits and demerits. In addition, many Web 2.0 tools and open source programs could be exploited for relevance in the midst of inadequate finance and commercial products. Web 2.0 is an umbrella term for second wave of evolution to a more social interactive Web that engages individuals and groups to create, share, organize and publish on the Internet (Berger & Trexter, 2010).

Highly educated workers have comparative advantage with respect to adjustment and implementation of new technology (Bartel & Lichtenberg, 1987). Level of human capital in ICT to a large extent is a function of combined personal traits, education, expertise in technology operations and concepts, and levels of performance. Level of expertise depends on exposure through accessing and practicing the technology nuances, while adoption decision is dependent on attitude and perceived capabilities of the medium to improving existing structures and modus operandi. ICT in higher education is not a preserve for only Engineering and Computer Science faculty and departments. All multidisciplinary faculty and students can engage via computer mediated communication technology for pedagogy and learning. Hence, individual faculty has to initiate the process of advancement in professional and personal practices, given that capital infrastructure and support systems are well-resourced in the universities. Faculty should be able to learn the nuances of educational technology and extend the expertise to their students, courseware, curriculum and teaching in response to the ICT policy in Ghana (IC4AD, 2003).

Macro Level: Higher Education and the Universities

Despite continuous developments by the government and other external agencies in the universities, the biggest challenge besides infrastructure is designing and merging instruction and pedagogy with ICT innovation, which in most part, is the responsibility of the universities. Prahalad (2010) argued "executives are constrained not by resources but by their imagination, and if [they] look for ways to develop next practices, opportunities abound" (p. 32). Based on findings in the study, the following recommendations are made:

Needs analysis and evaluation: Inadequate knowledge in learning and teaching through ICT and types of available resources to influence practice and performance exist in the universities. Feasibility studies regarding needs assessment, analysis and evaluation are suggested to quantify direct and indirect benefits and costs of using the ICT medium for different learning and course management systems and research. Performance discrepancies can occur due to inadequate knowledge, personal interactions, policy conflicts, unacceptable practices (Mager & Pipe, 1997); hence, the need for this exercise. Evaluating for valued judgment based on relative consequences and paybacks accruing from either ignoring or fixing performance gaps could help in designing high-quality cutting edge services and interventions. Doing nothing is an option that has to be evaluated for its consequences.

***ICT teaching and resource centers*:** Few departmental ICT center exist to assist, primarily, graduate students, which are commendable; however, none was observed exclusively for the teaching staff. Besides regular omnibus ICT centers, it is proposed that purposeful well-resourced ICT centers for academic staff be established as a means to best help them to develop the necessary skills sets and to succeed. The ICT/technology resource center should have: a) improved Internet access with high bandwidth connections through which tons of multidisciplinary pedagogical and research materials can be accessed and customized to enhance the teaching and learning process; b) enhanced technology-rich learning environments; at least one multimedia classroom in each department to assist faculty in the selection and application of appropriate pedagogical resources, c) training to trouble-shoot simple technology-related problems, d) online instructional design consulting department to assist staff with a variety of instructional media, designs, multimedia application, and support systems, and e) supporting walk-in help centers to promptly trouble-shoot technical glitches. Creating liaison coordinators positions could bridge the communication and performance gaps between academic departments, faculty and students.

Course management systems: Universities prioritize research to inform individual and community practice. It is recommended that the universities conduct research and pilot test secured learning and course management systems (CMS), commencing with Web 2.0s and open-sources. The results could provide the basis for decision making. Experimenting with these tools can afford both staff and students the opportunity to communicate via myriad tools without students commuting from long distances to submit assignments. Implementing CMS through universities' websites can afford students the chance to access course documents and materials faster and easily. It can reduce the drudgery of queuing to photocopy dated materials as observed in this study. Academic staff desiring to integrate ICT for presentations, workshops, seminars, and online teaching must be supported with relevant incentives. They should be helped to move their courses online in order to increase enrollment of potential students to receive same education and degrees as regular students at a “distance”

Leadership and support: Inherent bureaucratic and conflicts of interest could stifle adoption and implementation of ICT. However, performance outcomes depend on prioritization and improvement efforts, while course of action is a strategic function of good leadership and clear focus. Effective and efficient ICT leadership and university administrative support are proposed as a result of reported apathy from authority. Improving performance means commitment and constant monitoring of change and management. Collaborating to explore emerging technology media for scholarly enterprise is a possibility. Pedagogy is and has never been independent of technology. Resources including hardware and software should be made available at affordable costs or for free to foster purposeful ICT integration in teaching and learning. Sustaining and stabilizing performance and adoption trends are prerogatives of these educational institutions.

Mega Level: National Policy

University teachers are highly-educated individuals with the potential to accelerate ICT adoption rate and diffusion for intended purpose. They can reach out to more regular and potential students with enhanced set of skill supported with perceived benefits and capabilities of the ICT medium. However, reported ICT policies in education seem more allegorical than realistic. Hardly is it implied in innovation-diffusion research that the source or channel of innovation is the cause of failure or promoter of unsustainable innovation.

Again, based on evidence from this study, the following are recommended at the mega or national level.

Capital infrastructure: Universities cannot function effectively with unreliable and inadequate capital infrastructure, and it is meaningless to have many people trained without the necessary tools to work with. As public institutions, primarily, supported by the government, the universities have to be supported with efficient capital infrastructure such as telecommunication and electricity power supply. Findings of this study showed the typical consumers of these services in Ghana including students and staff hold multiple Internet providers, mobile telephony and other telecommunication services in anticipation for failures and non-functional services. General practices and services are characterized by inefficiencies, latitude and lack of consumer protection. Still new to trade liberalization and its concomitants, the government has to enforce better regulatory procedures and customer protection against corrupt and inefficient corporations to ensure better services for its citizenry. It makes no sense to hold many inefficient mobile telephony and Internet services in anticipation for failure. Somebody should account for such failures and inefficiencies.

Income levels: Most teaching faculty complained of unaffordable and high cost of ICT and related devices since ICT programs are inadequately funded in the universities. To offset these inadequacies, levels of income should reflect the economic capacity of the individual academic staff to afford teaching and research software to commensurate performances. Essentially economic, promoting ICT growth depends on investment to developing, adopting and diffusing the technology without which the process will stall. Individuals should be able to make financial commitments to the acquisition of required devices to aggregate expertise and computer attitudes across disciplines in order to achieve the national goals in education. The goal of making all graduates sufficiently computer literate by 2015 and similar plans (ICT4AD, 2003) are just mirages without funding. Culminating teachers' performance is the support they receive from the universities and the government. The government can provide small seed grants for faculty to enhance their technology skills and to become more innovative with more supervision and accountability.

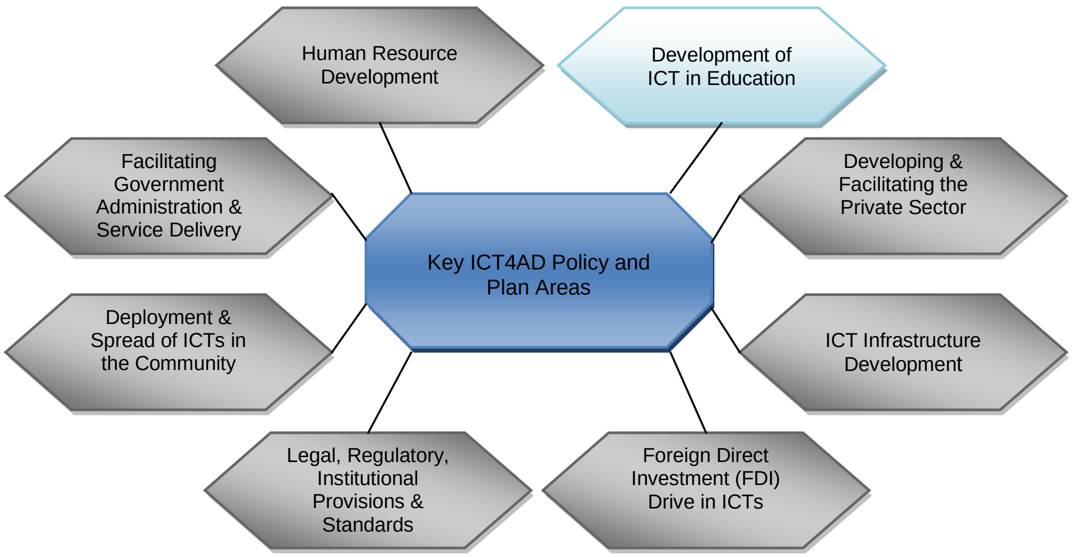
Performance tracking: Performance is enhanced through effective tracking, monitoring and evaluation. Projects and programs developed by foreign agents for developing countries are important, but sometimes contextually flawed. African countries need not always depend on foreign aid and responding to external peer pressure. For example, the African Virtual University projects of the World Bank are in distressed in all three public universities in Ghana as a result of inadequate feasibility studies, lack of clear focus, managerial, financial, and human resources. Keeping in mind limitations of scarce capital resources and opportunities associated with providing quality education to more prospective students at a distance in real time, it is important for higher educational institutions to focus on performance indicators that facilitate and increase growth, rather than omnibus implementations with low impact. Rogers (1998) asserted, oftentimes foreign investment comes without maintenance and sustainability package, which corroborates observed and existing structures in the current study. Needs assessment, performance tracking and evaluation are proposed to situate challenges and prospects in their proper contexts. Results of this study implied the university teachers have the right attitude to embrace ICT for pedagogy and research, but lack the tools and support to function effectively. Supporting teachers with adequate resources can generate and sustain required knowledge and classroom practices to impact students learning outcomes.

Limitations of the Study and Future Research

Investigated phenomena are comprehensively significant with implications for mega, macro, and micro level policies and practices. However, the study involved only three out of seven public higher educational institutions and universities in Ghana. Further studies would be desirable in all other universities for general academic and practical significance. Second, this study emphasized only percentile description of overall computer attitude in relation to perceived affective, usefulness, control and behavioral constructs. Further studies could be decomposed on demographic factors such as age, gender, professional status, and academic discipline to examine their influence differentially. Third, pro-innovation bias has been ignored in innovation-adoption research; however, the result indicates late majority and laggards outperformed all members in the adopter categories and other research factors. Characterizing laggards as traditional and locals with limited knowledge and no opinions is inconsistent with these results; hence, auxiliary studies are proposed in the context of evolving technology innovation, personality profiles, and adopter categorization. For example, unlike a type of car model or agro-chemical, ICT is dynamic with various players entering and exiting the arena.

ICT adoption was examined with a cross-sectional survey design, which could impact the innovations' adoption and performance. Longitudinal studies of the population studied are recommended to determine differences in results from series of data points from over a period of time. Distinctively, the teaching faculty's performance did not reflect practices in each of their affiliated institutions because a pooled sample from the three universities was used for analysis. It is recommended the study be replicated in the individual universities for atypical themes and patterns. It is important each university knows what the academic staff is doing to drive the ICT agenda for teaching, learning, and research. Peer institutional performances could be benchmarked against each other for comparability and purposeful improvement. Exploring needs, indicators and levels of innovativeness and the means to improve it, is vital for both theory and practice (Nasierowski, 2010).

APPENDIX A: THE NATIONWIDE ICT POLICY AND DEVELOPMENT PLAN (ICT4AD, 2003).



Source: Adapted from The Republic of Ghana: An Integrated ICT led Socio-economic development policy and plan development framework for Ghana http://unpan1.un.org/intradoc/groups/public/documents/un/unpan032381.pdf

APPENDIX B: SAMPLE LETTER REQUESTING APPROVAL TO CONDUCT STUDY AT RESEARCH SITES

JOSEPHINE A. LARBI-APAU
PHD Candidate, MPS, MPHIL
Instructional Technology
Department of Administrative & Organizational Studies
College of Education Building
Wayne State University, Detroit MI 48202

20925 Lasher Rd
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Southfield, MI 48033
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Fax: (248) 327-6207
jlarbiapau@wayne.edu
jlarbiapau@gmail.com

LEADERSHIP & EXCELLENC

July 17, 2009
The Office of the Vice-Chancellor
University of Cape Coast
Cape Coast

Dear Vice-Chancellor:

I am a Ghanaian and PhD student at Wayne State University (WSU), College of Education, Department of Administrative and Organizational Studies, Detroit, Michigan, USA. My major is Instructional and Human Performance Technology with a cognate in Management and International Development, and I intend to conduct a field study for my dissertation on Educational Technology, specifically, on teaching faculty who integrate information and communication technology in higher education in Ghana.

This exploratory study will help in understanding where information communication and technology (ICT), instructional strategies, personal influence, and performance merge for meaningful learning and application. The results of the study could help in diagnosing personal challenges and determine workable solutions for promoting better ICT implementation and integration, with predictable ripple effects on secondary and teacher education. Selected public universities for the field study are the Ghana Institute of Management and Public Administration, Achimota, the University of Cape Coast, Coast, and the Kwame Nkrumah University of Science and Technology, Kumasi.

In fulfilling the policy requirements of PhD proposal prospectus, I am obliged to submit to the Human Investigation Committee (HIC) at Wayne State University a Formal Letter of Approval from the Vice-chancellors and the Rector of the Universities permitting that I carry out this field study at the selected sites. The Human Investigation Committee oversees and ensures safe and ethical conduct of human participant research by all WSU faculty, staff and students. By this letter, I am requesting your approval in writing to fulfill the requirements of the HIC proviso and to conduct this study on your campus from January 2010 to March 2010. The proposal will be submitted to the HIC by the end of August, 2009.

I am an alumnae of the University of Cape Coast (B.S. (Honors) Agriculture), the University of Ghana, Legon (Master of Philosophy, Agricultural Administration), and Cornell University, Ithaca, USA (Master of Professional Studies, International Development). While in Ghana, I worked as an Assistant Director with the Ministry of Education and a teacher at Aburi Girls', Mfantsiman Girls' and Achimota Secondary Schools.

I would be grateful to receive your written response before the due date, ending August, 2009.

Should you need additional information, please contact me though my e-mail for quick delivery.

Thank you.

Sincerely,

Josephine A. Larbi-Apau (Mrs.)
(PhD candidate, Instructional Technology)

APPENDIX C(i): LETTERS OF APPROVAL: ISTE

Permission BY EMAIL from Tina Wells, Book & Production Editor of the International Society for Technology in Education (ISTE-NETS-T) to use the ISTE Standards.

From: Tina Wells <twells@iste.org>
To: Josephine Larbi-Apau <jlarbiapau@gmail.com>
cc: Tina Wells <twells@iste.org>
Date: Fri, Oct 30, 2009 at 5:08 PM
Subject: Re: NETS T Standards 2000, Josephine Larbi-Apau

Dear Josephine Larbi-Apau,

Thank you for your request for permission to use ISTE's National Educational Technology Standards for Teachers. Please note that the NETS.T was updated in 2008. We prefer that you reference the 2008 edition rather than the 2000 edition. You may order a print copy of NETS.T 2008 edition from ISTE (the booklet includes helpful rubrics in addition to the standards) and your may access the revised 2008 standards from our website:
http://www.iste.org/Content/NavigationMenu/NETS/ForTeachers/2008Standards/NETS_for_Teachers_2008.htm

As long as your usage is noncommercial, not for profit, and for educational purposes only, you have our permission to use the NETS.T for the purpose described below. The rights granted herein are non-exclusive, non-transferable, print rights only. Please use the following credit lines in all uses of the material: NETS for Teachers.

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If the NETS are altered, then 1) you must not call your adaptation NETS and 2) you must indicate where the complete (unaltered) NETS can be found.

Please let us know if we can be of additional assistance. We wish you every success with your assessments.

Best regards,

Tina Wells
Book Production Editor
Rights & Permissions
International Society for
Technology in Education
541.434.8925
twells@iste.org

APPENDIX C(ii): LETTERS OF APPROVAL: UCC

UNIVERSITY OF CAPE COAST

CAPE COAST, GHANA

OFFICE OF THE VICE-CHANCELLOR

Telephone: 233-42-32378 Direct: 042-32050
Telex: 2552, UCC, GH.
Fax: 233-42-32485
E-mail: vc_ucc@yahoo.com

Telegrams & Cables:
UNIVERSITY, CAPE COAST

Our Ref: VC/V/2/Vol.

Your Ref:

August 11, 2009

Mrs. Josephine A. Larbi-Apau,
20925 Lasher Road,
Apt 610,
Southfield, MI 48033.
U. S. A.

Dear Mrs. Larbi-Apau,

RE: LETTER OF APPROVAL : JOSEPHINE A. LARBI-APAU (MRS.)

I write to acknowledge receipt of your letter of July 17, 2009 requesting for permission to conduct field study in the University.

I wish to inform you that you can conduct the field study in the University for the period stated.

Thank you.

Yours sincerely,

nOpoku-Agyemang

Prof. Naana J. Opoku-Agyemang
VICE-CHANCELLOR

cc: File VC/R/13

APPENDIX C(iii): LETTERS OF APPROVAL: KNUST

KWAME NKRUMAH
UNIVERSITY OF SCIENCE
AND TECHNOLOGY

Private Mail Bag
University Post Office
Kumasi, Ghana

Tel: 233-51-60331
Fax: 233-51-60137
E-mail: registrar@knust.edu.gh
Website: www.knust.edu.gh

OFFICE OF THE REGISTRAR

DR/GEN/SF.1/VOL. 3

5th August, 2009

MRS JOSEPHINE A. LARBI-APAU
WAYNE STATE UNIVERSITY
USA

APPROVAL TO CONDUCT SURVEY

Reference to your letter dated July 17, 2009, approval has been granted for you to conduct your study on KNUST Campus from January, 2010 to March, 2010.

For your accommodation, you may contact Engineering Guesthouse on Telephone Number 051 – 63078 or KCCR on Telephone Numbers 051 – 60351, 60511 for the necessary arrangement.

Regards.

PAUL PINAMAN ADADE
ASSISTANT REGISTRAR (GENERAL)
FOR: REGISTRAR

APPENDIX C(iv): LETTERS OF APPROVAL: GIMPA

GHANA INSTITUTE OF MANAGEMENT AND PUBLIC ADMINISTRATION (GIMPA)

MOTTO: EXCELLENCE IN LEADERSHIP, MANAGEMENT AND ADMINISTRATION

Our Ref:...............................

Your Ref:............................

P. O. Box AH 50
Achimota, Accra

25th November, 2009.

Josephine Larbi-Apau,
PhD student
Wayne State University
Instructional Technology/HPT
Detroit MI
U.S.A.

Dear Madam,

RE: APPROVAL REQUEST

This is to inform you that you have the approval of the Management of GIMPA to undertake an exploratory research on our campus, as part of the requirements for your PhD programme.

You are required to indicate the actual period you will be at GIMPA, the specific Schools/Units/Centres you will be dealing with, so as to inform them before hand.

It is our hope that the outcome of the research would be beneficial to all parties.

We look forward to welcoming you next year, and thank you for choosing our Institution.

Yours sincerely,

Professor Yaw Agyeman Badu
RECTOR

APPENDIX D: T-FIIPHE QUESTIONNAIRE

TEACHING FACULTY ICT/COMPUTER TECHNOLOGY INTEGRATION SURVEY

This survey is designed to capture the individual teaching faculty's ICT/Computer technology use. The purpose is to determine where information communication and technology, instructional strategies, personal influence, and performance merge for meaningful learning and application. Your response will be treated with the utmost confidentiality, and only GROUP data will be reported as the outcome of this study. This questionnaire will take approximately **45 minutes** to complete. Thank you for your time and input.

A. DEMOGRAPHY

This section of the study is designed to gather demographic data on individuals who respond to this survey. Please respond to questions **1 to 13** as applicable.

1. Gender

    - ❑ Female
    - ❑ Male

2. Age

    -- (years)

3. What is the type of your appointment or contract?

    - ❑ Full-time
    - ❑ Adjunct or Part-time

    Other (please specify) ---

4. What is your academic rank?

    - ❑ Professor Emeritus/Emeriti
    - ❑ Professor
    - ❑ Associate Professor
    - ❑ Assistant Professor
    - ❑ Senior Lecturer
    - ❑ Lecturer
    - ❑ Teaching/Research Assistant

    Other (please specify) ---

5. What is your administrative position/office?

    - ❑ Pro Vice Chancellor
    - ❑ Dean
    - ❑ Head of Department
    - ❑ Assistant Head/Dean

    Other (please specify) ---

6. How many years, in total, have you been a member of the academic/university teaching staff?

   --------------------------------- (years)

7. Which of the following institutions is your primary affiliation?

   - ❑ Ghana Institute for Management and Public Administration, Achimota
   - ❑ University of Cape Coast
   - ❑ Kwame Nkrumah University of Science and Technology, Kumasi

8. In which Faculty/Department and area do you hold your major appointment? Select all that apply.

   - ❑ Agriculture
     Please specify your specialty

   - ❑ Arts/Humanities/Social Science
     Please specify your specialty

   - ❑ Business
     Please specify your area of specialty

   - ❑ Science/Medicine
     Please specify your area of specialty

   - ❑ Engineering
     Please specify your specialty

   - ❑ Computer Science
     Please specify your area of specialty

   - ❑ Other Major Program/Department not listed (please specify)

     Please specify your area of specialty
     ----

9. What is the type of student with whom you are engaged?

   - ❑ Undergraduates
   - ❑ Graduates
   - ❑ Both undergraduates and graduates

10. What is the average number of students you teach in one semester?

----

11. Do you supervise students' projects such as Theses and/or Dissertations?

    - ❑ Yes

- ❑ No

12. If you answered; *Yes*, to question 11, please indicate the level.
    - ❑ Undergraduates
    - ❑ Graduates
    - ❑ Both Graduates and Undergraduates

13. How many students, in total, do you currently supervise?

B. COMPUTER/ICT ATTITUDE

The following questions are intended to capture attitude towards the use of ICT/Computer technology. Please, on a scale of **Strongly agree** to **Strongly disagree,** complete questions **14 to 35** based on your level of agreement to each of the statements.

STATEMENT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Affective Component					
14. When I use ICT/computer technology, I am afraid that I might damage it in some way.	❑	❑	❑	❑	❑
15. I hesitate to use ICT/computer technology for fear of making mistakes I cannot correct	❑	❑	❑	❑	❑
16. Using ICT/computer technology does not scare me.	❑	❑	❑	❑	❑
17. I rarely use ICT/computer technology because it makes me feel uncomfortable.	❑	❑	❑	❑	❑
18. I avoid contact with ICT/computer technology at all times.	❑	❑	❑	❑	❑
19. I hesitate to use ICT/computer technology at work in order to avoid looking clumsy to others.	❑	❑	❑	❑	❑
Perceived Usefulness Component					
20. Computers help me to organize my work	❑	❑	❑	❑	❑
21. I am more productive when I use the computer.	❑	❑	❑	❑	❑
22. Computers allow me to do more imaginative work.	❑	❑	❑	❑	❑
23. Using computers help to improve my presentations.	❑	❑	❑	❑	❑
24. I can easily adapt to ICT/computer technology.	❑	❑	❑	❑	❑
Perceived Control Component					
25. I can teach myself most of the things I need to know about computers.	❑	❑	❑	❑	❑

26. I always require the assistance of an expert when I use a computer.	❑	❑	❑	❑	❑
27. I have absolute control when I use a computer and need no assistance.	❑	❑	❑	❑	❑
28. I can solve most application problems when I use computers.	❑	❑	❑	❑	❑
29. I cannot solve any of the ICT/computer-related problems.	❑	❑	❑	❑	❑
Behavioral Component					
30. I avoid a job that requires working with ICT/computer technology.	❑	❑	❑	❑	❑
31. I only use computers at home, not on campus.	❑	❑	❑	❑	❑
32. I only use computers on campus, but not at home.	❑	❑	❑	❑	❑
33. I use ICT/computers when it is absolutory necessary.	❑	❑	❑	❑	❑

34. How often do you use computers for professional work at home?

----

35. How often do you use computers for professional work on campus?

C. PATTERNS OF ICT/COMPUTER-TECHNOLOGY USE

The following questions **36 to 48** gather information about individual computer/ICT adoption, initial use, and support systems. Please select the response that best represents your experience, opinion, or situation.

Computer Access and Initial Use

36. Do you own a personal computer?

❑ Yes ❑ No

37. In what year did you FIRST PURCHASE a personal or home computer?

----------------------------------- (year)

38. In what year did you FIRST USE the computer for personal, academic or professional engagement such as e-mail, presentation, word processing, etc?

----------------------------------- (year)

39. In what role did you FIRST USE the computer on campus?

❑ As a secondary school student
❑ As an undergraduate student

- ❑ As a graduate student
- ❑ As a pre-college/university teacher
- ❑ As a new faculty member
- ❑ As experienced faculty member
- ❑ Have never used computers before

Other (please specify) ---

40. In what year did you FIRST USE the computer for teaching?

-- (year)

41. In what year did you FIRST USE the computer for research (e.g., retrieve information, data collection, data analysis, etc)?

--------------------------------------- (year)

42. Do you have EXCLUSIVE access to the computer for PROFESSIONAL use?

❑ Yes ❑ No

43. Do you have READY ACCESS to the computer including teaching and research software on campus?

❑ Yes ❑ No

44. Do you personally purchase teaching and research software for use?

❑ Yes ❑ No

45. How did you acquire your INITIAL computer skills?

- ❑ Self-teaching
- ❑ Formal courses
- ❑ Both self-teaching and formal courses
- ❑ From a student
- ❑ From a colleague
- ❑ From ICT support staff

Other (please specify) ---

46. On the average, how many hours do you spend on the computer per day?

------------------------ (Hours)

47. Do you teach computer science or ICT-related subject(s) (or ever taught any of these subjects)?

❑ Yes ❑ No

48. If you answered, **Yes** to question 47, what is/was the typical course level?

- ❑ Pre-secondary school level
- ❑ Secondary school level

- ❑ Undergraduate level
- ❑ Graduate level

Other (please specify) --

D. ICT/COMPUTER-TECHNOLOGY PERFORMANCE LEVELS

These questions are based on the International Society for Technology Education (ISTE) National Education Technology Standards for Teachers (ISTE-NETS-T, 2000). On a scale of *Advanced*, *Intermediate, Basic, and Unable*, please complete questions **49 to 80** below by selecting one of the choices that best describes your performance in ICT/Computer – technology for professional tasks.

- *Advanced*: Exceptionally good, and can teach others most ICT/Computer-technology skills for teaching, instruction, curriculum design, and research.
- *Intermediate*: Good, and can access ICT/Computer-technology resources for teaching, learning, and research.
- *Basic*: Can only perform basic ICT/Computer-technology functions.
- *Unable*: Cannot perform any of the ICT/Computer-technology functions.

STATEMENT	Advanced	Intermediate	Basic	Unable
Technology Operations and Concepts				
49. Select ICT/Computer-technology resources available in the University for planning teaching instruction.	❑	❑	❑	❑
50. Utilize ICT/Computer-technology resources available in the University for planning teaching and instruction.	❑	❑	❑	❑
51. Evaluate the effects of ICT/Computer-technology resources available in the University on instructional planning.	❑	❑	❑	❑
52. Select SPECIFIC ICT/Computer-technology resources designed for use by university students to meet SPECIFIC teaching and learning objectives.	❑	❑	❑	❑
53. Utilize SPECIFIC ICT/Computer-technology resources designed for use by university students to meet SPECIFIC teaching and learning objectives.	❑	❑	❑	❑
Planning and Designing Learning Environment				
54. Plan appropriate ICT/Computer –technology activities for teaching and learning activities.	❑	❑	❑	❑
55. Implement appropriate ICT/Computer –technology strategies for teaching and learning activities.	❑	❑	❑	❑
56. Design ICT/Computer-technology enriched learning activities for diverse audience.	❑	❑	❑	❑
57. Plan for potential problems when managing electronic instructional resources within a lesson.	❑	❑	❑	❑
58. Teach ICT/Computer-technology learning activities that connect content standards with student technology standards (students' levels of	❑	❑	❑	❑

performance and diverse needs).				
Teaching, Learning, and Curriculum				
59. Select specific ICT/Computer-technology applications to maximize diverse curriculum requirements.	❑	❑	❑	❑
60. Develop student-centered learning activities and lessons in which students apply ICT/Computer technology tools and resources.	❑	❑	❑	❑
61. Teach student-centered activities and lessons in which students apply ICT/Computer technology tools and resources.	❑	❑	❑	❑
62. Design a lesson that merges content area standards with ICT/Computer technology practices in teaching and learning.	❑	❑	❑	❑
63. Teach a lesson that merges content area standards with ICT/Computer technology practices in teaching and learning.	❑	❑	❑	❑
Assessment and Evaluation				
64. Research the accuracy (relevance, appropriateness, comprehensiveness and bias) of electronic information resources to be used by students.	❑	❑	❑	❑
66. Evaluate the accuracy (relevance, appropriateness, comprehensiveness, and bias) of electronic information (Internet resources to be used by students.	❑	❑	❑	❑
67. Discuss ICT/Computer technology-based assessment and evaluation strategies with students.	❑	❑	❑	❑
68. Assess multiple strategies for evaluating technology-based student products and processes used to create those products.	❑	❑	❑	❑
69. Utilize ICT/Computer technology evaluation tools to evaluate and report student performance data (e.g. assessment and grading protocols).	❑	❑	❑	❑
70. Integrate technology-based assessment strategies for evaluating SPECIFIC learning activities.	❑	❑	❑	❑
Productivity and Professional Practice				
71. Develop a portfolio of technology-based products for general coursework.	❑	❑	❑	❑
72. Develop technology-based opportunities for professional education (including lifelong learning and distance education).	❑	❑	❑	❑
73. Apply online resources to support problem-solving and related decision for maximizing student learning.	❑	❑	❑	❑
74. Participate in online professional collaboration with colleagues and experts.	❑	❑	❑	❑
75. Apply ICT/computer technology productivity tools required for professional tasks (e.g. research).	❑	❑	❑	❑

Social, Ethical, Legal, and Human Issues				
76. Evaluate ICT/Computer technology-related legal and ethical issues, including copyright, privacy, and security of technology systems, data, and information.	❑	❑	❑	❑
77. Apply acceptable policies for the use of ICT/Computer technology in the university, including strategies for addressing threats to security of technology systems, data, and information.	❑	❑	❑	❑
78. Identify issues related to equitable access to technology in the university, community, and home environments.	❑	❑	❑	❑
79. Apply safety and health issues related to computer technology use in the university.	❑	❑	❑	❑
80. Utilize assistive technology to meet the SPECIAL physical needs of students.	❑	❑	❑	❑
81. Evaluate assistive technologies to meet the SPECIAL physical needs of students.	❑	❑	❑	❑

E. INCENTIVES TO INTEGRATE ICT/COMPUTER TECHNOLOGY FOR TEACHING, LEARNING AND RESEARCH

Please on a scale of **Very Important to Very Not Important**, indicate the extent to which the following statements, **82 to 94** influence your decision to integrate ICT/Computer technology for teaching, learning and research.

STATEMENT	Very Important	Important	Neutral	Not important	Very Not Important
82. Economic incentive.	❑	❑	❑	❑	❑
83. Provides better alternative to conventional face-to-face teaching practices.	❑	❑	❑	❑	❑
84. Spends less time to prepare for class.	❑	❑	❑	❑	❑
85. Social prestige.	❑	❑	❑	❑	❑
86. Personal gratification.	❑	❑	❑	❑	❑
87. Previous knowledge and experience.	❑	❑	❑	❑	❑
88. Compatibility with professional goals, needs and requirements.	❑	❑	❑	❑	❑
89. Ability to cope with ICT complexities.	❑	❑	❑	❑	❑
90. Easy to try or experiment with ICT/Computer applications.	❑	❑	❑	❑	❑
91. External support (colleagues, university ICT staff, etc).	❑	❑	❑	❑	❑

92. ICT benefits are visible.	❑	❑	❑	❑	❑
93. ICT benefits are adaptable.	❑	❑	❑	❑	❑
94. Easy access to ICT resources at the Department.	❑	❑	❑	❑	❑

General comments: Please express your general view about ICT/Computer technology integration and how its adoption has influenced student learning, and the way you teach and conduct research.

Student Learning --------------------

Teaching --------------------

Research --------------------

F. BARRIERS TO INTEGRATING ICT/COMPUTER TECHNOLOGY

This section of the study is designed to assess general challenges. How would you rate the following barriers **95 to 111** as a major factor to integrating ICT/Computer technology in education from **A Great Deal** to **Never.**

STATEMENT	A Great Deal	Much	Somewhat	Little	Never
95. Teaching faculty time schedule prevents maximum utilization of ICT/Computer technology for teaching and learning.	❑	❑	❑	❑	❑
96. Many teaching faculty members are not sure of how to integrate ICT/Computer technology in the classroom.	❑	❑	❑	❑	❑
97. Inadequate computers for the number of faculty members on campus.	❑	❑	❑	❑	❑
98. Inadequate computers for the number of students on campus.	❑	❑	❑	❑	❑
99. Inadequate computer peripherals such as printers, scanners and projectors for effective use of ICT for teaching and learning.	❑	❑	❑	❑	❑
100. Hardware is unstable and always dysfunctional.	❑	❑	❑	❑	❑
101. Present curriculum makes no provision for ICT/Computer integration for classroom teaching and learning.	❑	❑	❑	❑	❑
102. Students pay too much to access computers on-campus.	❑	❑	❑	❑	❑
103. Students pay too much to use computers off-campus.	❑	❑	❑	❑	❑
104. Inadequate university financial support to develop instructional materials.	❑	❑	❑	❑	❑
105. Unreliable telecommunication connectivity/Network access problems.	❑	❑	❑	❑	❑
106. ICT/Computer technology is irrelevant to the course I teach.	❑	❑	❑	❑	❑
107. Inadequate technical support.	❑	❑	❑	❑	❑
108. Generally, faculty is unfamiliar with the convergence ICT/Computer and online instructional design.	❑	❑	❑	❑	❑
109. ICT/Computer technology can be intimidating to novice faculty members in other areas other than computer science.	❑	❑	❑	❑	❑
110. Inadequate professional training to support ICT use.	❑	❑	❑	❑	❑
111. No access to ICT/Computer resources.	❑	❑	❑	❑	❑

General comments: Please use the extra sheets provided to expand on any item(s) in this questionnaire that you would like to discuss or comment.

THANK YOU

APPENDIX E: INTERVIEW PROTOCOL

SPECIFIC PROFICIENCY AND OPINION ABOUT ICT IN HIGHER EDUCATION

This interview is a follow-up to the questionnaire you just completed. It is intended to solicit your views on specific proficiency level and general opinion about ICT in higher education. All information is confidential and will be reported anonymously. You have the right not to answer any question(s) you find uncomfortable. The interview will take approximately **30 minutes** and will be recorded. You would be required to approve the transcribed version before I report. Please, do you have any questions regarding this interview?

Date: January 19, 2010 to April 15, 2010 *Time*: 30mins *Place*: Face-to-Face (Respondent's office)

Interviewer: Josephine A. Larbi-Apau (PI)
Interviewees: 21 respondents (subset of sampled respondents).

1. Would you briefly tell me about yourself and what you do at this university?

2. With which of the following computer operating systems are you familiar, and how will you rank your level of proficiency with the selected applications from a scale of None, Basic, Intermediate, and Advanced? *Thank you.*

OPERATING SYSTEM	Advanced	Intermediate	Basic	None
i. MS-DOS	❑	❑	❑	❑
ii. Macintosh	❑	❑	❑	❑
iii. UNIX/VARIANTS	❑	❑	❑	❑
iv. LINUX/VARIANTS	❑	❑	❑	❑
v. Windows 95	❑	❑	❑	❑
vi. Windows 98	❑	❑	❑	❑
vii. Windows 2000	❑	❑	❑	❑
viii. Windows XP	❑	❑	❑	❑
ix. Windows VISTA	❑	❑	❑	❑
x. Other	❑	❑	❑	❑

3. Is there any particular preference for the selected operating systems? Please explain.

4. On the proficiency scale used previously, please respond to how well you can use the following computer applications and tools?

COMPUTER APPLICATIONS	Advanced	Intermediate	Basic	None
i. Text editing	❑	❑	❑	❑
ii. Word processing	❑	❑	❑	❑
iii. Desktop publishing	❑	❑	❑	❑
iv. Database management	❑	❑	❑	❑

v. Spreadsheet	❑	❑	❑	❑
vi. Graphing/Charting	❑	❑	❑	❑
vii. Statistical package	❑	❑	❑	❑
viii. Music composition	❑	❑	❑	❑
ix. Grading/Assessment package	❑	❑	❑	❑
x. Other	❑	❑	❑	❑

5. Which of these applications do you use frequently, and why?
6. How frequently do you use graphic software and for what purpose?
7. How will you rate your performance on a scale of None to Advanced with the following software applications? For example:

SOFTWARE APPLICATION	Advanced	Intermediate	Basic	None
i. Presentation package	❑	❑	❑	❑
ii. Drawing programs	❑	❑	❑	❑
iii. Clip Art	❑	❑	❑	❑
iv. Drafting	❑	❑	❑	❑
v. Other	❑	❑	❑	❑

8. For what purpose do you use these applications?
9. How would you rank yourself with the following computer communication applications in teaching and interacting with students and/or collaborating with colleagues?

COMMUNICATION	Advanced	Intermediate	Basic	None
i. Email	❑	❑	❑	❑
ii. Newsgroup	❑	❑	❑	❑
iii. Listserv	❑	❑	❑	❑
iv. File Transfer Protocol (Upload/Download files	❑	❑	❑	❑
v. Internet	❑	❑	❑	❑
vi. E-Library/Database	❑	❑	❑	❑
vii. Multimedia Application (Visual, Audio/Text)	❑	❑	❑	❑
viii. Bookmark	❑	❑	❑	❑
ix. Favorites	❑	❑	❑	❑
x. Social networking (e.g., Blogs/Facebook/Twitter)	❑	❑	❑	❑
xi. Other	❑	❑	❑	❑

10. How would you rank yourself with the following instructional courseware

INSTRUCTIONAL COURSEWARE	Advanced	Intermediate	Basic	None
i. Tutorial	❑	❑	❑	❑
ii. Drill & Practice	❑	❑	❑	❑
iii. Simulation	❑	❑	❑	❑
iv. Integrated Learning System	❑	❑	❑	❑
v. Games	❑	❑	❑	❑
vi. Video Conferencing	❑	❑	❑	❑
vii. Teleconferencing	❑	❑	❑	❑
viii. Streaming Video	❑	❑	❑	❑
ix. Other	❑	❑	❑	❑

11. In what ways do you integrate the following instructional courseware in your lessons? How would you rate your performance?
12. Do you produce these other applications – robotics, video, virtual reality and for what purpose? Please rank your proficiency levels with the following applications.

OTHER APPLICATIONS	Advanced	Intermediate	Basic	None
i. CD-ROM preparation (Burn/Save materials)	❑	❑	❑	❑
ii. Video production	❑	❑	❑	❑
iii. Robotics	❑	❑	❑	❑
iv. Virtual Reality (Avatar, Second Life, etc.,)	❑	❑	❑	❑
v. Web page creation	❑	❑	❑	❑
vi. Other	❑	❑	❑	❑

13. In your opinion, how do you generally perceive the ICT/Computer integration policy in higher education with regard to the role and performance of teaching faculty in public-funded universities?
14. Could you name 4 major challenges to using ICT in the classroom, and explain why?
15. Thank you very much for this valuable information. Is there anything else you would like me to know about this survey?

THANK YOU

APPENDIX F. MEAN, STANDARD DEVIATION AND PEARSON CORRELATION MATRIX OF MRA1 WHERE ADOPTION PATTERN IS REPRESENTED BY COMPUTER PURCHASE

		P.tot	F'ale	Age	T.Exp	Hict/d	Prof	AProf	S.Lec	Lec	Agric	A/S/H	B&M	S/MN	Eng'g	C Sc,	Educ.	IN	EA	EM	LM
P.Cor	P.tot	1.000	-.037	-.332	-.135	.420	-.032	.008	-.054	.095	-.074	-.125	-.024	-.035	.312	.226	-.093	.032	.170	.009	-.040
	F'ale	-.037	1.000	.099	-.007	-.184	.062	-.110	-.123	.151	.004	-.037	.042	.061	-.149	-.086	.117	-.018	-.077	-.087	.029
	Age	-.332	.099	1.000	.627	-.374	.243	.196	.319	-.314	.118	-.035	-.173	.122	-.089	-.145	.160	.173	.159	.028	-.208
	T.Exp	-.135	-.007	.627	1.000	-.271	.168	.393	.469	-.594	.208	-.118	-.224	.186	.069	-.058	-.016	.191	.087	-.026	-.125
	Hict/d	.420	-.184	-.374	-.271	1.000	-.037	-.131	-.079	.177	-.027	.056	.006	.015	.115	.070	-.224	-.077	.068	.100	-.006
	Prof.	-.032	.062	.243	.168	-.037	1.000	-.035	-.080	-.194	-.053	.109	-.065	.074	-.048	-.027	-.053	.193	.223	-.082	-.131
	AProf	.008	-.110	.196	.393	-.131	-.035	1.000	-.134	-.323	-.088	.030	.055	-.018	.023	-.046	.006	.227	.166	-.136	-.157
	S.Lec	-.054	-.123	.319	.469	-.079	-.080	-.134	1.000	-.740	.254	-.237	-.115	.129	-.016	.163	.001	.103	.062	.068	-.106
	Lec	.095	.151	-.314	-.594	.177	-.194	-.323	-.740	1.000	-.130	.139	.101	-.085	.050	-.174	-.040	-.234	-.160	.052	.182
	Agric	-.074	.004	.118	.208	-.027	-.053	-.088	.254	-.130	1.000	-.248	-.162	-.154	-.119	-.069	-.133	-.082	-.084	.095	.016
	A/S/H	-.125	-.037	-.035	-.118	.056	.109	.030	-.237	.139	-.248	1.000	-.304	-.288	-.223	-.129	-.248	-.015	-.015	-.107	.041
	B&M	-.024	.042	-.173	-.224	.006	-.065	.055	-.115	.101	-.162	-.304	1.000	-.188	-.146	-.084	-.162	.246	-.071	.052	-.066
	S/M/N	-.035	.061	.122	.186	.015	.074	-.018	.129	-.085	-.154	-.288	-.188	1.000	-.138	-.080	-.154	-.095	.165	-.014	.044
	Eng'g	.312	-.149	-.089	.069	.115	-.048	.023	-.016	.050	-.119	-.223	-.146	-.138	1.000	-.062	-.119	-.074	.072	.088	-.013
	ComS	.226	-.086	-.145	-.058	.070	-.027	-.046	.163	-.174	-.069	-.129	-.084	-.080	-.062	1.000	-.069	.134	-.076	.070	-.018
	Educ	-.093	.117	.160	-.016	-.224	-.053	.006	.001	-.040	-.133	-.248	-.162	-.154	-.119	-.069	1.000	-.082	-.021	-.105	-.027
	IN	.032	-.018	.173	.191	-.077	.193	.227	.103	-.234	-.082	-.015	.246	-.095	-.074	.134	-.082	1.000	-.090	-.127	-.203
	EA	.170	-.077	.159	.087	.068	.223	.166	.062	-.160	-.084	-.015	-.071	.165	.072	-.076	-.021	-.090	1.000	-.226	-.361
	EM	.009	-.087	.028	-.026	.100	-.082	-.136	.068	.052	.095	-.107	.052	-.014	.088	.070	-.105	-.127	-.226	1.000	-.508
	LM	-.040	.029	-.208	-.125	-.006	-.131	-.157	-.106	.182	.016	.041	-.066	.044	-.013	-.018	-.027	-.203	-.361	-.508	1.000
	Mean	81.12	.17	44.88	8.82	5.38	.02	.06	.23	.64	.12	.32	.17	.15	.10	.03	.12	.05	.14	.24.	.45
	SD	22.04	.38	9.27	7.80	2.78	.14	.23	.43	.48	.32	.46	.37	.35	.30	.18	.32	.22	.35	.43	.50

Note: Computed from survey data.

APPENDIX G. MEAN, STANDARD DEVIATION AND PEARSON CORRELATION MATRIX OF MRA2 WHERE ICT ADOPTION PATTERN IS REPRESENTED BY GENERAL USE

		P.tot	F'ale	Age	T.Exp	Hict/d	Prof	AProf	S.Lec	Lec	Agric	A/S/H	B&M	S/M/N	Eng'g	ComS	Educ	ING	EAG	EMG	LMG	LG
P.Cor	P.tot	1.000	-.038	-.297	-.082	.405	-.032	.060	-.044	.063	-.075	-.119	-.027	-.035	.311	.226	-.093	.089	.030	.088	-.191	-.039
	F'ale	-.038	1.000	.104	.011	-.190	.063	-.101	-.126	.146	.006	-.032	.027	.064	-.147	-.085	.119	-.053	-.088	.062	-.005	.191
	Age	-.297	.104	1.000	.605	-.362	.246	.139	.348	-.313	.123	-.061	-.151	.127	-.086	-.144	.165	.301	.089	-.264	-.068	.072
	T.Exp	-.082	.011	.605	1.000	-.254	.182	.316	.512	-.595	.233	-.173	-.223	.212	.086	-.053	-.002	.371	.082	-.332	-.058	.112
	Hict/d	.405	-.190	-.362	-.254	1.000	-.039	-.103	-.086	.170	-.031	.071	.003	.011	.112	.068	-.228	-.086	.123	.144	-.183	-.057
	Prof	-.032	.063	.246	.182	-.039	1.000	-.032	-.081	-.195	-.052	.110	-.067	.074	-.047	-.027	-.052	.327	-.072	-.112	-.082	-.021
	AProf	.060	-.101	.139	.316	-.103	-.032	1.000	-.125	-.302	-.081	-.013	.064	-.004	.036	-.042	.019	.247	.050	-.173	-.127	.194
	S.Lec	-.044	-.126	.348	.512	-.086	-.081	-.125	1.000	-.756	.247	-.239	-.092	.124	-.018	.159	-.002	.142	.044	-.168	.016	.032
	Lec	.063	.146	-.313	-.595	.170	-.195	-.302	-.756	1.000	-.133	.162	.082	-.088	.046	-.175	-.044	-.289	.009	.307	-.075	-.094
	Agric	-.075	.006	.123	.233	-.031	-.052	-.081	.247	-.133	1.000	-.244	-.168	-.152	-.117	-.068	-.131	.013	.141	-.104	-.008	-.052
	A/S/H	-.119	-.032	-.061	-.173	.071	.110	-.013	-.239	.162	-.244	1.000	-.313	-.283	-.219	-.127	-.244	-.100	-.113	-.006	.162	.110
	B&M	-.027	.027	-.151	-.223	.003	-.067	.064	-.092	.082	-.168	-.313	1.000	-.194	-.150	-.087	-.168	.181	-.095	.047	-.098	-.067
	S/M/N	-.035	.064	.127	.212	.011	.074	-.004	.124	-.088	-.152	-.283	-.194	1.000	-.136	-.079	-.152	.021	.032	-.009	-.017	-.061
	Eng'g	.311	-.147	-.086	.086	.112	-.047	.036	-.018	.046	-.117	-.219	-.150	-.136	1.000	-.061	-.117	.045	.072	.036	-.185	.117
	ComS	.226	-.085	-.144	-.053	.068	-.027	-.042	.159	-.175	-.068	-.127	-.087	-.079	-.061	1.000	-.068	.019	.001	.010	-.020	-.027
	Educ	-.093	.119	.165	-.002	-.228	-.052	.019	-.002	-.044	-.131	-.244	-.168	-.152	-.117	-.068	1.000	-.160	.035	.028	.091	-.052
	ING	.089	-.053	.301	.371	-.086	.327	.247	.142	-.289	.013	-.100	.181	.021	.045	.019	-.160	1.000	-.219	-.342	-.252	-.064
	EAG	.030	-.088	.089	.082	.123	-.072	.050	.044	.009	.141	-.113	-.095	.032	.072	.001	.035	-.219	1.000	-.383	-.282	-.072
	EMG	.088	.062	-.264	-.332	.144	-.112	-.173	-.168	.307	-.104	-.006	.047	-.009	.036	.010	.028	-.342	-.383	1.000	-.440	-.112
	LMG	-.191	-.005	-.068	-.058	-.183	-.082	-.127	.016	-.075	-.008	.162	-.098	-.017	-.185	-.020	.091	-.252	-.282	-.440	1.000	-.082
	LGP	-.039	.191	.072	.112	-.057	-.021	.194	.032	-.094	-.052	.110	-.067	-.061	.117	-.027	-.052	-.064	-.072	-.112	-.082	1.000
	Mean	81.16	.17	44.78	8.51	5.41	.02	.05	.24	.65	.12	.31	.18	.15	.10	.03	.12	.16	.20	.37	.24	.02
	SD	21.89	.38	9.14	7.53	2.75	.14	.21	.43	.48	.32	.57	.38	.36	.30	.18	.32	.37	.40	.49	.43	.14

Note: Computed form survey data

APPENDIX H. MEAN, STANDARD DEVIATION AND PERASON CORRELATION MATRIX OF MRA3 WHERE ICT ADOPTION PATTERN IS REPESENTED BY TEACHING

		P.tot	F'ale	Age	T.Exp	Hict/d	Prof	AProf	S.Lec	Lec	Agric	A/S/H	B&M	S/M/N	Eng'g	ComS	Educ	INT	EAT	EMT	LMT	LT
P.Cor	P.tot	1.000	-.054	-.323	-.122	.372	-.050	-.038	-.040	.081	-.084	-.125	-.092	-.047	.309	.228	-.007	-.084	-.084	.281	-.081	-.209
	F'ale	-.054	1.000	.128	.030	-.216	.073	-.103	-.108	.114	.029	.021	-.028	.047	-.150	-.086	.119	.029	.029	-.059	.002	.009
	Age	-.323	.128	1.000	.635	-.368	.255	.207	.337	-.386	.100	-.049	-.094	.109	-.098	-.155	.148	.100	.100	.062	.065	-.216
	T.Exp	-.122	.030	.635	1.000	-.268	.175	.427	.456	-.623	.173	-.095	-.205	.162	.072	-.060	-.017	.173	.173	.023	-.050	-.115
	Hict/d	.372	-.216	-.368	-.268	1.000	-.051	-.124	-.080	.180	-.019	.073	-.035	.007	.098	.059	-.189	-.019	-.019	.104	-.025	-.111
	Prof	-.050	.073	.255	.175	-.051	1.000	-.036	-.088	-.202	-.057	.117	-.068	.077	-.053	-.030	-.053	-.057	-.057	.052	-.014	-.117
	AProf	-.038	-.103	.207	.427	-.124	-.036	1.000	-.137	-.313	-.088	.060	-.015	-.006	.028	-.047	.028	-.088	-.088	.223	-.185	.028
	S.Lec	-.040	-.108	.337	.456	-.080	-.088	-.137	1.000	-.764	.214	-.236	-.070	.146	-.028	.160	-.028	.214	.214	-.110	-.018	.027
	Lec	.081	.114	-.386	-.623	.180	-.202	-.313	-.764	1.000	-.105	.133	.127	-.120	.056	-.180	-.046	-.105	-.105	.018	.136	-.071
	Agric	-.084	.029	.100	.173	-.019	-.057	-.088	.214	-.105	1.000	-.249	-.166	-.157	-.128	-.074	-.128	1.000	1.000	-.067	-.003	.003
	A/S/H	-.125	.021	-.049	-.095	.073	.117	.060	-.236	.133	-.249	1.000	-.300	-.284	-.231	-.133	-.231	-.249	-.249	-.127	.083	.060
	B&M	-.092	-.028	-.094	-.205	-.035	-.068	-.015	-.070	.127	-.166	-.300	1.000	-.189	-.154	-.089	-.154	-.166	-.166	.034	-.098	.035
	S/M/N	-.047	.047	.109	.162	.007	.077	-.006	.146	-.120	-.157	-.284	-.189	1.000	-.146	-.084	-.146	-.157	-.157	-.103	.106	-.019
	Eng'g	.309	-.150	-.098	.072	.098	-.053	.028	-.028	.056	-.128	-.231	-.154	-.146	1.000	-.068	-.119	-.128	-.128	.077	-.066	-.010
	ComS	.228	-.086	-.155	-.060	.059	-.030	-.047	.160	-.180	-.074	-.133	-.089	-.084	-.068	1.000	-.068	-.074	-.074	.101	-.073	.012
	Educ	-.007	.119	.148	-.017	-.189	-.053	.028	-.028	-.046	-.128	-.231	-.154	-.146	-.119	-.068	1.000	-.128	-.128	.201	-.015	-.112
	INT	-.084	.029	.100	.173	-.019	-.057	-.088	.214	-.105	1.000	-.249	-.166	-.157	-.128	-.074	-.128	1.000	1.000	-.067	-.003	.003
	EAT	-.084	.029	.100	.173	-.019	-.057	-.088	.214	-.105	1.000	-.249	-.166	-.157	-.128	-.074	-.128	1.000	1.000	-.067	-.003	.003
	EMT	.281	-.059	.062	.023	.104	.052	.223	-.110	.018	-.067	-.127	.034	-.103	.077	.101	.201	-.067	-.067	1.000	-.387	-.381
	LMT	-.081	.002	.065	-.050	-.025	-.014	-.185	-.018	.136	-.003	.083	-.098	.106	-.066	-.073	-.015	-.003	-.003	-.387	1.000	-.600
	LT	-.209	.009	-.216	-.115	-.111	-.117	.028	.027	-.071	.003	.060	.035	-.019	-.010	.012	-.112	.003	.003	-.381	-.600	1.000
	Mean	83.20	.16	44.97	8.83	5.58	.02	.05	.25	.64	.12	.31	.17	.15	.11	.04	.11	.12	.12	.20	.38	.37
	SD	21.14	.37	9.23	8.04	2.76	.15	.23	.44	.48	.32	.47	.37	.36	.31	.19	.31	.33	.33	.40	.49	.49

Note: Computed from survey data.

APPENDIX I. MEAN, STANDARD DEVIATION AND PEARSON CORRELATION MATRIX OF MRA4 WHERE ICT ADOPTION PATTERN IS REPRESENTED BY RESEARCH

		P.tot	F'ale	Age	T.Exp	Hict/d	Prof	AProf	S.Lec	Lec	Agric	A/S/H	B&M	SMN	Eng'g	Comp S	Educ	IN	EA	EM	LM	L
P. Cor.	P.tot	1.000	-.040	-.315	-.109	.424	-.030	-.010	-.035	.084	-.069	-.131	-.042	-.005	.315	.228	-.102	.069	.029	.041	-.040	-.118
	F'ale	-.040	1.000	.127	.016	-.201	.066	-.100	-.119	.137	.012	-.029	.003	.082	-.144	-.084	.115	-.047	-.024	.005	.017	.040
	Age	-.315	.127	1.000	.619	-.370	.240	.193	.329	-.316	.111	-.048	-.139	.103	-.096	-.148	.174	.266	.196	-.021	-.301	.076
	T.Exp	-.109	.016	.619	1.000	-.274	.171	.415	.478	-.606	.215	-.121	-.220	.167	.075	-.055	-.004	.410	.033	-.088	-.214	.124
	Hict/d	.424	-.201	-.370	-.274	1.000	-.038	-.102	-.083	.166	-.028	.057	.018	.009	.115	.069	-.224	-.127	.070	.015	.040	-.078
	Prof	-.030	.066	.240	.171	-.038	1.000	-.033	-.081	-.195	-.053	.107	-.064	.078	-.047	-.027	-.054	.343	.078	-.111	-.108	-.037
	AProf	-.010	-.100	.193	.415	-.102	-.033	1.000	-.126	-.302	-.081	.051	-.013	.000	.036	-.042	.013	.320	.091	-.172	-.167	.209
	S.Lec	-.035	-.119	.329	.478	-.083	-.081	-.126	1.000	-.755	.246	-.250	-.076	.136	-.019	.159	-.015	.102	-.002	.102	-.116	-.077
	Lec	.084	.137	-.316	-.606	.166	-.195	-.302	-.755	1.000	-.131	.145	.098	-.103	.048	-.175	-.026	-.308	-.021	.096	.135	-.107
	Agric	-.069	.012	.111	.215	-.028	-.053	-.081	.246	-.131	1.000	-.250	-.161	-.149	-.118	-.068	-.136	-.014	.155	-.013	-.047	-.093
	A/S/H	-.131	-.029	-.048	-.121	.057	.107	.051	-.250	.145	-.250	1.000	-.306	-.282	-.224	-.130	-.258	-.013	-.115	-.072	.161	.006
	B&M	-.042	.003	-.139	-.220	.018	-.064	-.013	-.076	.098	-.161	-.306	1.000	-.182	-.144	-.084	-.166	.099	-.076	.005	-.060	.117
	S.MN	-.005	.082	.103	.167	.009	.078	.000	.136	-.103	-.149	-.282	-.182	1.000	-.133	-.077	-.154	-.034	.054	.050	-.060	-.024
	Eng'g	.315	-.144	-.096	.075	.115	-.047	.036	-.019	.048	-.118	-.224	-.144	-.133	1.000	-.061	-.122	.004	.000	.040	-.048	.013
	Comp S	.228	-.084	-.148	-.055	.069	-.027	-.042	.159	-.175	-.068	-.130	-.084	-.077	-.061	1.000	-.071	-.051	-.077	.090	-.061	.108
	Educ	-.102	.115	.174	-.004	-.224	-.054	.013	-.015	-.026	-.136	-.258	-.166	-.154	-.122	-.071	1.000	-.019	.084	-.028	.026	-.096
	IN	.069	-.047	.266	.410	-.127	.343	.320	.102	-.308	-.014	-.013	.099	-.034	.004	-.051	-.019	1.000	-.111	-.208	-.202	-.070
	EA	.029	-.024	.196	.033	.070	.078	.091	-.002	-.021	.155	-.115	-.076	.054	.000	-.077	.084	-.111	1.000	-.314	-.305	-.105
	EM	.041	.005	-.021	-.088	.015	-.111	-.172	.102	.096	-.013	-.072	.005	.050	.040	.090	-.028	-.208	-.314	1.000	-.570	-.196
	LM	-.040	.017	-.301	-.214	.040	-.108	-.167	-.116	.135	-.047	.161	-.060	-.060	-.048	-.061	.026	-.202	-.305	-.570	1.000	-.191
	L.	-.118	.040	.076	.124	-.078	-.037	.209	-.077	-.107	-.093	.006	.117	-.024	.013	.108	-.096	-.070	-.105	-.196	-.191	1.000
	Mean	80.82	.16	45.06	8.69	5.39	.02	.05	.24	.64	.12	.32	.16	.14	.10	.03	.12	.07	.14	.37	.36	.06
	SD	22.04	.37	9.25	7.91	2.76	.14	.21	.43	.48	.32	.47	.37	.35	.30	.18	.33	.25	.35	.48	.48	.24

Note: Computed from survey data.

REFRENCES

AAU. Association of African Universities (http://www.aau.org).

Ajzen, I. (1988). *Attitudes, personality, and behavior*, Chicago: Dorsey Press.

Ajzen, I. (2005). *Attitudes, personality, and behavior,* (2nd ed.). Milton-Keynes, England: Open University Press/McGraw-Hill.

Akman, I. & Mishra, A. (2009). Ethical behavior issues in software use: An analysis of public and private sectors, *Computers in Human Behavior*, 25, 1251–1257.

Albion, P. R. (1999). *Self-efficacy beliefs as an indicator of teachers' preparedness for teaching with technology*, In J. Price et al. (Ed.). *Proceedings of Society for Information Technology and Teacher Education International Conference* (pp. 1602-1608). Chesapeake, VA: AACE.

ALO. (2003). *USAID Cooperative Agreement HNE-A-0097-00059,* the Association Liaison Office for University Cooperation Development, September 2003.

American Psychological Association (APA): *Technophobic*. (n.d.). Collins English Dictionary, Complete & Unabridged (10th ed.). Retrieved from Dictionary.com website: http://dictionary.reference.com/browse/technophobic

Anderson, R. E. (2003). *Introduction.* In T. Plomp, E. R. Anderson, N. Law, & A. Quale (Eds.). *Cross-national information and communication technology policies and practices in education: A volume in research and educational policy: Local, national, and global perspective,* (pp. 3-13). Greenwich, CT: Information Age Publishing, Inc.

Anderson, R. E., & Dexter, S. L. (2001). *School technology leadership: Incidence and impact*. Teaching, Learning and Computing, National Survey Report Number 6, Irvine, CA: Retrieved from http://www.crito.uci.edu/tlc/findings/report_6/startpage.html

Assié-Lumumba, T. N. (2008). The global development learning network (GDLN) and the tertiary education in Africa: Opportunities and predicaments of centralized knowledge broadcasting programs on the world scale. *Perspectives on Global Development and Technology*, 7, 231-258.

Assié-Lumumba (2003b). Introduction: *Africa and Asia Studies*, *Special Issues*, 2(4), 365-380.

AVU. African Virtual University (http://www.avu.org).

Bartel, A. P. & Lichtenberg, F. R. (1987). The comparative advantage of educated workers in implementing technology, *The Review of Economics and Statistics*, Harvard University, Elsevier Science, LXIX (1), 1-11.

Becker, H. J. (2000). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Contemporary Issues in Technology and Teacher Education* [Online serial], 1(2), 274-293. (Originally published in *Journal of Research on Computing in Education*, (1994), 26(3), 291-321).

Berge, Z. L. (1995). Facilitating computer conferencing: Recommendations from the field. *Educational Technology*, 35(1); 22-30.

Berger, P. & Trexler, S. (2010). *Choosing Web 2.0 tools for learning and teaching in a digital world*. Santa Barbara, CA: Library Unlimited.

Bitter, G. G. & Pierson, M. E. (2005). *Using Technology in the classroom* (6th ed.). Boston, MA: Pearson Education, Inc.

Bloom, B. S. (1980). The new direction in educational research: alterable variables. *Phi*

Delta Kappa, 61(6), 382-385.

Bonk, C. J. & Dennen, V. (2003). Frameworks for research, design, benchmarks, training, and pedagogy in Web-based distance education. In M. G. Moore & B. Anderson (Eds.). *Handbook of distance education* (pp. 331-348). Mahwah, NJ: Lawrence Erlbaum Associates.

Brabazon, T. (2003) *Digital hemlock: Internet education and the poisoning of teaching*. Sydney, University of New South Wales Press.

Cázares, A. (2010). Proficiency and attitudes toward information technologies' use in psychology undergraduates, *Computers in Human Behavior*, 26, 1004–1008.

Carroll, J. B. (1963). A model of school learning. *Teachers College Record*, 64, 723-733.

Carroll, J. B. (1989). The Carroll model: A 25 year retrospective and prospective view. *Educational Researcher*, 18(1), 26-31.

Chin, T.O. (n.d.).Assessment of staff attitudes towards computers and its implications on the use of IT in school. Anglo-Chinese School (Independent), Singapore. Retrieved from http://www3.moe.edu.sg/edumall/mpite/edtech/papers/b6_3.pdf

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, 53(4), 445-459.

Clark, R. E. & Feldon, D. F. (2005). Five common but questionable principles of multimedia learning. In R. E. Mayer (Ed.). *Cambridge handbook of multimedia learning*, Cambridge: Cambridge University Press.

Cohen, J., Cohen, P., West, S. G, & Aiken, L.S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Coolidge, F. L. (2006). *Statistics: A gentle introduction* (2nd ed.). Thousand Oaks: CA, Sage Publications, Inc.

Dankwa, W. A. (n.d.). SchoolNet: *A catalyst for transforming education in Ghana. Council for Scientific and Industrial Research* (CSIR) Retrieved from http://www.isoc.org/isoc/whatis/confrences/inet/96proccedings/c6/c6_1.htm.

Dede, C. (1999). The role of emerging technologies for knowledge mobilization, dissemination, and use in education. Retrieved from http://www.virtual.gmu.edu

Dede, C. (2000). Emerging influences of information technology on school curriculum. *Journal of Curriculum Studies*, 32(2), 281-303.

DiBiase, D. (2000). Is distance teaching more work or less work? *American Journal of Distance Education*, 14(3); 7-19.

Douglas, I. (2001). *Instructional design based on reusable learning objects: Applying lessons of object-oriented software engineering to learning systems*. Paper presented at the 31st ASEE/IEEE Frontiers in Education Conference, October 10 - 13, 2001. Reno, NV.

Doutrich, D., Hoeskel, R., Wykoff, L. & Thiele, J. (2005). Teaching teachers to teach with technology. *Journal of Continuing Education in Nursing*, 36(1), 25-31.

Erumban, A. A. & de Jong, S.B. (2006), Cross-country differences in ICT adoption: A consequence of culture? *Journal of World Business*, Elsevier, Inc. 41, 302-314.

Finnegan, D. E., & Hyle, A. E. (2009). Assistant to “Full”: Rank and the development of expertise, *Teachers College Record*, Retrieved from http://www.tcrecord.org/

Fishbein, M. & Ajzen, I., (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*, Reading, MA: Addison Wesley.

Frank, A. M. (Winter, 2003-2004). Integrating computer-mediated communication into pedagogical education Course: Increasing opportunity for reflection. *Journal of Computing in Teacher Education*. International Society for Technology in Education (ISTE), 20(2); 81-89.

Gharajedaghi, J. (2006). *Systems Thinking: Managing chaos and complexity* (2nd ed., Chapter 1). Burlington, MA: Butterworth-Hahnemann.

GIMPA. Ghana Institute for Management and Public Administration. http://www.gimpa.edu.gh/

Greenagel, F. L. (2002). The illusion of e-learning: Why we are missing out on the promise of technology. Phoenix: League for Innovation in the Community College, occasional papers. Retrieved from http://www.league.org/publication/whitepapers/0802.html

Guerra, I. J. & Rodriquez, (2005). Educational planning and social responsibility: Eleven years of mega planning at the Sonora Institute of Technology (ITSON). *Performance Improvement Quarterly*, 18(3), pp, 56-64.

Harington, C. F., Gordon, S. A., & Schibik, T. J. (2004). Course management system utilization and implications for practice: A national survey of department chairpersons. *Journal of Distance Learning*, 7(14). Retrieved from http://www.westga.edu/~distance/ojdla/winter74/harrington74.htm

Hawkins, R. J. (2001-2002). *Ten lessons for ICT and education in the developing world*, In S. Dutta, B. Lanvin, & F. Paua, *Global information technology report* (Chapter 4, pp. 48-43). Retrieved from http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan008676.pdf

Hawthorn, D. (2007). Interface design and engagement with older people. *Behavior*

& Information Technology, 26(4), 333–341.

Hsu, M. K., Wang, S. W., & Chiu, K. K. (2009). Computer attitude, statistics anxiety and self-efficacy on statistical software adoption behavior: An empirical study of online MBA learners, *Computers in Human Behavior* 25, 412–420.

Huizingh, E. (2007). *Applied statistics with SPSS*, London, G.B: Sage Publications Ltd.

ICT4AD (2003). *Information and communication technology for accelerated development*, National ICT Policy and Plan Development Committee. Retrieved form http://img.modernghana.com/images/content/report_content/ICTAD.pdf

IST (2002). Gender and ICT in Norway: An overview of Norwegian research and some relevant statistical information, *Information Society Technologies*, IST-2000-26329 SIGIS.

ISTE (2009). International Society for Technology in Education: National Education Technology Standards for Teachers. NETS-T http://www.iste.org/Content/NavigationMenu/NETS/ForAdminstratrors/2009SStandards/NETS-A_2009.pdf.

ISTE (2008). International Society for Technology in Education: National Education Technology Standards for Teachers. Retrieved from http://www.iste.org/standards/nets-for-teachers/nets-for-teachers-2008.aspx

ISTE (2000). International Society for Technology in Education National Education Technology Standards for Teachers. Retrieved from http://www.cnets.iste.org/teachers/t_stands.html.

Jacobsen, D. M. (1998). *Adoption patterns and characteristics of faculty who integrate computer technology in higher education* (Doctoral dissertation). Alberta, Calgary:

Department of Educational Psychology, University of Calgary, Canada.

Januszweski, A., & Molenda, M. (2008). *Educational technology: A definition with commentary*, New York, Taylor and Francis Group.

Jegede, P. O. (2008). ICT attitudinal characteristics and use level of Nigeria teachers *Issues in Informing Science and Information Technology*. 5, 261-265.

Jegede, P. O. & Josiah, O. (2005). Effects of professional status, subject discipline and computer access on computer attitudes among teacher educators in Nigeria Colleges of Education. *Information Technology Journal*, 4(2), 58-162.

Jegede, P. O., Dibu-Ojerinde, O. O. & IIori, M. O. (July 2007). Relationships between ICT competence and attitude among some Nigerian tertiary institution lecturers. *Educational Research and Review*, 2(7), 172-175.

Jones, C. M. & Liu, M. (2001). Web-based instruction: The effect of design considerations on learner perceptions and achievement, ED-Media, World Conference on Educational Multimedia, Hypermedia & Telecommunications. *Proceedings of the Association for the Advancement of Computing in Education, (*AACE) at 13 Tampere, Finland, June 25-30, pp. 835-840.

Karahanna, E., Straub, D. W. & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *Management Information System Quarterly*, 23(2), 183-213.

Kaufman, R. (1998). *Strategic thinking: A guide to identifying and solving problems*, Washington D.C. International Society for Performance Improvement.

Keppel, G., & Wickens, T. D. (2004). *Design and analysis: A researcher's handbook* (4th ed.). Upper Saddle River: NJ. Pearson Education, Inc.

Kerlinger, F. N. & Lee, H. B. (2000). *Foundations of behavioral research* (4th Ed.). New York: Harcourt College Publishers.

Klassen, R. M., Bong. M, Usher, E. L., Chong, W. H., Hua, V.S., Wong, I. Y. F., & Georgiou, T. (2009). Exploring the validity of a teachers' self-efficacy scale in five countries, *Contemporary Educational Psychology*, 34; 67–76.

Kirkup, G. & Kirkwood, A. (2005). Information and communications technology (ICT) in higher education teaching – A tale of gradualism rather than revolution, *Learning Media and Technology,* 30(2), 185-199.

Kozma, R. E. (1994a). A reply: Media and methods. *Educational Technology, Research & Development*, 42(3), 11-14. DOI: 10.1007/BF02298091.

Kozma, R. E. (1994b). "Will media influence learning: Reframing the debate", *Educational Technology Research and Development*, 42(2), 7-19.

Kozma, R. E. (2003). Information and communication technologies and educational change: A global phenomena. In R. Kozma (Ed.), *Technology, innovation, and educational change: A global perspective*. Eugene, OR: International Society for Educational Technology.

Kozma, R. B. (2006, January). *The roles of information, communication, technology, and education in achieving the millennium development goals: Toward an African knowledge network.* Research Report in Support of the Millennium Villages Project and People of Sauri, Kenya, Center for Technology, SRI International.

Kyoto Computer Gakum (2004). *International development of computer education*. Retrieved from http://www.kcg.ac.jp/kcg1/id_e.html.

KNUST. The Kwame Nkrumah University of Science and Technology.

http://www.knust.edu.gh/pages

KNUST-KVCIT Policy (2010). *Policy Statement*, The Kwame Nkrumah University of Science and Technology-Kumasi Virtual Centre for Information, KNUST, Kumasi, Ghana.

Larbi-Apau, J. A. & Sarpong, D. B. (2010). Performance measurement: Does education impact productivity? *Performance Improvement Quarterly*, 22(4), pp. 81-97.

Law, N. & Plomp, T. (2003). *Curriculum and staff development for ICT in education*. In T. Plomp, E. R. Anderson, N., Law, & A. Quale (Eds.). *Cross-national information and communication technology policies and practices in education. A volume in research and educational policy: Local, national, and global perspective* (pp. 15-30) Greenwich, CT: Information Age Publishing, Inc.

Law, N. Yuen, H. K., Ki, W. W., & Lee, Y. (1999). *SITES-Hong Kong SAR report. Hong Kong. Center for IT in School and Teacher Education*, University of Hong Kong.

LeCompte, M. D., & Schensul, J. J. (1999). *Designing and Conducting Ethnographic Research*. In J. J. & Schensul & M. D. LeCompte (Eds.). *Ethnographer's Toolkit*, Vol.1. Walnut Creek, CA: Altamira Press.

Leganger, A., Kraft, P., & Røysamb, E. (2000). Perceived self-efficacy in health behaviour research: Conceptualisation, measurement and correlates. *Psychology & Health*. 15(1), 51-69.

Luszczynska, A., Scholz U. & Schwarzer, R. (2005). The General self-efficacy scale: Multicultural Validation Studies. *The Journal of Psychology*, 139(5), 439-457.

Maor, D. (2003). The teacher's role in developing interaction and reflection in an online learning community, *Education Media International*. EMI 40, p.128-137. Routeledge, Taylor and Francis.

Martey, A. (2004). ICT in distance education in Ghana. *Library High Tech News*, Emerald Publishing Limited, 5; pp.16-18.

Massachusetts Department of Elementary & Secondary Education (2008). *Massachusetts Technology Literacy Standards and Expectations*. Retrieved from http://www.doe.mass.edu/edtech/standards/tool.pdf). Malden: MA

Mayer, R. E. (2002). *Multimedia learning*. Cambridge University Press, New York. USA

Melle. E. V., Cimellaro, L. & Shulha, L. (2003). A dynamic framework to guide the implementation and evaluation of educational technology. *Educational Information Technologies.* The Netherlands: Kluwer Academic Publishers 8(3), 267-285..

MoESS-ICT4AD (2003). *National ICT for Accelerated Development Policy Statement, Ministerial Policy Statement.* The Ministry of Education, Science, and Sports, Accra: Ghana

Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barret, K. C. (2004). *SPSS for introductory statistics: Use and interpretation*, Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Morris, L. V., Xu, H. & Finnegan, C. L. (2005). Roles of faculty in teaching asynchronous undergraduate courses. *Journal of Asynchronous Learning Networks* (JALN), 9(1), 65-82.

Morris, M. G. & Venkatesh, V. (2000). Age differences in technology decision adoption: Implications for a changing workforce. *Personnel Psychology*, 52(2), 375-403.

Motschnig-Pitrik, R. & Holzinger, A. (2002). Student-centered teaching meets new media: concept and case study. *Educational Technology and Society*, 5(4); 160-172.

Nasierowski, W. (2010). Composite indexes and indicators of innovativeness: Some critical comments, *Global Management Journal*, 2(1), 42-51, Retrieved from http://gmj.x25.pl/.

National Geographic (2009). Retrieved from http://travel.nationalgeographic.com/places/maps/map_country_ghana.html.

NCES (2001). *Internet access in U.S. public school and classrooms: 1994-2000*. National Center for Education Statistic, Statistics in Brief, U.S. Department of Education, Office of Educational Research and Improvement, NCES 2001-071, pp.1-20.

NCTE (2009). *Strategic plan: 2004-2008,* National Council for Tertiary Education, Retrieved from http://ncte-ghana.org/downloads.php.

Nett, B. (2008). A community of practice among tutors enabling student participation in a seminar Preparation. *Computer-Supported Collaborative Learning*, 3, 53-67.

NSSE (2009). *Assessment for improvement: Tracking students' engagement over time, Annual Results 2009. National Survey of Student Engagement*, Bloomington, IN: Indiana University Center for Postsecondary Research.

Nye, B., Hedges, L.V., & Konstantopoulos, S. (2000). Effects of small classes on academic achievement: The results of the Tennessee class size experiment. *American Educational Research Journal*, 37, 123-151.

Obeng-Adow, E. (March, 2003). *Information and Communication Technology for Development.* Speech delivered by the Vice-Chancellor of the University of Cape Coast, Ghana at an open forum organized by The National ICT Policy and Plan

Development Committee on March 26, 2003 at the University of Cape Coast. Ghana.

Oliver, R. (2002). *The role of ICT in higher education for the 21st century: ICT as a change agent for education. Proceedings of the Higher Education for the 21st Century Conference.* Miri, Sarawak, Curtin University.

Oyelaran-Oyeyinka, B. & Adeya, C. N. (2004). Dynamics and adoption of ICTs in African Universities: A study of Kenya and Nigeria, *Technovation*, Elsevier, 24, 841-851.

Pallof, R. M. & Pratt, K. (2001). *Lessons from cyberspace classroom: The realities of online teaching.* San Francisco, CA: Jossey-Bass.

Park, Y. & Moser, F. Z. (2008). Identifying the role of international consortium “MIT/LINC” in supporting the integration of ICT in higher education in emerging countries, *Journal of Science Education and Technology*, 17(20, 197-207. DOI: 10.1007/s10956-007-9056-4.

Pauling, B. (2006). *The international handbook of virtual learning environments*. J. Weiss, et al. (Ed.), Springer: Netherlands, pp. 609-652.

Plomp, T., Anderson, E. R., Law, N. & Quale, A. (Eds.). (2003). *Cross-national information and communication technology policies and practices in education. A volume in Research and Educational Policy: Local, National, and Global Perspective*. Greenwich, CT: Information Age Publishing, Inc.

Prahalad, C. K. (April 2010). Best practices get you only so far, *Harvard Business Review*, Column, p. 32.

Prasad, A., & Mahajan, V. (2003). How many pirates should a software firm tolerate? An analysis of piracy *protection on the diffusion of software. International Journal* of Research in Marketing, 20(4), 337–353.

Prensky, M. (2001). Digital natives, digital immigrants, Part 1, On the Horizon, 9 (5), 1-6. Retrieved from http://www.marcprensky.com

Provenzo, E. F. (2005). *The Internet and online research for teachers* (3rd ed.), Boston, MA: Pearson Education, Inc.

Quale, A. (2003). Trends in instructional ICT infrastructure. In T. Plomp, E. R. Anderson, N. Law, & A. Quale. (Eds.). *Cross-national information and communication technology policies and practices in education. A volume in Research and Educational Policy: Local, National, and Global Perspective.* Greenwich (pp. 31-42), CT: Information Age Publishing, Inc.

Quaynor, N., Tevie, W. & Bulley, A. (1997). *Expansion of the Internet Backbone in Ghana.* Retrieved 3/10/07 http://www.isoc.org/inet97/proceedings/E5/E5_2.

Richey, R. C., Fields, D. F., & Foxon, M. (2001). *Instructional Design Competencies: The Standards* (3rd ed.). Syracuse, NY: ERIC Clearinghouse on Information and Technology.

Rivkin, S. G., Hanushek, E. A. & Kain, J. E. (2005). Teachers, schools, and academic achievement, *Econometrica*, 73(2) 417-458.

Roblyer, M. D. & Knezek, G. A. (2003). New millennium research for educational technology: A call for a national research agenda, *Journal of Research on Technology in Education*, 36(1); 60-71.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

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

Rogers, E. M. & Shoemaker, F. F. (1971*). Communication of innovations: A cross cultural approach*. (2nd ed.). New York, NY. Free Press.

Rogers, J. (1998). The Internet: Emerging technologies in two West African Countries. *Educational Technology, Research and Development*, 46(3), 103-109.

Romiszowski, A. J. (2004, January-February). How's is the e-learning baby? Factors leading to success or failure of an educational technology innovation. *Educational Technology*, 44(1), 5-27.

Rossi, B., Russo, B. & Succi, G. (2007). *Open source development, adoption and innovation.* In J. Feller, B. Fitzgerald, W. Sacchi, & A. Sillitti (Eds.). *IFIP International Federation for Information Processing* (pp, 325-330). Boston, MA: Springer,

Rudestam, K. E., & Newton, R. R. (2007). *Surviving your dissertation: A comprehensive guide to content and process* (3rd ed.). Thousand Oaks: CA, Sage Publications, Inc.

Rudestam, K. E., & Newton, R. R. (2001). *Surviving your dissertation: A comprehensive guide to content and process* (2nd ed.). Thousand Oaks: CA, Sage Publications, Inc.

Rummel, N. & Spada, H. (2005). Learning to collaborate: An instructional approach to promoting collaborative problem solving in computer mediated settings. *The Journal of the Learning Sciences* 14(2), 201-241.

Saadé, R. G. & Kira, D. (2009). Computer anxiety in e-Learning: The effect of computer Self-efficacy, *Journal of Information Technology Education*, 8, 176-191.

Salmon, G. (2002). *E-tivities: The key to active online learning*. London, UK: Kogan.

Schwarzer R. (1996). *Thought control of action: Interfering self-doubts*, In I. Sarason, G. Pierce, & B. Sarason (Eds.), *Cognitive Interference*. Hillsdale, NJ: Erlbaum.

Schwarzer, R. & Jerusalem, M. (1995) *Generalized self-efficacy scale*. In: J. Weinman, S. Wright, & M. Johnson (Eds.), *Measures in health psychology: A user's portfolio, causal and control beliefs*, (pp. 35-37), Windsor, England, UK: NFER-NELSON.

Schwarzer, R., Mueller, J. & Greenglass, E. (1999). Assessment of perceived general self-efficacy on the Internet: Data collections in cyberspace. *Anxiety, Stress and Coping*, 12, 145-161.

Seels, B. & Richey, R. (1994). *Instructional technology. The definition and domains of the field.* Washington, DC: Association for Educational Communications and Technology.

Selwyn, N. (1997). Students' attitude towards computers: Validation of a computer attitude scale for 16-19 education. *Computer Education*, 28(1), 35-41.

Shenkar, O. (2010 April). Imitation is more valuable than innovation, *Harvard Business Review,* 28-29.

Smith, P. L. (1997). Gender-related differences in ethical and social values of business students: Implications for management, *Journal of Business Ethics*, 16(1), 37-45.

Soh, K. C. (1998a). *Cross cultural validity of Selwyn Computer Attitude Scale,* Paper submitted to Computer and Education. Unpublished manuscript.

Soh, K. C. (1998b). *Teacher use of computer checklist: A validation study.* Paper submitted to Computer and Education. Unpublished manuscript.

Spector, J. M., Klein, J. D., Reiser, R. A., Sims, R. C., Grabowski, B. L. & de la Teja, I. (2006). *Competencies and standards for instructional design and educational technology.* A discussion paper for ITFORUM April 17-21, 2006. IBSTPI Competencies and Standards. Washington, DC: Department of Audio-Visual Instruction. National Education Association.

Spector, M. J. & de la Teja, I. (2001, December). Competencies for online teaching. *Eric Digest*, Syracuse, NY: Eric Clearinghouse of Information & Technology

Swanson, R. A. (1999). *The foundations of performance improvement and implications for practice.* In R. Torraco (Ed.). *The theory and practice of performance improvement* (p, 125) San Francisco, CA: Berrett-Koerhler.

Tangen, S. (2004). Professional Practice: Performance measurement: From philosophy to practice. *International Journal of Productivity and Performance Management*, 53(8), 726-737.

Taylor J. & Machado, M. L. (2006). Higher education leadership and management: from conflict to interdependence through strategic planning. *Tertiary Education and Management*, 12: 137-160.

Technophobia. (2010). *In Merriam-Webster Online Dictionary*. Retrieved from http://www.merriam-webster.com/dictionary/technophobia

The National Accreditation Board (2008). *List of Accredited Institutions as at April 2008*. Retrieved from http://www.nab.gov.gh/nabsite/index.php

Todd, Z., Nerlich, B., McKeown, S. & Clarke, D. D. (Eds.) (2004). *Mixing methods in psychology: The integration of qualitative and quantitative methods and practice*, New York: Psychology Press.

Trochim, W. M. K. (2006). *Research methods: Knowledge base.* Retrieved from http://www.socialresearchmethods.net/kb/.

UCC. University of Cape Coast, Cape Coast. Retrieved from http://governance.ucc.edu.gh/aboutucc)

Van Brakel, P. A., & Chisenga, J. (2003). Impact of ICT-based learning: The African story. The Electronic Library, Emerald Insight, MCB UP Limited, 21(5), pp. 474-486.

Visser, J. V. (2000). Faculty work in developing and teaching web-based distance courses: A case study of time and effort. *American Journal of Distance Education*, 14(3); 21-32.

Wedman, J. (2007). *The performance pyramid: Needs assessment made simple*. Requested manuscript. School of Information Sciences & Learning Technologies, University of Missouri-Columbia, MO.

Weiner, I. B., Freedheim, D. K., Stricker, G., & Widiger, T. A. (Eds.). (2003). *Handbook of psychology: Clinical psychology,* New York: John Wiley and Sons, Inc.

West, B. A. (2003). Student attitudes and the impact of GIS on thinking skills and motivation. National Council for Geographic Education, Journal of Geography, 102, 267-274.

Wheeler, B. C. (2002). A *course management system strategy for Indiana University*, Indiana, IN: Office of the Vice President for Information & CIO.

White, K. W. & Weight, B. H. (2000). *The online teaching guide: A handbook of attitudes, strategies, and techniques for the virtual classroom,* Boston, MA: Allyn and Bacon.

Winn, W. (2004). *Cognitive perspectives in psychology*. In D. L. Jonassen (Ed.). (2nd Ed.). *Handbook of research for educational communications and technology* (pp. 79-112). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Yaghi, H. M. & Abus-Saba, M. B. (1998). Teachers’ computer anxiety: An international perspective, Computers in Human Behavior, 14 (2), 321-336.

Yushau, B. (2006, December). Computer attitude, use, experience, software familiarity, and perceived pedagogical usefulness: The case of mathematics professors, Eurasia *Journal of Mathematics, Science and Technology Education*, 2(3), 1-17.

ABSTRACT

COMPUTER ATTITUDE, AND THE IMPACT OF PERSONAL CHARACTERISTICS AND INFORMATION AND COMMUNICATION TECHNOLOGY ADOPTION PATTERNS ON PERFORMANCE OF TEACHING FACULTY IN HIGHER EDUCATION IN GHANA, WEST AFRICA

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This study examined computer attitude, and the impact of personal characteristics and information and communication technology (ICT) adoption patterns on performance of teaching faculty in Ghana, West Africa. The study was modeled within the theoretical framework of innovation-diffusion (Rogers, 2003), computer attitude (Selwyn, 1997), and professional performance standards (ISTE-NETS-T, 2000). A cross-sectional research design was applied in surveying three public universities. Mixed methods of quantitative and qualitative instruments were applied in collecting data and information. Pooled data from 164 randomly sampled multidiscipline academic staff were subjected to descriptive and multivariate analysis using the Statistical Package for Social Sciences (SPSS, 17.0/18.0) and Microsoft Excel 2007. MANOVA was applied in testing differences in variability, while Simultaneous Multiple Linear Regressions (MRAs) was used in estimating ICT performance impact on defined independent variables. ICT adoption patterns were analyzed and compared to the standardized normal distribution of Rogers (2003, 1996).

Result of overall computer attitude is high and positive. Affective and usefulness constructs dominated computer attitude scores compared with behavior and control factors. Evidence of differential ICT adoption thresholds for general purpose, teaching, research and computer purchase is reported. Significant variability in mean differences are observed in ICT performance factor levels on age and academic discipline, but not on gender and professional status. Also reported are mixed regression statistics for ICT performance impact. Independently, laggards predicted overall high statistically significant impact of ICT performance at 52% ($p < .01$). All other significant predictors fall within moderate to high coefficient scores of 17 and 38% ($p < .05$ and .01 levels). Age is consistently negative and significant on ICT performance impact. Only Engineering and Computer Science are the positive and significant covariates of academic discipline on performance. Regression coefficients of gender and professional status are mixed and nonsignificant, while ICT adopter categories varied in predicting statistical significant impact on performance. Years of teaching experience has no significant impact on ICT-based performance. Reasons, incentives and barriers to ICT integration were examined and reported together with special computer proficiency levels for triangulation.

Inclusive development is a palpable opportunity and the best practices are those supported in totality for their impact. For personal, professional and institutional growth and to bridge gaps in policy and practice, mega, macro and micro level strategies plus future research directions are recommended.

Keywords: Computer attitude, higher education, information and communication technology, ICT- adoption patterns, teaching faculty, performance.

AUTOBIOGRAPHICAL STATEMENT

Josephine A. Larbi-Apau completed a PhD in Instructional Technology with a focus on Interactive and Human Performance Technologies at Wayne State University, Detroit MI. She graduated from Cornell University, (CIIFAD) Ithaca, New York, USA with a Master of Professional Studies in International Development in 2004, and from the University of Ghana, Legon with a Master of Philosophy in Agricultural Administration in 2003. She holds an undergraduate degree in B.Sc. (Honors) Agriculture from the University of Cape Coast, Ghana, 1994, a Graduate Certificate in College and University Teaching, Wayne State University, 2009, and a Diploma in Education (High School Teaching) from the University of Cape Coast, 1994.

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