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Digital Divide among Pakistani Faculty regarding their Information and Communication Technology (ICT) Access

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ABSTRACT

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The issue of digital divide is a complex and multidimensional phenomenon. It centers on various dimensions of information and communication technology (ICT) access including physical access, motivation, skills, and actual usage of digital technologies. The examination of digital divide is helpful in taking necessary measures to remove or at least minimize the problem of digital divide. The past research does not provide adequate literature on digital divide among higher education faculty especially in the context of developing countries.

I developed and validated a quantitative survey instrument to examine digital divide among higher education faculty in terms of their access to information and communication technologies at motivational, physical, skills, and usage levels. The survey was used in a cross-sectional design to provide a broad view of Pakistani faculty's motivation to adopt digital technologies, their physical access to various ICTs, their digital skills, and actual use of such technologies by them. The data were collected from 322 faculty members working in public and private sector universities in Sindh, Pakistan. The data were analyzed using descriptive statistics and multiple regressions.

In addition, I investigated the digital gap among the faculty in respect of their personal and positional categories including their age, gender, academic disciplines, and university type. The dissertation also attempted to examine the relationship between faculty's instructional usage of ICT and other dimensions of ICT access. The findings from this study indicated that faculty's endogenous motivation, physical access to ICT at university, and general usage of ICT predicted their instructional usage of digital technologies.

The findings of the study are discussed with theoretical and practical implications. Based on the findings of the study, recommendations are provided for educational administrators and policy makers. The dissertation ends with directions for future research.

Keywords: digital divide, ICT, faculty, Pakistan, access to technology

Dedication

I dedicate this dissertation research to
my parents, and wife
for their endless backing and unfailing support
during the time we missed being together. You have sacrificed
more than I did during my studies in the US.

&

I dedicate this research to
my sons, Mudassir and Mubashir
whom I missed the most during my stay in the US,
thousands of miles away from them.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS/ABBREVIATIONS

AIOU	Allama Iqbal Open University
FICTA	Faculty's Information and Communication Technology Access
LID	Learning Innovation Division
HEC	Higher Education Commission
HEIs	Higher Education Institutions
ICT	Information and Communication Technology
IRB	Institutional Review Board
NAHE	National Academy of Higher Education
NICT Strategy	National Information and Communication Technology Strategy
PERN	Pakistan Education and Research Network
UGC	University Grants Commission
VEPP	Virtual Education Program of Pakistan
VU	Virtual University

Chapter 1: INTRODUCTION

Today's contemporary networked society is heavily influenced by information and communication technology. In today's world, it is difficult to conceive of any aspect of people's lives that does not benefit from technology in one way or another (Cooper, 2006). People in modern society need to equip themselves with technology-supported practices so that they can compete with the people who are extensively using emerging technologies to improve their work and lifestyles. Unfortunately, not everyone in the society has access to information and communication technology (ICT) to do so, which contributes to the problem of digital divide.

In simple terms, digital divide refers to the divide between groups of individuals who have access to information and communication technology and those who have not. It is argued that the problem of digital divide may induce other economic and social divides (Hameed, 2007). People having better ICT access, are expected to participate in society more effectively. Digital divide in a society may prevent people on the wrong side of the divide – people with not adequate ICT access, from giving an effective participation in the society.

In the past, the issue of digital divide was narrowly interpreted by limiting it to only physical access to digital technologies such as computer and the Internet. This problem is, however, more complex than it was treated in the past. The issue is not a simple matter of a "yes" or "no", but an important concern that requires the understanding of dimensions other than physical access.

Van Dijk (2005) has proposed a very comprehensive theory to understand the phenomenon of digital divide. According to van Dijk, the personal and positional categorical inequalities such as age, gender, race, nation, and education, lead to unequal distributions of resources in the society which then result in digital divide – unequal access to ICTs in the society. In his theory of digital divide, *access to ICT* refers to four consecutive levels of access, namely motivational, physical, skills, and usage access.

It is important to examine the problem of digital divide in terms of ICT access by people from all walks of life. Such investigations will help taking necessary measures to remove or at least minimize this problem, enabling all people to participate in the society more positively and effectively with the help of ICT.

In regard to digital divide in educational settings, the past research has largely paid attention to students' access to ICT in schools and homes (Ritzhaupt, Liu, Dawson, & Barron, 2013). Research on teachers' access levels to digital technologies (explaining specific access levels) has not been sufficiently reported in the literature. Especially, higher education faculty's access to four levels of ICT in the context of developing countries has yet to be explored.

The present study aimed to examine Pakistani higher education faculty's access to information and communication technologies in terms of their motivational, physical, skills, and usage access. The study also investigated the gap in faculty's access to ICT with respect to their gender, age, academic disciplines and the type of university they teach in. Additionally, the relationship between instructional usage of ICT and various sub-levels of ICT access was explored. Faculty from universities in Pakistan were invited to participate in the study. The data were collected through a self-administered paper survey. Descriptive statistics and regression analysis were performed to analyze the collected data in order to answer specific research questions.

This present study is an initial and significant contribution to the literature by portraying a big picture of Pakistani faculty's motivation to adopt digital technologies, their physical access to various ICTs, their digital skills, and actual use of such technologies by them. The findings and information gained from this research study provide implications for plans of action for professional development of the faculty and other ICT initiatives in higher education of Pakistan. The findings of the study also may be helpful to other researchers in understanding some demographic variables that predict the divide in faculty's access to ICT, and in determining the relationship of faculty's technology-supported instructional practices with other levels of their ICT access – motivational, physical, and skills access.

Statement of the Problem

While many studies have attempted to measure individuals' access to digital technologies, most of them have employed a narrow approach of treating to the concept of *access to ICT*, viewing it as only physical or material access (van Dijk, 2012). The measurement of digital divide with this narrow approach does not tell the full story because the actual purpose of ICT access is only achieved with a particular and satisfactory use of it, rather merely having physical access to it (van Dijk, 2005). Additionally, in regard to digital divide in educational settings, the past research has largely paid attention to students' access to ICT in schools and homes (Ritzhaupt et al., 2013).

Researchers and educators have recognized the significance of technology in education, particularly to enhance teaching-learning processes (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Youssef, Dahmani, & Omrani, 2013). Teachers may leverage ICT to support their instructional practices provided they have access to ICT at all four levels, as suggested by van Dijk (2005). They should be motivated to acquire, learn, and utilize technologies, they should have physical access to them at school and home, they should have enough capabilities to use them, and finally they should have opportunity, need, and time to use such technologies.

Studies investigating teachers' access levels to digital technologies (explaining specific access levels) have not been sufficiently reported in the existing literature, whereas such research in the context of developing countries such as Pakistan is totally absent in the literature. Although various policy documents of education in Pakistan recognize and recommend employment of ICT in education including its potential to support teaching-learning processes (Higher Education Commission, 2014; Ministry of Education, 2009), Pakistani teachers' access to the four levels of ICT has yet to be examined. The available literature provides only some limited information on ICT infrastructure at educational institutions (Safdar, Hussain, Malik, Masood, & Yaqoob, 2011), and on teachers' opinions and attitudes about ICT utilization for teaching (Safdar et al., 2011; Shaikh & Khoja, 2011). However, the information on teachers' skills to use them, and their actual practices with such technologies, is not available in the literature.

Thus, this dissertation research targets higher education faculty from a developing country, Pakistan, as the element of investigation, to examine their access to ICT at four levels: motivational, physical, skills, and usage levels.

Purpose of the Study

The purpose of the present study was to investigate the digital divide among faculty of higher education institutions (HEIs) in Pakistan, through examining their ICT access at the four levels: motivational, physical, skills, and usage access. More specifically, the purpose of this study was twofold. The first purpose was to examine: a) Pakistani faculty's motivation to acquire, adopt, and use ICT, b) their physical access to ICT such as computers, the Internet, software, and other digital technologies, c) their abilities to use such technologies, and d) their actual use of ICT for general as well as instructional purposes.

The second purpose of this study was to investigate if there is a difference in faculty's overall ICT access or in a specific level of ICT access (motivational, physical, skills, or usage access) in respect of their age, gender, academic disciplines, and type of university they teach in. In addition, this study also aimed to examine relationships between faculty's instructional usage of ICT and other levels of ICT access, particularly with the specific type of their motivational access (endogenous or exogenous) and with specific types of digital skills (operational, informational, or strategic skills).

The study was conducted with 322 faculty members who teach at universities/HEIs in Pakistan. Both the public as well as private sectors universities located in the province of Sindh were included in the study. The study utilized a survey design research method with the data collected through a quantitative questionnaire which had already been tested for its preliminary validity and reliability in a pilot project conducted for my candidacy examination.

Insights gained from this study are beneficial for policy makers and administrators of HEIs in Pakistan to build plans of action for adoption of technological transformation in higher education, and to design professional development programs for the faculty. The findings of the study may also be useful for other researchers in understanding the relationship of technology-supported instructional practices with other levels of ICT access.

Research Questions

This present study investigated three main research questions. First of all, I was interested in examining Pakistani higher education faculty's access to information and communication technologies. Unlike most of the previous studies, the concept of access to ICT, in this research, was not limited to physical or material access only. But, this study attempted to measure four types/levels of ICT access, namely motivational, physical, skills, and usage access. In specific terms, the first research question for the study was:

RQ1. *What is Pakistani faculty's access to digital technologies at the four levels (motivational, physical, skills, and usage level)?*

The literature has reported gender, ethnicity, and socio-economic status (SES) as the main factors of students' unequal physical access to ICT (Ritzhaupt et al., 2013). A review of research examining the evidence for the digital divide based on gender, suggested that females are at a disadvantage relative to men in learning computers skills (Cooper, 2006). Similarly, in a study conducted at a Pakistani university, Mahmood (2009) found that more male students than female students use computers at home and university, and that male students use the Internet more than female students. Likewise, Thunman and Persson (2013) found that younger teachers are more inclined to use computers for audio-visual aid in their teaching than older teachers. But it is still not clear if such variables are also significant factors of faculty's access to ICT in terms of their motivational, physical, skills, and usage access. It is also unknown if this holds true for Pakistan or even outside of western/European countries.

In addition to traditional demographic variables (age and gender), the proposed study also investigated the influence of two relatively new positional variables (type of university and academic disciplines) to faculty's access to ICT at four levels. The type of university refers to whether the faculty is working at a public sector university or private sector university. It is a general perception in Pakistan that public sector universities lack in resources and skillful faculty. Thunman and Persson's study (2013) on Swedish school-teachers' access to and use of

ICT suggested significant differences between teachers of public schools and teachers of independent (private) schools. Also, Burnip (2006) found that government school teachers had poor access to ICT both at home and at school. As such, there is a need to examine this variable in the context of higher education in Pakistan.

Academic disciplines are also of importance. In a survey study with 625 students from University of Punjab, Pakistan, Mahmood (2009) found differences in students' computer access at university among three groups. Students from science and technology and social sciences disciplines have significantly more computer access at university than students from arts and humanities disciplines. He argued that the difference is due to the policy preferences aiming at developing science and technology with more funding while ignoring humanities. Another possible reason for the difference might be the nature of work in humanities which does not require as much ICT tools as required by other disciplines (Mahmood, 2009). The differences found in his study were regarding students' physical access to computers and their use of the Internet at the university. However, no differences in respect of disciplines were found in students' frequency of ICT use.

Also, people in Pakistan generally believe that digital technologies is the congenital domain of the people associated with science and technology disciplines, whereas faculty working in arts, social sciences, and humanities are not good at digital skills. Therefore, looking into these positional variables provided valuable information on general perceptions prevailing in the society. Thus, the second question of this study was:

RQ2. *How does faculty's ICT access differ with respect to their personal (age and gender) and positional categories (university type and academic disciplines)*?

Based on the aforementioned discussion and literature review, this question led to propose following four hypotheses:

H_{2a}: There is a statistically significant difference in faculty's access to ICT with respect to their age. Particularly, younger faculty have a higher usage access level than older faculty.

H_{2b}: There is a statistically significant difference in faculty's access to ICT with respect to their gender. Particularly, female faculty members have a lower skills access level than their male counterparts.

H_{2c}: There is a statistically significant difference in faculty's access to ICT with respect to the type of university they teach in. Particularly, faculty of public sector universities have a lower level of physical access than faculty of private sector universities.

H_{2d}: There is a statistically significant difference in faculty's access to ICT with respect to their academic disciplines. Particularly, faculty of science and technology subjects have higher level of physical access than faculty of arts, and humanities subjects.

Further, in the context of Pakistan, there is not enough evidence whether faculty use ICT to support their instructional practices or not. If they do, is there a significant relationship between their technology-supported instructional practices and other levels of their ICT access? Understanding the relationship between faculty's technology-supported instructional practices and various access levels to ICT (and their sub-components) may be helpful to answer some questions which are not reported in the existing literature. For instance: what type of digital skills (operational, informational, or strategic skills) is positively related to faculty's technology-supported instructional practices? Does exogenous motivational access influence faculty's technology-supported instructional practices? Or, is this type of motivation associated with their general usage of ICT only? The answers to these questions may add valuable information to the literature. This justifies the need for the third research question of this study:

RQ3. *How does faculty's use of ICT to support their instructional practices relate to their motivational access, physical access, skill access, and general usage access?*

To sum up, the present study was guided by the following three research questions:

1. What are Pakistani faculty's access to digital technologies at the four levels (motivational, physical, skills, and usage level)?
2. How do faculty's ICT access differ with respect to their personal (age and gender) and positional categories (university type and academic discipline)?
3. How does faculty's use of ICT to support their instructional practices relate to their motivational access, physical access, skill access, and general usage access?

Theoretical Framework and Identification of Variables

I used van Dijk's (2005) model of successive kinds of access to information and communication technologies (ICT) as the theoretical framework for this study. The model of successive kinds of access to ICT suggests that there are four successive kinds of access to ICT, namely motivational, physical, skills, and usage access. van Dijk has further classified digital skills into three types: operational, informational, and strategic skills. Although this model is discussed in details in Chapter 2, the variables corresponding to the research questions and hypothesis statements described above are defined and described shortly in the following:

Physical Access

Physical access refers to the possession or permission to use digital technologies such as computer, the Internet and other digital devices and resources. It was measured through a checklist comprising of various digital devices, software etc. Respondents were asked to report whether they have access to the devices given in the list at home and on campus. This variable created by computing the sum of participant's response for each item in the list, shows each participant's score for physical access.

Endogenous Motivational Access

Endogenous motivational access refers to an individual's desire to adopt ICT that originates from the inside of an individual, and is not directly affected by external sources. It was measured through a series of items formatted on a 5-point Likert scale (ranging from 1= strongly disagree to 5= strongly agree), with a higher score indicating a higher level of motivation. This variable, created by computing the average of participant's response for each item in the sub-scale, shows each participant's score for endogenous motivational access.

Exogenous Motivational Access

Exogenous motivational access indicates an individual's desire to adopt ICT that originates from the outside sources including social influence, time, and material resources. It was measured through a series of items formatted on a 5-point Likert scale (ranging from 1= strongly disagree to 5= strongly agree), with a higher score indicating a higher level of motivation. This variable, created by computing the average of participant's response for each item in the sub-scale, shows each participant's score for exogenous motivational access.

Motivational Access

Motivational access refers to an individual's wish to "adopt, acquire, learn, and use" digital technologies (van Dijk, 2005, p.27). This variable, created by computing the average of participant's score for endogenous motivational access and exogenous motivational access, shows each participant's overall score for motivational access.

Operational Skills Access

Operational skills, one's ability to operate computer, network, and software, are a necessary condition to higher levels of digital skills – informational and strategic skills (van Dijk, 2005). It was measured through a series of items formatted on a 5-point scale (ranging from 1=strongly disagree to 5=strongly agree), with a higher score indicating a higher level of skills access. This variable, created by computing the average of participant's response for each item in the sub-scale, shows each participant's score for his/her operational skills.

Informational Skills Access

Informational skills access refers to one's ability to search, select, and assess information in computer and on the Internet (van Dijk, 2005). It was measured through a series of items formatted on a 5-point Likert scale (ranging from 1=strongly disagree to 5=strongly agree), with a higher score indicating a higher level of skills. This variable, created by computing the average of participant's response for each item in the sub-scale, shows each participant's score for his/her informational skills.

Strategic Skills Access

Strategic skills reflect individuals' capabilities to use computer and network resources as the vehicle to reach specific goals (van Dijk, 2005). It was measured through a series of items formatted on a 5-point scale (ranging from 1=strongly disagree to 5=strongly agree), with a higher score indicating a higher level of skills. This variable, created by computing the average of participant's response for each item in the sub-scale, shows each participant's score for his/her strategic skills.

Skills Access

Skills access refers to an individual's ability to learn, use, and manage digital hardware, software, and Internet connection (van Dijk, 2005). This variable, created by computing the average of participant's score for the three kinds of skills: operational, informational, and strategic skills, shows each participant's overall score for skills access.

General Usage Access

General Usage Access indicates faculty's utilization of various ICTs to cope with a variety of tasks associated with one's life, which are not directly related to faculty's primary professional responsibilities – instructional practices. It was measured through a series of items formatted on a 5-point Likert scale (ranging from 1=never to 5=very often), with a higher score indicating a higher level of usage. This variable, created by computing the average of participant's response for each item in the sub-scale, shows each participant's score for his/her general usage access.

Instructional Usage Access

Instructional Usage Access indicates faculty's ICT usage to support their instructional practices. It was measured through a series of items formatted on a 5-point Likert scale (ranging from 1=never to 5=very often), with a higher score indicating a higher level of usage. This variable, created by computing the average of participant's response for each item in the sub-scale, shows each participant's score for his/her instructional usage access.

Usage Access

Usage access indicates that after fulfilling the requirements of motivational, physical, and skills access, an individual gets time, opportunity, and need to actually use digital technologies (van Dijk, 2005). This variable, created by computing the average of participant's score for the two kinds of usage access, general and instructional usage access, shows each participant's overall score for usage access.

ICT Access

ICT access reflects participants' overall access to information and communication technology including their access to motivational, physical, skills, and usage access. This variable was created by computing the average of participant's score motivational access, physical access, skills access, and usage access.

In addition to the main variables described above, the study recorded some demographic variables. These include age, gender, teaching position (Lecturer/Assistant/Professor/Associate Professor etc.), teaching experience, academic discipline (arts, social sciences, physical sciences etc.), and the type of university (public sector university/private sector university).

Research Design and Procedures

The present study examined Pakistani faculty's access to information and communication technologies. In total, 322 faculty participants teaching in HEC-recognized public and private sector universities in the province of Sindh, Pakistan were included in the study. The research used purposive sampling to make selection of HEIs/universities that were included in the study, and employed convenience sampling to select potential participants within these selected institutions. The potential participants came from a mix of academic disciplines, teaching experience, age levels, and genders. Participation in this study was completely voluntary.

The study employed a self-administered paper survey to record participants' responses. The instrument consisted of five-page questionnaire along with a one-page cover letter. The questionnaire consisted of 63 items measuring respondents' access to ICT at four levels, and six demographic items including age, gender, academic discipline, teaching experience, teaching position, and type of university (public/private sector). The questionnaires along with postage-paid return envelopes were sent to potential participants at their institutional addresses. However, in order to maximize the response rate, I personally visited the selected institutions and attended some public events such as academic seminars and conferences where ever made possible.

Various statistical tests were performed in SPSS to analyze the data in order to answer the research questions proposed, and to assess the validity and reliability of the data. Descriptive statistics were generated for each variable/construct of investigation. These descriptive statistics included the mean scores and frequency distributions for constructs of interest including motivational access, physical access, skills access, usage access, and for some demographic variables such age, gender, teaching position, and type of university where faculty teach. Cronbach alpha was performed to check the reliability of the overall scale as well as each of the constructs within the scale. Multiple linear regression and ANOVA analysis also were performed to determine any group differences and relationships between the selected variables.

Significance of the Study

The significance of this study is manifold. Firstly, the present research is significant as it is an initial contribution to the literature on faculty's access to ICT in the context of Pakistan. It attempted to depict a big picture of faculty's access to ICT at the four levels: their motivation to adopt ICT, their physical access to digital technologies at their home as well as on campus, their abilities to use such technologies, and their actual use of ICT for general as well as instructional purposes. The findings of this study provided valuable information to policy makers and high level administrators, helping them to make informed decisions on adoption of technological innovations in higher education of the country. For example, the information gained from the study may assist Higher Education Commission of Pakistan to make informed decisions whether more ICT infrastructure needs to be established at public sector universities; and which academic disciplines should be paid special attention while selecting participants for faculty's professional development in the area of computer literacy and educational technology. Findings from this study also may influence the planning of educational technology focused professional development programs such as determining the type of digital skills faculty are good at, and the type of skills needed to be more emphasized.

The study has also determined the personal and positional categorical inequalities, such as age, gender, university type, and academic disciplines, which are significant factors in predicting the divide in faculty's access to ICT. Additionally, this study also served as the field test of the FICTA (Faculty's Information and Communication Technology Access) scale with a relatively large sample size (N=322), helping to confirm the factor structure and to assess the reliability of the scale. The validated scale may be a valuable tool to examine faculty's access to ICT at other geographic locations. The scale also may be used with teachers of different educational settings with some minor modifications.

Assumptions

Following assumptions regarding the study were made:

- The FICTA scale, which had already been tested with a small group of potential participants, is a valid and reliable tool to measure faculty's access to ICT in terms of their motivation, physical access, skills, and usage.
- Participants who completed the questionnaire are representative of the target population.
- Participants understood all questions, terms, and format for completing the survey.
- Each participant completed his/her own survey, understanding that his/her responses are confidential.

- Participants responded honestly because participation was completely voluntary, and confidentiality of the participants had been taken care of.

Organization of the Dissertation

This dissertation is organized into five chapters. The first chapter provides the introduction of the study, statement of the research problem, purpose of the study, research questions, and significance of the research. Chapter 2 presents a review of the related literature, providing a theoretical basis for this research. The literature review is divided in three parts. The first part gives an overview of ICT and its significance in the society and in teaching-learning process in particular. The second part introduces the research context, Pakistan, giving some basic introduction about the country, its education, and ICT penetration in the country. The third and the last part of chapter 2 highlights the theories of digital divide with more focus on the theoretical framework employed in the present study.

The third chapter provides a detailed discussion of the research methods used in this study. It presents the research questions under investigation, detailed description of research design, and sampling procedures. Testing and development of the instrument used in this study is also described at length. This chapter also describes procedure of data collection and ethical considerations for the research. The chapter ends with a discussion of the statistical analysis used in this study.

Chapter 4 presents the analysis and results of the data collected with the help of proper statistical tests in order to answer the proposed research questions and to test the above stated research hypotheses. Finally, chapter 5 discusses the conclusions drawn from the findings presented in chapter 4, suggests some practical recommendations, and proposes some recommendations for further research on the same topic. The last chapter is followed by the references and appendices.

Chapter 2: REVIEW OF LITERATURE

This chapter reviews the existing literature that helps to build the foundation for this study. The present study was aimed to examine the digital divide among higher education faculty in Pakistan in terms of their access to ICT at four levels: motivational, physical, skills, and usage access. In order to demonstrate the theoretical foundations of the present study, the literature review presented in this chapter is divided into three parts. The first part of this chapter presents an overview of ICT and its importance in the society, including its significance in educational settings. This part also provides an introduction to the issue of digital divide, and discusses some studies on the issue. The second part provides information about the research context, giving an introduction to Pakistan, discussing its education system, and ICT infrastructure available particularly in higher education institutions of the country. The third part of this chapter highlights the existing theories of digital divide, and provides a detailed explanation of the theoretical framework adopted in the present study. Lastly, the chapter concludes with a short summary of the literature review giving the rationale for the present study.

Part I: ICT and Digital Divide

Today, people are living in the information age, also referred to as the information society, which is associated with modernization and globalization of the society (Alampay, 2006). The information society is the society where its socioeconomic development is greatly dependent on information. The economy of the world has already shifted from slow-paced basic industries (i.e., manufacturing and agriculture) to a fast-paced economy that is grounded on information (Shafique & Mahmood, 2008). As a result of the development of information superhighways, our society has undergone rapid and deep changes in social, cultural, political, and economic aspects (Shafique & Mahmood, 2008). Information and Communication Technology (ICT) has become pervasive in the society; and it has positively affected every walk of today's life (Mahmood, 2009), transforming the way people do jobs, business, entertain, socialize, and educate.

In common, diffusion of ICT in the society is considered as an important indicator of a nation's development and success. It acts as an amplifier of socioeconomic development (Hanafizadeh, Hanafizadeh, & Bohlin, 2013; Youssef et al., 2013). However, access to ICT itself does not guarantee development in the society, but it is people's response that matters once they are provided access to digital technologies (Alampay 2006). As Sianou-Kyrgiou and Tsiplakides (2012) have argued, the socio-economic relationships in the society are structured on the exploitation of information and knowledge rather than on the basis of material goods.

Like other segments of the society, the utilization of ICT has positive consequences for students and teachers as well as for educational institutions (Youssef et al., 2013). It has become an essential part of the education, and its impact on teaching-learning processes is widely accepted (Mahmood, 2009). In a research study, K-12 teachers reported to successfully use technology in their instructional practices for content delivery, reinforcement of students' skills, complementing the curriculum, and transformation – experimenting, implementing, and refining of new approaches to teaching-learning (Ertmer et al., 2012). While learning-by-studying is the most traditional form of learning, the use of digital technologies opens and supports other possibilities, for instance learning-by-doing, and learning-from-peers (Youssef et al., 2013).

The most credible characteristic of emerging technologies is their use as a collaborative tool, which enables learning to become an active and engaging process. Especially a new wave of emerging technologies called Web 2.0 can facilitate students' learning through sharing knowledge and ideas, and practicing collaborative writing (Goh & Kale, 2015). Indeed, access to the impressive tools for communication and collaboration is almost a “non-issue” if teachers and students have computers and Internet connection; since teachers and institutes no longer require to pay for pricey hardware to offer their students digital content or server-based applications (Ertmer et al., 2012).

Ertmer et al. (2012) suggest that technology can be practiced in classroom in both manners: teacher-centered, and student-centered. In a teacher-centered approach, teacher’s role is primarily didactic mostly limited to present information and manage classrooms; and technology is often used for drill and practice, and direct instruction purposes (Ertmer et al., 2012). On the other hand, in a student-centered-approach, teacher plays his or her role to facilitate interaction, guide discovery, and model active learning among the students while practicing technology for exploration and knowledge construction, collaboration, and problem solving (Ertmer et al., 2012).

“School” is a fundamental resource in the development of the knowledge society (Thunman & Persson, 2013) and in particular, universities and other higher education institutes are considered to be the key sources of skilled workforce upon which a knowledge society is built. This way, the significance of ICT becomes more vivid in universities and other institutions of higher education and research, to help build a knowledge society.

People from all walks of life can play their part toward such development more effectively if they leverage ICT to meaningfully support their work and lives. This requires that everyone needs to have physical access to various ICTs, and to equip themselves with digital skills. Doing so, they can compete with the people who are extensively using emerging technologies to improve their works and lifestyles. But not all people in the society are able to use ICT to participate more effectively in various aspects of the society, due to their unequal access to ICT. This unequal access to ICT creates a complex problem that is known as digital divide.

Digital Divide

The digital divide is a complex and multidimensional issue (Chang, Wong, & Park, 2014). It refers to the gap or space between the subsets of the population who have easy access to ICT, and those who have 'zero' or poor access to modern technologies. With the appearance of World Wide Web and multimedia computers, the issue of digital divide was given much recognition in societies all over the world (van Dijk, 2005). The issue of digital divide prevails, at least to some extent, in various groups at every level from very large to very small scale. It may occur between rich and poor countries, rural and urban areas, men and women, skilled and unskilled populations, and large and small organizations (Hameed, 2007).

This digital gap is vivid between the developed and developing countries. Although it is still widening in most part of the world, "the digital divide is *deepening* where it has stopped widening" (van Dijk, 2005, p.2). The *deepening* here emphasizes that the gap in terms of physical or material access to digital devices has closed, whereas the divide between digital skills and usage levels has arisen.

Even the United States, which is considered one of the most modern, advanced, and economically stable country, has no exception when it comes to digital divide (Goh & Kale, 2015; Ritzhaupt et al., 2013). For example, in a study with a large sample (n=5,990) of Florida middle school students, Ritzhaupt et al. (2013) found a digital divide in students' ICT literacy correlated with their SES (socio-economic status), ethnicity, and gender. Similarly, a study examining West Virginia school teachers' Web 2.0 access levels evidenced digital divide at physical and usage access levels (Goh & Kale, 2015).

Digital devices are getting cheaper and simpler day by day, and people with very low income are also getting access to these devices. But advent of new and latest technologies and the fact that not all people have access to the latest devices, have still preserved the issue of digital divide. The question of digital divide cannot be answered simply with a "yes" or "no." But the issue of digital divide should be viewed on a spectrum. van Dijk (2005) argues that most inequalities of access to digital resources are not absolute inequalities showing a gap between those 'have' and those 'have not' ICT access; but it is of a more relative kind. This means that some individuals might have full access and some might have poor access. Some people might have expertise level skills to use these devices whereas others might be very beginner users having basic ICT skills. Some people might be faster and quicker to adopt latest technologies while others might adopt them at a later time.

In examining the inequalities of access to information and communication technologies, researchers found that the traditional demographic variables such as age, gender, ethnicity, and socioeconomic status are the main factors for the digital gap (Alampay, 2006; Ritzhaupt et al., 2013; van Dijk, 2005). Socio-economic status was the most found indicator of digital divide in terms of individuals' physical access to ICT, in various studies conducted in educational settings (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008).

Most of the previous studies have approached to the notion of ICT access in a very narrow manner, considering and focusing only on physical access to digital devices. Indeed, the issue is more complex and multidimensional. The phenomenon of digital divide is not solely limited to the physical access only, but there are other aspects of the divide which should be paid equal attention to. Van Dijk (2005) has provided a refined and more explanative view of the access to ICT. Van Dijk argues that access to ICT here does not mean having only physical access to digital technologies. But it also indicates some other types of access including their motivation to adopt ICT; their capabilities to utilize these technologies; and getting time, opportunity, or need to actually utilize ICT (van Dijk, 2005).

Part II: Pakistan: The Research Context

Pakistan: A Brief Introduction

Pakistan (officially the Islamic Republic of Pakistan) emerged on the map of the world on 14th August, 1947. Pakistan, which means 'land of the pure' is a sovereign country located in South Asia. It is bordered to the north by Afghanistan, to the west by Iran, to the northeast by China, to the southeast by India, and to the south by Arabian Sea. Covering an area of 307, 374 square miles (796,095 sq. km), excluding the Pakistani-held part of Jammu and Kashmir (Shafique & Mahmood, 2008), it has an estimated population of 182 million.

Pakistan's economy is primarily based on agriculture, which employs 48% of the labor force and accounts for 60% of the export earnings of the country (Shafique & Mahmood, 2008). Main export crops of the country include cotton, wheat, and rice. Pakistan's agriculture mainly relies on a massive irrigation canal system that makes about twenty-six percent of the country's total land area farmable (Shafique & Mahmood, 2008).

Pakistan consists of four provinces: Sindh, Punjab, Baluchistan, and Khyber Pakhtunkhwa (previously known as North West Frontier Province), and federal territories including Islamabad Capital Territory, Federally Administered Tribal Areas (FATA), and Federally Administrative Northern Areas (FANA). Rapid urbanization in the country has directed cities to turn into mega-cities that include Karachi, Lahore, Faisalabad, Hyderabad, Gujranwala, Sialkot, Peshawar and Quetta (Ministry of Culture, n.d).

Pakistan is one of the most heavily populated nations of the world with a major percentage of youth (Ministry of Culture, n.d). Major population (about 97%) consists of Muslims while the non-Muslims include Hindus, Christians, Parsis, and Qadiyanis (Ahmedis). Having Islam as the state religion of the country, Pakistani constitution promises equal rights to Muslims and non-Muslims.

The national language of Pakistan is Urdu, written right-to-left in Persian script, while the official language of the country is English. While Urdu is widely spoken and understood connecting people across the country, many regional languages are spoken in different regions of the country. According to National Education Policy 2009, the medium of instruction practiced by the educational institutions is mainly Urdu (65%) with higher percentage for public institutions (68.3%) compared with the private sector institutions (57.2%) (Ministry of Education, 2009).

ICT Penetration in Pakistan

Like other countries in the world, Pakistan is also pressurized by the shifting of world economy from basic industries to information-based economy, to capture the rising opportunities prevailing in the information society (Shafique & Mahmood, 2008). This pressure resulted in various ICT based initiatives in the country. There are various indications of the emergence of an information society in Pakistan including a rapid growth of IT and telecom sector, increased tele-density, fast Internet penetration, formulation of IT policy, and e-commerce, e-learning, and e-government practices (Shafique & Mahmood, 2008).

The information technology and telecom industry of Pakistan has expanded with explosive rate, as the most rapidly growing telecom sector across Asia, in the last two decades (Shafique & Mahmood, 2008). Formulation and adoption of the first information technology policy by the Government of Pakistan, in August 2000, led to extensive efforts and investments in accelerating ICT infrastructure in the country (Hameed, 2007). One of the major expansions was in cellular market where the number of subscribers has elevated from 3 million in 2003 to 30 million in 2006 (Hameed, 2007). During the last decade, cell phones have become one of the most common and affordable electronic devices, and have become a permanent companion of both the rich and the poor people in the country (Kalhoro, Chowdhry, Abbasi, & Abbasi, 2010). Smart phones, having GPRS, Bluetooth, GPS, and wifi, are very common in Pakistan now.

Similarly, there was a significant increase in the Internet penetration rate in Pakistan in the last two decades. The bandwidth and number of subscribers to the Internet have increased significantly in the last few years. The use of social media has become pervasive in the society. Further, the culture of developing websites for business has also emerged. Today, most of the private companies as well as government organizations/departments maintain their website to provide information about their business or services to their customers. However, most of the websites provide information in English which is a foreign language for the people of the country. About 68.3 percent of public institutions of the country employ Urdu as the medium of instruction (Shafique & Mahmood, 2008).

Though other countries in the region have already been using fast mobile Internet services (3G/4G) much before, commercial services of 3G and 4G Internet have recently been launched in Pakistan after a long halt in auction of licenses for these services. But still, the country lags behind in ICT development in comparison to many of the neighboring developing countries. Pakistan was ranked at 129th position in ICT Development Index 2012 with India being on a higher position (International Telecommunication Union, 2013).

Education in Pakistan

The education system of Pakistan can be classified into 4-tiers: Pre-Secondary (grades 1–8); secondary (grades 9-10), higher secondary (grades 11–12); and higher education (undergrad and graduate qualifications) (Higher Education Commission, 2014). Available statistics show that only 50 percent of the population is literate (Ministry of Education, n.d.). Student-enrollment cuts radically at the upper primary, secondary, and tertiary levels (Ministry of Education, n.d.). A major reason of high dropouts at primary level is poverty, resulting a great number of children remaining illiterate (Siddiqui, 2010). The public sector accounts for about 64% of overall enrolments at all educational levels compared to private sector (36%) in the country (Ministry of Education, 2009).

18th amendment in the constitution of Pakistan, promising more autonomy to the provinces, has shifted powers and rights of many subjects, including education, from federal government to the provinces. Before the 18th amendment, education was the subject of both the federal as well as provincial governments. But now, education is primarily executed by respective provincial governments: Sindh, Punjab, Khyber Pakhtunkhwa, and Baluchistan. However, it has been disputed that the contents of the curricula should be controlled by the federal government because the provinces could take liberties which may lead to put the ideology and harmony of the country at risk (Siddiqui, 2010).

Higher education in Pakistan. High quality human capital has got its due importance and value all over the world. It is believed that this is the most important pillar of socio-economic development of a nation. That being the case, higher education institutions of Pakistan can benefit the country in establishing a knowledgeable and skilled human capital who are very essential for the country in increasing its productivity as well as in competing with other nations of the world (Khan, Janjua, Naeem, & Kayani, 2014).

Universities in Pakistan function as semi-autonomous bodies chartered by federal and provincial governments. All higher education institutions in the country work under the policy guidelines set by an apex body called Higher Education Commission (HEC). After 18^{th} amendment in the constitution of Pakistan, the provincial governments of Punjab and Sindh have established their own higher education commissions, and the remaining two provinces are also planning to form their own. However as of 2015, HEC Pakistan, centrally administered by the government of Pakistan, remains the main regulatory body for all universities across the country.

Higher Education Commission (HEC) of Pakistan was established in 2002 replacing University Grants Commission (UGC) through an ordinance issued by then President of Pakistan (Government of Pakistan, 2002). It was aimed for the improvement and promotion of higher education, research, and development in the country. HEC is responsible to formulate, and facilitate implementation of policies, plans, guiding principles, programs, priorities, and standards, of higher education leading to socio-economic development of the country (Ministry of Education, 2009).

Higher education of Pakistan is largely contributed by public sector institutions. In total, there are 160 HEC recognized universities in the country (Higher Education Commission, n.d.). These include 91 public sector universities and 69 private sector universities located in the capital, four provinces, and Azad Jammu and Kashmir. Many of these chartered universities have multiple campuses and affiliated colleges which offer bachelor and master programs.

In the result of HEC initiatives for the promotion of quality and access of higher education in the country, HEC Pakistan made some significant achievements in the last decade. These achievements include: ranking of six Pakistani universities among the top 300 Asian universities, ranking of two Pakistani universities among top 300 world universities of science and technology, establishment of 41 new universities, increase in the number of university campuses from 168 to 258, increase in student enrolment from 330,000 to over a million, increase in female enrollment from 36% to 46%, and award of more than ten thousand indigenous and overseas scholarships to students (Higher Education Commission, 2014). Despite several initiatives aiming to enhance equitable access to higher education in the country taken by the government of Pakistan and in particular by HEC, higher education enrollment of the 18 to 23 years age group in the country remained low (4.7% as of 2008) compared to other countries in the region: India (7%) and Malaysia (12%) (Ministry of Education, 2009).

Distance education in Pakistan. Distance education in Pakistan was started with the establishment of People's Open University in 1957, which was renamed as Allama Iqbal Open University (AIOU) in 1977 (Ahmad, Ameen, & Jawwad, 2009). AIOU, the first distance education university in South Asia, is the largest institution of distance education in the country, offering a large number of educational programs starting from basic literacy programs to the PhD programs in a variety of academic disciplines. The total number of students, enrolled in various programs of AIOU, is over one million (Ahmad, Ameen, & Jawwad, 2009). Though the university is utilizing various emerging technologies such as the Internet to support its educational operations in some of its programs, correspondence method still dominates in most of the programs.

Another institution of higher education providing distance education is Virtual University (VU). VU of Pakistan, holding a federal charter to award degrees, is a public sector institution with a mission to provide affordable quality education to ambitious students all over Pakistan. It is Pakistan's first university which primarily utilizes modern information and communication technologies including the Internet and free-to-air satellite television broadcasts, allowing students to enjoy programs offered by it, irrespective of their physical locations (Shafique & Mahmood, 2008). VU started its functions in the year 2002, and its outreach has reached over one hundred cities of Pakistan in a short span of time (Virtual University, n.d). In addition to students living in different corners of the country, Pakistani students residing in foreign countries are also benefiting from the university's programs.

Technology in Education of Pakistan

As mentioned in the above section, Pakistan is a developing country with increasing but poor ICT infrastructure. Use of technology in education is not established in most of the educational institutions. The use of technology is mostly to support administrative tasks of educational institutions, rather than to support instructional practices. Although practicing ICT to support teaching-learning processes is not seen very often in the country, various policy documents by the government recognize, emphasize, and recommend exploitation of digital technologies to enhance various dimensions of educational services. For example, the policy documents of the Ministry of Education of the Government of Pakistan clearly emphasizes ICT and the skills to use ICT to enrich learning as the key to preparing citizens who can compete in the knowledge society (Ministry of Education, n.d.).

In December 2004, realizing the potential of ICT to offer innovative, and cost-effective solutions to educational needs of the country, the Ministry of Education called upon Pakistan's educators and technologists to design a framework to harness ICT as part of its continuous work to improve education in the country (Ministry of Education, n.d). The united efforts by this team of leaders culminated in the development of a document titled *National Information and Communications Technology (NICT) Strategy*. The NICT Strategy comprises of following six elements and action recommendations for each element: (Ministry of Education, n.d)

1. Use ICT to increase the reach of educational opportunity.
2. Utilize ICT to heighten the capacity of teaching and educational management.
3. Apply ICT to reinforce student learning.
4. Establish complementary approaches to utilizing ICT in education.
5. Build on the present experiences of prevailing and rewarding ICT programs.
6. Establish ICT capability in department of education at federal as well as provincial levels.

The most recent National Education Policy of Pakistan (2009) recalls the NICT Strategy in these words: "Use of Information Communication Technologies (ICTs) in Education shall be promoted in line with Ministry of Education's "National Information and Communication Technology Strategy for Education in Pakistan"" (Ministry of Education, 2009, p. 45).

Considering the value of ICT in Education, a course titled Information and Communication Technologies in Education was introduced in new teacher-certification programs in 2010 (Higher Education Commission, 2010). The course aims to provide pre-service teachers with the knowledge and skills about how ICTs can be employed to engage students in the learning process, enhance understanding of learning material along with instructional and assessment practices, and facilitate collaboration among the learners (HEC, 2012).

Technology in higher education of Pakistan. National Education Policy 2009 of Pakistan recognizes ICT as the means to amplify efficiency and impact of higher education programs in Pakistan (Ministry of Education, 2009). The policy suggests that “ICT must be effectively leveraged to deliver high quality teaching and research support in higher education both on-campus and using distance education, providing access to technical and scholarly information resources, and facilitating scholarly communication between researchers and teachers” (Ministry of Education, 2009, p. 59).

HEC Pakistan “aims to ensure a comprehensive ICT strategy for implementation so as to develop a knowledge society in Pakistan while providing means and resources to increase productivity, workability, and innovation” (Higher Education Commission, 2014, p. 92). HEC, being the main regulatory body for the development and promotion of higher education in the country, has taken many measures to exploit digital technologies to support research and academic activities in higher education and research institutions of Pakistan over the past decade.

HEC Annual Report 2012-13 reports a number of ICT-based initiatives, aiming to cultivate a knowledge society in Pakistan while equipping means and resources to boost productivity, and innovation in higher education of the country (Higher Education Commission, 2014). The following paragraphs highlight and discuss some major ICT initiatives taken by HEC.

Pakistan Education and Research Network (PERN). PERN is a major project by HEC which interconnects higher education and research institutes across the country. The PERN, using advance technologies such as Metro Gigabit Ethernet, IP over DWDM, and Cloud technology, offers a nationwide platform to higher education and research institutes for research and collaboration in areas like high energy physics, telemedicine, grid-computing, VoIP, research related multimedia exchange, and enterprise level video conferencing (Higher

Education Commission, 2014). The PERN also provides connectivity with other national research and education networks and their consortia.

National Digital Library Program. National Digital Library program is one of the most significant initiatives taken by HEC Pakistan. It provides researchers/higher education faculty, within public and private universities and other research institutions in Pakistan, with access to international scholarly literature in electronic form, providing access to high quality, peer-reviewed journals and databases covering a wide range of academic disciplines (Shafique & Mahmood, 2008).

Pakistan Research Repository. Another compelling project is the development of the Pakistan Research Repository to promote and raise the visibility of research generating in the higher education institutions of Pakistan. The aim is achieved through maintaining a digital archive of the research produced in the institutions of higher education in the country. The repository, currently populated with 9666 full-text of PhD theses and 114 other reports, can be accessed by anyone in the world at http://eprints.hec.gov.pk/.

National Video Conferencing Network. Another HEC's ICT-supported leading project is National Video Conferencing Network that provides high quality video conferencing resource at public sector universities of the country. As of 2014, this network has spread over 30 cities facilitating more than 80 public sector universities of Pakistan (Higher Education Commission, 2014). According to HEC, National Video Conferencing Network has proven to be a cost effective solution to fulfill the need of faculty at the universities located in remote areas, and to promote student-faculty interactions (Higher Education Commission, 2014).

Virtual Education Program of Pakistan (VEPP). Under Virtual Education Program of Pakistan (VEPP), foreign as well as local eminent educators, scientists, and scholars are invited to deliver series of lectures in selected academic fields for students of various levels of degree programs. In the year 2012-13 alone, more than 300 interactive lectures from the eminent educators of 18 different countries were organized and delivered to the students under the virtual education project (Higher Education Commission, 2014).

HEC annual report 2012-13 (2014) mentions other ICT-based initiatives including investment in ICT infrastructural development, HEC-Microsoft Education Alliance, National Digital Library Program, Pakistan Research Repository, hosted data centers and private cloud facilities for HEIs, ICT services at HEC central and regional offices, online reservation system for degree attestation, online reservation system for degree equivalence, HEC Scholarships Portal, and facilitation of Turnitin software to suppress plagiarism.

Additionally, HEC's Learning Innovation Division (LID) is the central hub for continuous professional development of faculty teaching at public and private HEIs across the country. One of LID's development projects, National Academy of Higher Education (NAHE) conducts a workshop on Incorporating Technology in Education in connection with faculty's professional development (Higher Education Commission, 2014). Similarly, as of 2013, Master Trainers-Faculty Professional Development Program has prepared 580 Master Trainers, equipping them with the latest pedagogical and research skills which included a module on ICT and e-Learning, under LID (Higher Education Commission, 2014).

Currently, HEC is working on a project to promote the concept of Smart Universities which will provide complete IT-enabled environment with Wi-Fi availability everywhere in the university, enabling students and teachers to carry out their research anywhere within their universities (Higher Education Commission, 2014b). Initially the program will be launched in seven universities and will spread to other universities across the country.

Despite the large investments and efforts by HEC to promote the use of ICT through its various projects, there is a well justified question to ask whether all faculty have adequate access to ICT that they require in order to benefit from ICT-based projects to support their instructional and research practices.

Higher education institutions of Pakistan, in comparison to institutions in other settings (institutions providing primary, secondary, and higher secondary education) in the country, have got relatively better ICT infrastructure. University of Punjab, the largest and oldest institution of higher education in Pakistan, has more than 5000 computers with Internet access available to university faculty and students in 64 departments (Mahmood, 2009). The university has also got an Internet Lab in the Central Library with 100 terminals.

Literature on Technology Practices by HEIs of Pakistan

Apart from HEC ICT initiatives to amplify the quality, productivity, and efficiency of academic and research activities in HEIs of Pakistan, as highlighted in its own reports, there is not sufficient literature available which may provide much evidence on technology practices of HEIs to support their functions. The limited literature available shows that public sector universities do not have better ICT infrastructure, and they face various challenges trying to implement ICT in order to improve the access and quality of education (Safdar et al., 2011; Farid et al., 2014). Identically, it is generally assumed that private sector universities of Pakistan are better in terms of ICT infrastructure.

Likewise, there is very limited research conducted on the availability of technological infrastructure in higher education institutions of Pakistan, and on faculty's skills and use of technology to support teaching-learning process. Findings from some of the available literature on this aspect are discussed in the following paragraphs.

On the basis of a survey conducted with teacher educators, Safdar et al., (2011) found that faculty (teacher educators) use ICT for preparing their class lectures, presentations, assessing students' assignments, and giving feedback to their students and disseminating their research work. However, findings of their study also suggested that certain barriers such as insufficient physical access to digital technologies, lack of professional development opportunities, and power failures prevent faculty to use ICT effectively.

A study conducted in private teachers' training colleges in Khyber Pakhtunkhwa (a province in Pakistan) suggested that faculty of these colleges neither use nor have access to instructional technologies such as computers, software, televisions, overhead and multimedia projectors, and VCRs (Suleman et al., 2011). Further, undergraduate and graduate students from public sector universities have agreed to the high significance of e-learning but they have reported poor ICT infrastructure, and poor ICT skills as barriers to implement e-learning in their institutes (Farid et al., 2014).

Although the use of information and communication technology to support learning processes does not seem to be well established in real practice by most of the universities in Pakistan, websites of some universities like Allama Iqbal Open University (AIOU) and Virtual University (VU), show that they have been successfully practicing ICT to support teaching-learning processes in distance learning programs for many years.

Part III: Digital Divide Theories and Theoretical Framework of the Present Study

In order to examine Pakistani faculty's ICT access and to investigate the digital divide among them, a comprehensive theoretical framework, that could address various dimensions of ICT access, was needed. A theoretical framework serves as a conceptual model that directs and formulates a research study. It centers on the variables to be investigated and the relationships to be learned.

Old theories of digital divide present a narrow interpretation of the term *access* which meant physical access; which is only one form of access to ICT (van Dijk, 2005). The notion of digital divide has now stretched beyond physical access to digital devices, and now includes whether people have the required ICT skills to benefit from them (Ritzhaupt et al., 2013). Researchers also argue that the issue of digital divide cannot be understood without paying attention to issues including “attitudes toward technology (e.g. technophobia and computer anxiety), the channels used in new media diffusion, educational views of digital skills, and cultural analyses of lifestyles and daily usage patterns” (Hanafizadeh et al., 2013, p. 38).

Past literature has defined the term digital divide in three ways 1) definitions focusing on physical access to digital technology, 2) definitions that also consider use of technology in addition to physical access, and 3) definitions that also examine purposes and quality of ICT use side by side to physical access (Hanafizadeh et al., 2013).

Hohlfeld et al., (2008) proposed a framework for examining the levels of digital divide within schools. On the basis of past literature on digital divide, they sketched three levels of digital divide among schools (see Figure 1).

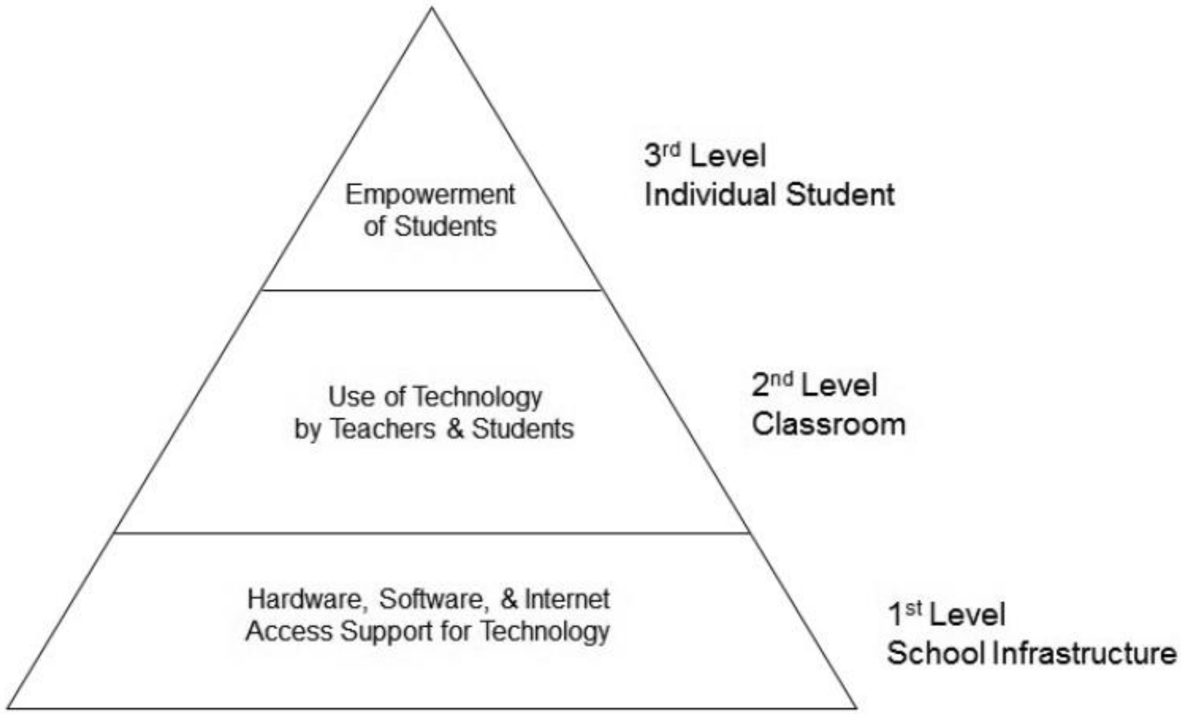

Figure 1. Levels of digital divide in schools (Hohlfeld et al., 2008, p. 1649).

The first level of this framework focuses on the technological infrastructure available in a school. This level corresponds to the narrow view of the term *access* to digital technologies. It supports the equitable access to technological resources including digital devices, software, Internet, and technology support within schools.

The second level of the digital divide in this framework pays attention to the frequency and purposes of technology use within classroom by students and teachers. This level is dependent on meeting the minimum requirements of the first level of the digital divide, which seems to be quite logical. Students and teachers need to get physical access to technological resources available in a school, and should have sufficient technology support within school before they effectively use technology within the classroom. This level of digital divide can be measured by examining the frequency and type of digital resources used by students and teachers, the purpose of their use (e.g., presentation of content, collaboration, or assessment), and the level of integration of these activities to support their regular instructional or learning practices (Hohlfeld et al., 2008).

The third and the top most level of this digital divide model centers around the measurement of how digital technology is used to empower the students within the context of a school. This level is contingent upon meeting the requirements of the two lower levels. It focuses on "schools' responsibility for preparing students with both the technological skills and the abilities to independently make decisions so that they are capable of selecting and using the appropriate ICT for accomplishing personally valuable objectives in efficient ways" (Hohlfeld et al., 2008, p. 1650).

Although the above mentioned framework may help to understand digital divide in school settings, it may not be effective to measure digital divide among faculty in the present study for a few reasons. Firstly, its first level focuses on physical access without any examination of users' motivation or mental readiness to adopt digital technologies. van Dijk (2005) has stressed that individual's mental readiness is the prerequisite to acquire, adopt, learn, and use digital technologies. Secondly, this framework seems to be more appropriate to be used with students and not with teachers, because its third level is directly concerned with the empowerment of students. Further, Hohlfeld et al.'s (2008) framework of digital divide does not address 'skills' explicitly.

van Dijk's (2005) model of successive kinds of access to digital technologies suggests a refined and detailed concept of access to digital technologies, rejecting narrowed approach of access *to ICT* employed by old theories. Both, the individual's motivational as well as skills access are explicitly addressed in van Dijk's model of successive levels of access to ICT, in addition to physical access and actual usage. This model is discussed at length in the following sections.

van Dijk's Theory of Digital Divide

van Dijk's model of the digital divide characterizes the most comprehensive and theoretically grounded attempt to comprehend the multifaceted phenomenon of digital divide (Lupac & Sladek, 2008). A potential theory of the digital divide is reflected in van Dijk's core argument (van Dijk, 2005). He presented a causal model to illustrate his core argument of the theory of digital divide (see Figure 2). van Dijk's theory acknowledges phenomena of the digital divide as successive kinds of access occurring due to a collection of causes which leads to possible consequences.

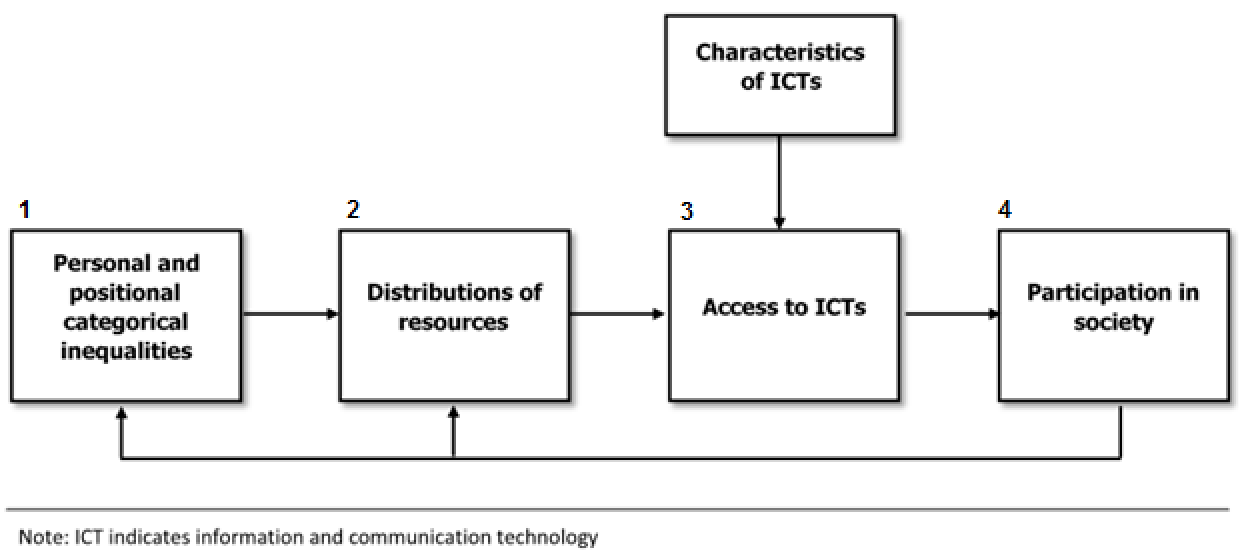

Figure 2. A causal model of the core argument (van Dijk, 2005, p. 15)

van Dijk's model of the core argument shows relationship between four states of 'affair': 1) Personal and positional categorical inequalities (gender, age, ethnicity, education level, employment status, etc.), 2) Distribution of resources, 3) successive kinds of access to ICT, and 4) Participation in society. Elements 1 and 2 in the model act as the causes, 3 as the phenomenon of the digital divide, and 4 as the possible consequence or output of the process. *Characteristics* *of ICT* has been included as a side element that defines the type of inequality to be analyzed. Here in this model, it is also important to note that *Participation in Society* reinforces the *positional categorical inequalities* as well as *Distribution of resources*.

Successive kinds of access to ICT. One of the most important characteristics of van Dijk's (2005) core argument is a rectification of the perception of *access* to digital technology. He refined the concept of *access* to ICT by conceptually dividing it into four precise, successive kinds of access to ICT namely motivational access, material or physical access, skills access, and usage access; where skills access is further divided into operational (instrumental), informational, and strategic skills (van Dijk, 2005). Figure 3 illustrates van Dijk's multifaceted model of access to digital technology, computers, and Internet connections.

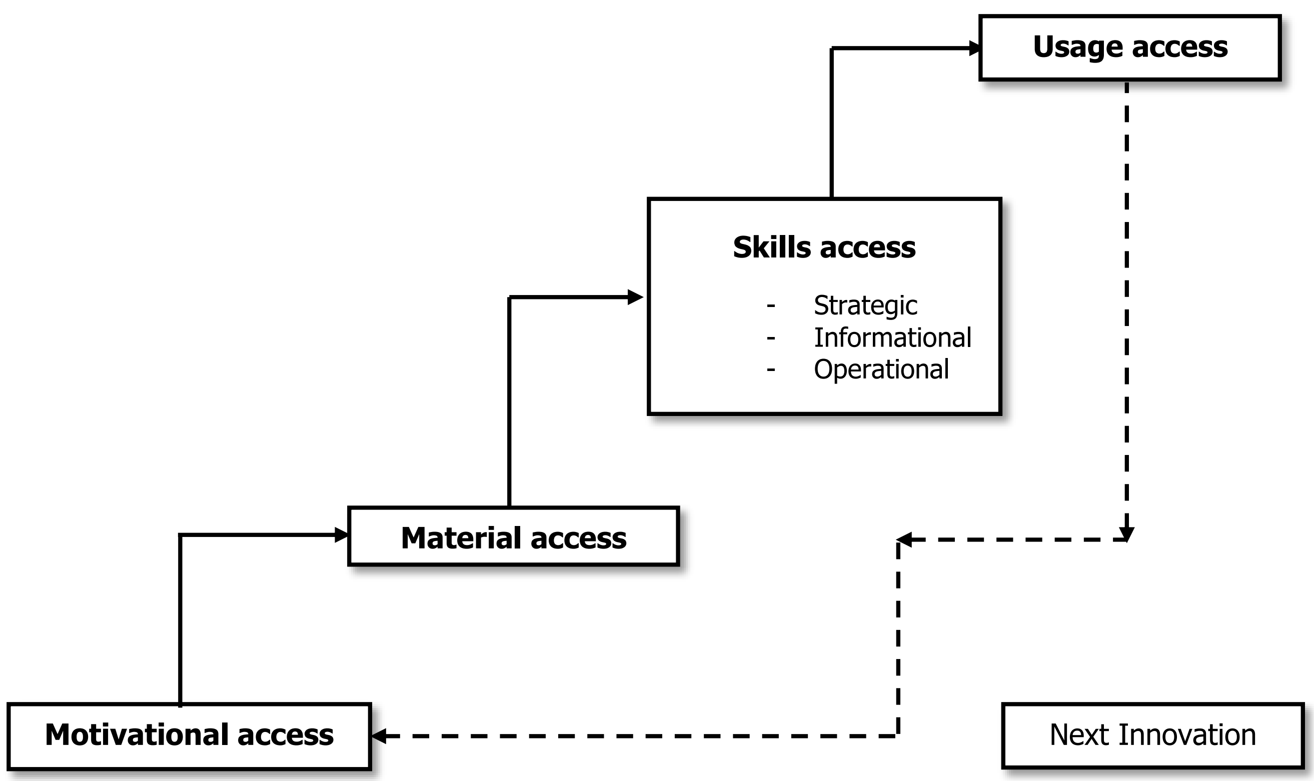

Figure 3. A cumulative and recursive model of successive kinds of access to digital technologies (van Dijk, 2005, p. 22)

van Dijk (2005) has argued that access problems of ICT progressively shift from the first two stages or kinds of access (material or physical and motivational access) to the last two (skills and usage access). This model suggests that the digital divide, between two groups or segments of the society, can occur at any one, two, three, or all four stages of access to digital technologies. Each of these four stages of access to ICT is further elaborated one by one in the following sections.

Motivational access. Motivational access is the first and the preliminary condition stage of the sequence of access to digital technology, computers and Internet connection. It refers to an individual's wish or intent to "adopt, acquire, learn, and use" digital technologies (van Dijk, 2005, p. 27). In other words, motivational access is about the mental readiness of an individual to have and use digital technologies.

Lack of motivation in acceptance of emerging technologies has always been on top of the list of problems preventing technology adoption (van Dijk, 2012). There are individuals who 'have-nots' but also 'want-nots' digital technologies, saying various reasons such as they don't need, don't like, aren't able to handle, or don't have time to use these technologies – computers and Internet connection in particular (van Dijk 2005).

van Dijk (2005; 2006) has suggested a variety of determinant factors to motivational access to ICT. These factors explaining motivational access are of material, social, cultural, emotional, mental, or psychological nature. Already having physical access to digital equipment or one's financial ability to purchase and maintain computers and Internet connection are examples of materialistic resources that influence people's motivation to adopt ICT. Similarly, getting awareness and inspiration to use computers from family, friends, co-workers, and teachers or students, represent how social resources can be influencing on motivational access.

Computer anxiety and techno-phobia are factors of mental and psychological nature (van Dijk, 2006).

Previous studies and some theories on acceptance of technology have suggested various factors such as perceived usefulness, perceived ease of use, peer-influence, superior-influence, self-efficacy, compatibility, and facilitating conditions that influence an individual's intention to adopt a particular behavior – acceptance of technology (Taylor & Todd, 1995a). Hence, they are all related to motivational access to digital technologies as well.

In traditional classification, motivation can be classified as intrinsic and extrinsic motivation. Intrinsic motivation refers to "doing something because it is inherently interesting or enjoyable" (Ryan & Deci, 2000, p. 55). Or in other words, it is defined as "doing something for its own sake" (Reiss, 2012, p.152). Extrinsic motivation, in contrast, is defined as "doing something because it leads to a separable outcome" (Ryan & Deci, 2000, p. 55).

To better understand the distinction between the two types of motivation, let us discuss an example. If a kid plays a game, for instance cricket, simply because he or she likes and enjoys to play it, it shows his or her intrinsic motivation to play cricket. On the other hand, if a kid is motivated to play cricket because he or she receives presents or prizes when he or she wins a match; his act is much influenced by extrinsic motivation. These two forms of motivation are not contradictory, and can co-exist most of the time. Researchers have considered the constructs of *perceived enjoyment* and *perceived usefulness* of technology corresponding with intrinsic and extrinsic motivation to technology use respectively (Chang, Wong, & Park, 2014).

In order to have more explanative understanding of motivational access to ICT, the measurement of this construct in the present instrument included two different aspects: *Endogenous Motivational Access*, and *Exogenous Motivational Access*. However, this approach to classify motivational access is somewhat different than the traditional classification of motivation – intrinsic and extrinsic motivation. I was interested to understand the phenomena of motivational access with more focus on the source of factors that influence an individual’s desire to adopt digital technologies. I was more curious to know: Are the factors influencing one’s desire to adopt ICT coming from the inside of an individual and related to one’s own perceptions and attitudes? Or, are there some external sources that influence one’s inclination to ICT, such as availability of material resources, and social or cultural factors? So I employed a new approach to distinguish between two types of motivational access to ICT: endogenous motivational access and exogenous motivational access.

In accordance with the approach I adopted for this study, endogenous motivational access refers to an individual’s desire to adopt ICT that originates from *the inside* of the individual, and is not directly affected by external sources. In this manner, an individual would be endogenously motivated if he or she adopts and utilizes ICT simply because of his or her own perceptions and beliefs that he or she will enjoy using them, or benefit from them in some way. For example, if a teacher utilizes ICT in his teaching because he or she believes that such technologies may enhance the effectiveness of his or her teaching, and not because other teachers at the school do so, or the school administrator wants him or her to do so; the teacher is said to be endogenously motivated to adopt ICT.

On contrast, exogenous motivational access takes focus on external and other contextual aspects into account. It denotes an individual’s desire to adopt ICT that originates from the outside sources including social influence, time, and material resources, rather than individual’s own beliefs and perceptions. Take an example of an instructor who utilizes ICT in his or her class. If the instructor’s ICT utilization is not because he or she thinks that it would enhance teaching and learning process, but it is because school administrators or students expect him or her to do so; I would say that the instructor is exogenously motivated to adopt and use ICT.

This new and different approach to view motivational access will allow to include aspects of different constructs (perceived enjoyment, perceived usefulness, perceived ease of use, peer-influence, superior-influence, and facilitating conditions), which will enhance the focus of traditional classification of motivation. In this relatively different adopted approach, aspects of perceived enjoyment, perceived usefulness, and perceived ease of use belong to endogenous motivation; because they are directly related with the individuals own beliefs, and are not influenced by outside factors. van Dijk (2006) has discussed similar concepts in terms of factors of emotional, mental, and psychological nature.

On the other hand, the aspects of peer-influence, superior-influence, and facilitating conditions belong to exogenous motivation, because they are indicators of the influence of outside environment, and are not directly related with individual’s own beliefs. In terms of van Dijk’s suggested factors to motivational access, material, social, and cultural resources correspond with exogenous motivational access. This break-up of motivational access can be seen in Figure 4 which depicts the decomposed framework to measure faculty’s ICT access.

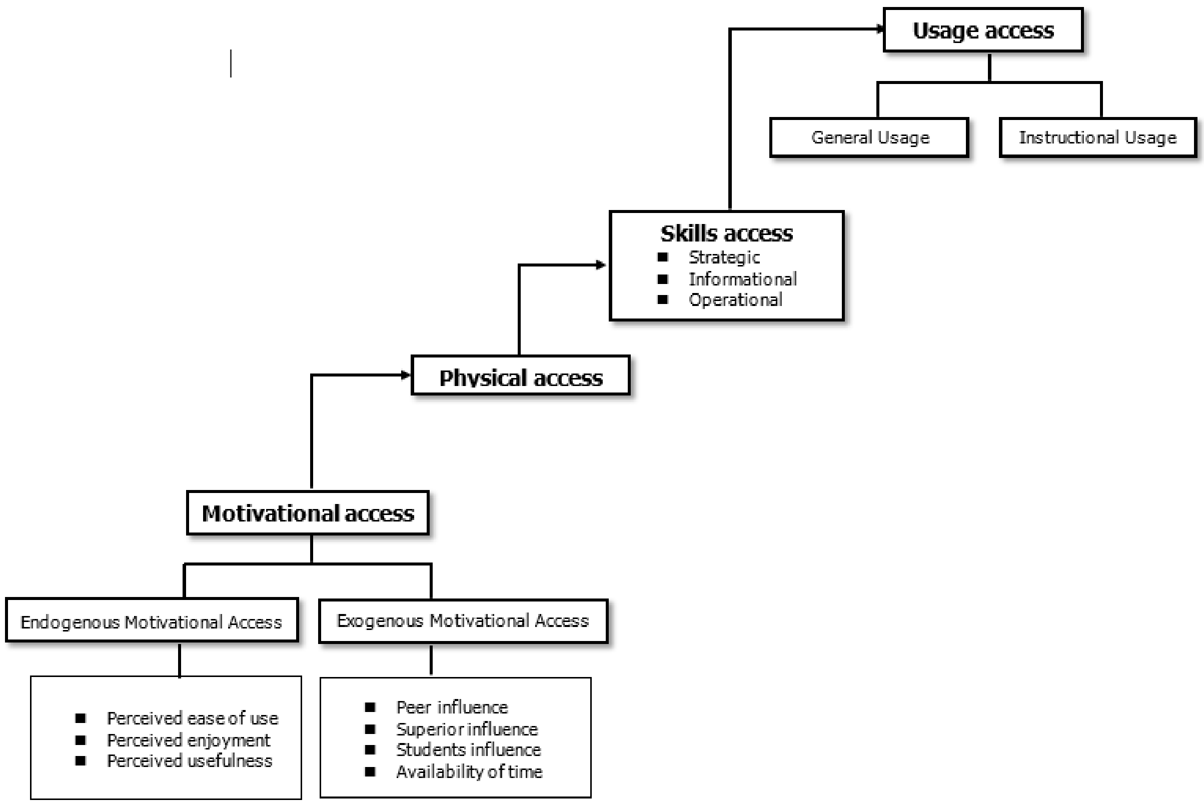

Figure 4. Decomposed theoretical framework to measure faculty's access to ICT.

Material or physical access. The second stage, material or physical access, is what initially has been understood by the notion of *access to ICT*. It is related to the custody or authorization to use computers, Internet, and other digital devices. An individual may have material access to digital technologies at home or work, or at school or any other public place such as a library (van Dijk, 2005). As infrastructure develops, digital technologies become more economical and ubiquitous (Goh & Kale, 2015) helping to solve the problem of physical or material access.

This is the type of access to ICT that has been heavily investigated in past studies. Most of the previous research on digital divide was devoted to examine the divides of physical access to computers and Internet connection, considering a narrow approach of access to ICT ignoring other types of access – motivational, skills, and usage access. People consider that digital divide can be bridged by providing everyone with a computer and Internet connection (van Dijk, 2005).

Van Dijk (2005) has argued that physical access should not be downplayed while emphasizing other kinds of access. This type of access is very important and an essential condition to develop digital skills and ultimately utilizing ICT to serve various purposes. In addition to emphasis on physical access to hardware of computer, smart phone, and Internet connection, van Dijk (2012) has emphasized *material access* – reach to software, subscription, peripheral equipment, and other materials such as ink, paper. According to him, companies sell their hardware equipment and connections at very low prices whereas software, content, and subscriptions are very expensive in most of the cases.

Skills access. When the problems of first two stages of access to ICT (motivational access and physical access) have been solved, next comes the skills access. In simple words, skills access denotes an individual's ability to learn, use, and manage digital hardware, software, and Internet connection. After an individual has got some sort of permanent physical access to computer and Internet connection, he or she needs to learn digital skills in a formal learning environment or through practice (van Dijk, 2005). van Deursen and van Dijk (2008) have strongly emphasized the levels of digital skills to understand digital divide, focusing on individuals' "can's and can-nots" with digital technologies.

According to van Dijk (2005), digital skills do not mean only the ability to operate computers and other related digital technologies but it also includes the skills of searching, selecting, and applying information strategically to promote one's position in the community. He has suggested three successive levels of digital skills: operational skills, informational skills, and strategic skills. He has noted that "Within the digital skills succession, operational skills are the skills used to operate computer and network hardware and software. Information skills are the skills needed to search, select, and process information in computer and network sources. Finally, strategic skills are the capacities to use these sources as the means for specific goals and for the general goal of improving one's position in society (in the labor market, in education, in households, and in social relationships)" (van Dijk, 2005, pp. 73-74).

Operational skills. Operational skills, one's ability to operate computer, network and software, is a necessary condition to higher levels of digital skills – informational and strategic skills. These skills, also referred to instrumental skills, involve handling computer files, skills to perform basic operations in word processing, spreadsheets, presentation, media-player and utility software, surfing Internet, and emailing. van Dijk (2005) argued that providing individuals physical access to digital technologies does not automatically solve the problems of skills access, but one has to put efforts and time to learn these skills. Once the basic and fundamental digital operations have been learned in a formal learning environment, one can further develop these skills through do-it-yourself, or trial and error approach and by taking help from people around him or her including parents, friends, and teachers (van Dijk, 2005). Young people, particularly students, are expected to have higher level of competency in these skills than older people have. In general, it is considered that digital skills are nothing but the operational skills. Although the significance of operational skills cannot be undermined, digital skills does not refer to merely operational skills but also include other sets of skills (informational and strategic skills), which are discussed in next sections.

Informational skills. Although operational or instrumental skills have received much attention, having ability to work with information is indispensable in an information society (van Dijk, 2005). van Dijk has defined informational skills as one's ability to search, select, process, and assess information in computer and network resources. He has further split this set of skills into two types: formal informational skills and substantial informational skills.

Formal informational skills are referred to the skills required to work with the formal characteristics of computers and Internet (van Dijk, 2005). Such skills involve understanding file and hyperlink structures, controlling multimedia screens, and handling continually changing contents. On the other hand, substantial informational skills are the capabilities “to find, select, process, and evaluate information in specific sources following particular questions” (van Dijk, 2005, p. 81). Having these skills shows someone’s potential to search, select, edit, and combine information from a variety of sources, and to evaluate information sources. As Internet is the biggest and most widely used source of information nowadays, informational skills are mostly associated with the Internet use.

Strategic skills. According to van Dijk (2005), strategic skills reflect individuals’ capabilities to use computer and network sources as the vehicle to reach specific goals as well as the general goal to promote one’s position in the society. Strategic skills are not learned in a formal educational environment or on the work in categorical ways but are assimilated into the day-to-day practices of work, education, and leisure time (van Dijk, 2005). However, it is clear that one cannot acquire strategic skills to work with computer and network resources without possessing minimum competence in the two other sets of skills – operational and informational skills.

van Dijk (2005) has suggested that the divides in skills access are much bigger than the divides in physical and material access. He argues that such bigger differences are mainly due to unequal distributions of mental resources than of material resources.

Usage access. The last stage of the successive kinds of access to digital technologies is usage access. An individual might have fulfilled the minimum requirements of the first three levels – he or she is motivated to possess and use a computer and Internet, has material access to them, and knows how to use them; but nevertheless he or she has “no need, occasion, obligation, time, or effort to actually use them” (van Dijk, 2005, p. 95). This level of access implies that individuals actually use digital technologies.

While van Dijk’s model of successive stages of access to digital technologies suggests that material access is contingent on motivational access – individuals must be first mentally ready to own and use ICT before they have physical access to it; sometimes, the situation may also be vice versa. In some cases, people get physical access to digital technologies even before they are motivated to possess or use them. For example one who never thought of using computers gets a computer and Internet connection as a birthday gift, or finds it already available at his or her workplace. Such situation implies that the undesired availability of digital devices can also motivate individuals to utilize them.

Van Dijk (2005) has also suggested that the divides in skills and usage access are bigger than the divides in motivational and physical access to ICT, particularly in developed countries where the physical access gaps are closing. That’s the reason that he has used the term the *deepening* of the divide rather than *widening* of the divide.

With regard to higher education faculty’s usage access, their ICT usage can be classified in two categories: *General Usage Access*, and *Instructional Usage Access*. The general usage access includes utilization of various ICTs to cope with a variety of tasks associated with one’s life, which are not directly related to faculty’s primary professional responsibilities – instructional practices. It may include activities related with communication, entertainment, office work, financial transactions, and social interactions. On the other hand, instructional usage access indicates faculty's ICT usage to support their instructional practices. It includes faculty's technology supported practices for planning and preparation of instruction, delivering learning content, enhancing teaching-learning process, and assessing students' learning.

van Dijk (2005)'s model of successive kinds of access to digital technologies suggests a refined and detailed concept of *access* to digital technologies, rejecting narrowed approach of *access to ICT* employed by old theories. He argues that digital divide is still widening in many parts of the world and it "is deepening where it has stopped widening" (van Dijk, 2005, p.2). The *deepening* here indicates that if the gap in terms of physical or material access to digital devices has closed, the divide between digital skills and usage level have arisen.

Although Goh and Kale (2015) examined West Virginia teachers' access levels (motivation, physical, skills, and usage) to ICT based on van Dijk's model, their study does not dim the need for development of a comprehensive instrument measuring faculty's access levels to digital technologies for several reasons. 1) They focused to measure teachers' access levels specifically to Web 2.0 resources rather than digital technologies in general. 2) Their measurement of motivational access seems to focus only on endogenous motivation (attitude and perceived usefulness), and they probably missed the element of exogenous motivation (influence by students, peers, and superiors). 3) They did not concentrate on specific kinds of skills access namely operational, informational, and strategic skills (van Dijk, 2005); rather, they relied on generic measure of digital skills. Therefore, a new survey instrument measuring faculty's access to ICT focusing on motivational, physical, skills, and usage access was developed and tested which may provide educational researchers a tool to examine the issue of digital divide among the faculty. The development and testing of the Faculty's ICT Access (FICTA) scale is discussed with detail in Instrumentation section of Chapter 3.

Summary

Information and communication technologies have become pervasive in the society having positive consequences on every walk of people's life including education. Researchers have also recognized the significance of technology in education particularly to enhance teaching-learning processes (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012; Youssef et al., 2013). These technologies can be very helpful to elevate the standards and quality of various dimensions of teaching-learning processes including content delivery, peer-learning, complementing the curriculum, and student assessment. Further, the significance of ICTs is more vivid in institutions of higher education due to their acknowledged role in building a knowledge society.

Pakistan has been experiencing a fast rate of ICT penetration over the last two decades. Recognizing the significance of ICTs, policy documents of the government of Pakistan emphasize and recommend exploitation of such technologies to enhance various aspects of educational services offered in different settings including higher education. For example, the latest national educational policy of Pakistan suggests that "ICT must be effectively leveraged to deliver high quality teaching and research support in higher education both on-campus and using distance education, providing access to technical and scholarly information resources, and facilitating scholarly communication between researchers and teachers" (Ministry of Education, 2009, p. 59). But yet there is not sufficient literature available that provides information whether the environment of higher education institutions of Pakistan is harmonious for adoption of technological innovations to support and elevate the quality and access of higher education in the country.

The first and foremost prerequisite for exploitation of ICT in education is ensuring adequate ICT access (that includes physical access to ICT and other dimensions of ICT access as discussed in the above literature review) by the teachers as well as students. As a first step, the present study highlights motivations of Pakistani faculty to adopt information and communication technology, their physical access to ICT, their capabilities to utilize digital technologies, and their actual usage of such technologies. The study also provides valuable information on digital divide among higher education faculty of Pakistan in respect of their personal and positional categorical variables. Such information is vital to know whether the faculty is in position to benefit from the ICT based initiatives taken by HEC Pakistan and to support their teaching and research practices through utilizing emerging technologies.

Chapter 3: METHODOLOGY

In order to investigate the digital divide among faculty in terms of their access to ICT, the present study employed a cross-sectional survey design. Data was collected through a self-administered questionnaire. This chapter elaborates the methods and procedures used in this study, including research design, research questions, and sampling. In addition, the development and testing of the instrument, and data collection procedures are explained. Ethical considerations of the research study are also discussed in this chapter. Finally, the chapter provides a detailed description of the statistical analysis used for this study.

To gain insight into Pakistani faculty's access to ICT in terms of their motivational access, physical access, skills access and usage access to ICT, the present study attempted to answer the following research questions:

1. What is Pakistani faculty's access to digital technologies at the four levels (motivational, physical, skills, and usage level)?
2. How does faculty's ICT access differ with respect to their personal (age and gender) and positional categories (type of university and academic disciplines)?
3. How does faculty's use of ICT to support their instructional practices relate to their motivational access, physical access, skill access, and general usage access?

The following sections discuss the study population and rationale for sampling procedure, human subject protection, development and testing of the instrument used, research design, survey procedures, and data analysis for this study.

Sampling Procedures

Decisions on sampling in a research study are one of the most important elements that provides the base for that study. These decisions suggest trade-offs among three things: what the researcher wants to do, what the researcher is able to do (in terms of time and resources), and what the researcher is permitted to do (Andres, 2012). This study employed primarily non-probability sampling to recruit potential participants. Non-probability sampling is based on judgments and rationale made by the researcher. Although literature recommends probability sampling for a survey study like this, compromises among what constitutes the ideal sample, what sample can realistically be met, and what is reasonable with the available finance and time, are unavoidable (Andres, 2012). The rationale for a non-probability sampling in this study is the lack of access to complete lists of the target population.

The unit of analysis for this study was faculty teaching in universities/HEIs of Pakistan. Pakistan is a developing country located in south Asia. It is one of the heavily populated nations of the world. It consists of four provinces. Its economy is mainly based on agriculture.

Sampling decisions taken for the present study were multi-stage. The first stage involved the decision on which universities/HEI should be included in the study. Due to limited time and resources available, this study was delimited to the province of Sindh of Pakistan. However, it is worthy to note here that universities in Pakistan are mainly dominated by policies and funding by the Higher Education Commission of Pakistan across all four provinces and federally administered areas. Provincial governments, so far, have not significantly impacted the infrastructure available within these universities. Although the provinces have now formed their own higher education commissions, these commissions have not yet performed significantly making the universities different across the provinces. Thus, the identified population for this study included faculty in both public and private universities and higher education institutions in the province of Sindh, Pakistan.

Sindh, located on the south east of Pakistan, is one of the four provinces of the country. It was the center of the ancient Indus civilization. The province is divided into 29 districts. Karachi, also known as City of Lights, is the capital of the Sindh province, which is the largest and most populous metropolitan city of Pakistan. Karachi is considered the financial hub of the country. The major languages of the province include Sindhi and Urdu.

There are 49 HEC recognized universities in Sindh (See Appendix A for a complete list). These universities include 19 public sector universities/HEIs, funded and administered by the federal government of Pakistan or by the provincial government of Sindh, and 30 private sector universities/HEIs. Many of these universities/HEIs offer degree programs in a variety of academic fields including arts, social sciences, natural sciences, education, and commerce. However, some HEIs/Universities specialize in engineering, medical, agriculture, or business studies. Eight universities/HEIs, including four public sector and four private sector universities/HEIs, were selected through a purposive sampling in order to represent participation from all academic disciplines and both public as well private sector universities. Purposive sampling is a non-probability sampling technique where a researcher selects the sample based on his/her judgment believing that the sample selected would be representative of the population or possess the necessary information about the population (Fraenkel & Wallen, 2008).

The following eight universities were included in the present study:

1. University of Sindh Jamshoro (Public sector: General university)
2. University of Karachi, Karachi (Public sector: General university)
3. Sindh Agriculture University Tando Jam. (Public sector: Agriculture university)

4. Quaid-e-Awam University of Engineering & Technology, Shaheed Benazirabad. (Public sector: Engineering university)
5. Iqra University Karachi (Private sector: General university)
6. Hamdard University Karachi (Private sector: General university)
7. Institute of Business Management, Karachi (Private sector: Engineering university)
8. Baqai Medical University, Karachi (Private sector: Medical university)

Such a selection allowed to represent not only the public and private universities but also the general and specialized ones including one engineering, one medical, one business, one agriculture, and four general universities. These universities are located in Karachi, Jamshoro, Shaheed Benazirabad, and Tando Jam districts of Sindh.

Considering the busy schedules of faculty in general, and my personal observation that people from Pakistan take least interest in participating in research studies and completing surveys, I attempted to gather data from as many faculty members as possible regardless of their status (regular/full-time, contractual, temporary etc.), position (such as Lecturer, Assistant Professor, Professor etc.), and experience (fresh or with many years' experience).

Response rate is considered as an indicator of the success of a survey study. It is the proportion of the selected sample who complete the survey questionnaire (Punch 2003). Low response rate for a study raises questions on the validity of its findings. Since participation in the present study was completely voluntary, the potential participants were free to disrespect the survey. Receiving a high response rate in voluntary studies without offering a monetary reward is a typical challenge for researchers.

For the present study, a total of 322 completed questionnaires were received out of 700 questionnaires mailed/distributed. The overall response rate of 46% was achieved. Separate response rate for mailed and distributed questionnaires is unknown because the participants returned completed questionnaires by mail regardless of the way they received them. Also, the reasons for why some potential participants responded and some did not participate are not known.

Ethical Considerations

It is very important for survey researchers to follow the principles of ethical conduct in each phase of the research, especially respect for human dignity which is fundamental to the ethical conduct of research (Andres, 2012). I made every possible effort to safeguard the protection of research participants for this study. First of all, I requested Higher Education Commission (HEC) of Pakistan to grant a letter of permission for data collection from faculty participants at universities/HEIs of Pakistan. The permission letter also certified that this research would not affect the cultural mores/codes of the participants (see Appendix C). This letter was a requirement by the Institutional Review Board (IRB) of West Virginia University to approve the research protocol. Next, I submitted the research proposal to the IRB at West Virginia University. The research protocol was approved for data collection after review. The approved protocol is on file with WVU's IRB (Protocol# 1412511777).

An important concern related to research participants' protection is the protection of their privacy. The present study used an anonymous survey – it did not collect specific demographic data or any other information that could be used to uniquely identify the respondents. As a matter of fact, I maintained the participants' anonymity throughout the research. Moreover, I have carefully stored the completed questionnaires, which will be destroyed after two years of completion of this research.

It is also a researcher's responsibility to adequately inform potential participants about the purpose and procedures of the research as well as the possible risks involved in research participation. There were no known risks to respondents for participating in this study. Further, the research study did not ask participants any question which could make them feel discomfort at any level. However, it was obvious that they were required to spend some time (about 20 minutes) to complete the questionnaire.

The survey questionnaire was accompanied by a cover letter written on West Virginia University letterhead (see Appendix D). This cover letter conveyed the purpose of the research study, and its usefulness. The cover letter also made it clear that the participation in the study was completely voluntary and the respondents could skip any questions in the survey or withdraw from the study at any stage. The cover letter further explained that the research study is being conducted by a doctoral student to meet his dissertation requirements. The letter concludes by thanking participants for their time and consideration. The present research study did not seem to need separate signed consent forms by the potential participants, because this study was conducted with adults in a regular academic setting, employing normal survey procedures. The return of the completed survey questionnaire indicated the respondent's implied consent to participate in the study.

Research Design

The present study employed a survey design to examine faculty's access to information and communication technologies in terms of their four consecutive access levels to ICT – motivational, physical, skills, and usage access, by using the FICTA scale. Survey research typically investigates questions of description, opinions, attitudes, and behavior, and is projected to generalize or be transferred in some manner beyond the actual sample in the study (Andres, 2012). It is also a suitable research design to describe and gain descriptive information on characteristics of large populations. A survey research design allows researchers to collect a large amount of information from a large sample size in a relatively short time period and at a reasonable cost.

The present study is a cross-sectional study with quantitative approach. Cross sectional studies collect data from participants at one point in time, rather than at multiple points in time as done in longitudinal studies (Punch, 2003). In comparison to longitudinal surveys, cross-sectional studies need less time to complete, demand less commitment from participants, and do not require much effort to find and maintain a sample. The data for the present study were collected through the researcher-designed quantitative survey, Faculty’s Information and Communication Technology Access (FICTA) scale, consisting mainly of checklist and Likert scale items. I developed and pilot tested the FICTA scale as my candidacy examination in partial fulfillment of the requirement for doctoral degree in Instructional Design and Technology. Details on development and testing of the FICTA scale is presented in the Instrument section of this chapter.

The current study employed a self-administered paper survey to collect data from potential participants. The choice of instrument format should be contingent on numerous considerations, including the potential participants, sample size, nature of questions to be answered, and the availability of budget and timeline for the project (Andres, 2012). Self-administered survey as a source of data collection was chosen for this study for a few reasons. First, the potential participants for this study are well-educated and literate, and the questionnaire used in this study was simple and straightforward. Therefore, it was hoped that the potential participants were able to read the questionnaire, follow the instruction, and respond the survey accurately unaided by an interviewer. Also, self-administered surveys provide a data collection instrument conducive to busy schedules of faculty participants allowing them to complete questionnaires at their own comfort and convenience while maintaining their privacy. Finally, a relatively large sample size and geographic norms related to data collection suggested that self-administered survey was the most appropriate source of data collection for the present study.

All data for the present study were collected through a paper-based questionnaire. A survey using an online version of the questionnaire would have restricted this study to the participants who have adequate ICT access, excluding potential participants who are the least convenient with technology. That, in turn, would have undermined the basic purpose of the study.

Instrumentation

This study used the Faculty's Information and Communication Technology Access (FICTA) scale to measure participants' ICT access focusing on four successive levels suggested by van Dijk (2005): Motivational access, Physical access, Skills access, and Usage access. The 63-item FICTA scale consists of primarily Likert scale and checklist items. In addition to the FICTA scale, the survey included six demographic items including age, gender, academic discipline, teaching experience, teaching position, and the type of university (public/private sector) where the respondents teach.

The final survey instrument was comprised of five-page questionnaire and one-page cover letter. Survey experts have emphasized on the proper layout, font size and type in readable surveys such as paper-based surveys (Andres, 2012). I paid due attention to these suggestions by experts ensuring that the paper survey for this study was easily readable by potential participants, and that the layout of the survey was appealing.

The FICTA scale was developed and pilot tested in fulfillment of my candidacy examination. In order to construct this instrument, I took several steps to affirm that the tool being developed meets adequate standards of validity and reliability. Quantitative as well as qualitative methods were employed to establish the extent of the validity and reliability of the FICTA scale. These involved a number of stages that included item generation, content validity, discriminant validity, cognitive interview, formal pilot testing, and assessment of reliability. Following sections describes these stages one by one at length.

Item Generation

The construction of the survey instrument used in the present study, FICTA (Faculty's Information and Communication Technology Access) scale, began with the process of reviewing the literature and examining the available instruments on the topic. Initially, a pool of 74 items was generated that addressed various dimensions of faculty's access to ICT (item generation for each construct addressed in the scale is elaborated in the subsequent sections). This considerably large number of items (74) was generated intentionally because the number of items could be reduced during various steps of instrument testing and validation. The generated set of items included some negatively worded items to control the pattern of consistent responses based on the format rather than the attribute being measured. Many of the items were identified and selected from existing scales. They were adapted to match the format of the instrument. Remaining items were created afresh in the light of construct definitions where required. Except the items measuring physical access to ICT, each item was formatted on a five-point Likert-type scale. These items were rated from 1 to 5, letting participants decide the position on the scale that best reflects their response to the item. Negatively worded items were reverse coded before statistical analysis, ensuring that higher score reflects higher access to ICT.

Following sections talk about construct-wise item generation in the scale:

Motivational access. To measure faculty's motivation to adopt and use digital technologies, participants were asked two sets of items focusing on their endogenous motivational access and exogenous motivational access. As mentioned in the literature review, this classification of motivation adopted in this study is different than the one from literature (Ryan & Deci, 2000). These two constructs mainly consisted of newly generated items. However, these items were inspired by other constructs such as perceived ease of use, perceived usefulness, peer influence, superior influence, and facilitating conditions used in different studies (Ajjan & Hartshome, 2008; Sadaf, Newby & Ertmer, 2012; Taylor & Todd, 1995b).

Items in the constructs representing two types of motivational access for this study were inspired from different constructs used in other studies because they fit the definitions for the two constructs. Each item within these constructs was formatted on a 5-point scale (from 1= strongly disagree to 5= strongly agree), with a higher score indicating a higher level of motivation.

Physical access. Physical access – possession or permission to use digital technologies is probably the most important dimension to understand the problem of digital divide. However, its measurement is potentially more direct and tangible in comparison to the measurement of other levels of ICT access. Therefore, it was decided to measure this construct with help of a checklist items rather than a Likert scale measurement. Previous studies have adopted a similar method to measure this construct (Goh & Kale, 2015; Kale & Goh, 2014). A list of digital devices and resources taken from existing research (Goh & Kale, 2015) was provided to the participants, and they were asked if they had access to these devices at home or on campus.

Skills access. I followed van Dijk's (2005) classification of skills access – operational skills, informational skills, and strategic skills. Separate questions were asked to measure these three types of digital skills. In order to measure operational skills, question stem was phrased as: "Following statements estimate your abilities to operate digital devices such as computer, and Internet. Please indicate your level of agreement with these statements (1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly agree)". Similarly, informational skills were measured by saying: "Following statements estimate your abilities to search, select, and evaluate information using computer, and the Internet. Please indicate your level of agreement with these statements (1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree)." And finally the strategic skills were measured through: "Following statements estimate your abilities to use computer and the Internet in reaching your goals. Please indicate your level of agreement with these statements (1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree)." Items within these three questions were drawn from an existing survey instrument on Internet skills (van Deursen, van Dijk, & Peters, 2012) with some minor changes. These items are intended to measure self-assessment of skills access by the respondents.

Usage access. Faculty's ICT usage was measured by focusing on two sub-domains: General Usage Access and Instructional Usage Access. In order to inquire about faculty's ICT usage access in general, the question stem was phrased as: "Please indicate how often (1=Never, 2=Rarely, 3=Not often, 4=Somewhat often, 5=Very often) do you engage with the activities mentioned in the following statements." Similarly, for faculty's instructional usage access, it was asked: "Please indicate how often (1=Never, 2=Rarely, 3=Not often, 4=Somewhat often, 5=Very often) do you engage with the following activities to support your instructional practices." Most of the items for general usage access were drawn afresh considering van Dijk's (2005) definition of usage access. However, items measuring instructional usage access were adapted from existing literature (Kale & Goh, 2014; Safdar et al., 2011) with some modifications.

Content Validity of the Provisional Tool

After I had developed the provisional 74-item FICTA scale covering various dimensions of the tool of interest, content validity of these items was performed. Content validity is the indication that the items in the scale sample the thorough range of the attribute under investigation (DeVon et al., 2007). I followed a quantitative approach of content validity suggested by Lawshe (1975).

A total of five experts including two researchers in the field and three doctoral candidates in Educational Technology were identified and approached for the purpose of content validity of the tool. The selected experts were invited to the online content validity questionnaire. They were briefed about the intent of the study and instructions to complete the questionnaire. The experts were requested to review the potential scale items by rating each item on a three-point scale ("1= not essential, 2=useful but not essential, and 3=essential") under definition of each construct, confirming if those items were suitable and necessary indicators of the construct. I also asked experts for any suggestion they wanted to make for addition or rewording of the items.

Upon completion of questionnaires by the five experts, the content validity ratio (CVR) for each item was calculated. The items that were not significant at 0.05 level were eliminated from the instrument. In the result of the content validation of the items, a total of 66 items were found to be worthy of retention, after elimination of eight items. Items removed on this stage are listed in the Appendix B.

Discriminant Validity

Discriminant validity is the scale's capability to differentiate or discriminate between constructs showing the correct pattern of relationship with other variables. In order to establish the discriminant validity of the FICTA scale, a confirmatory Q-sorting procedure was adopted (Zait & Bertea, 2011). Q-sorting procedure is used to separate items in a multi-dimensional scale matching with their specific domain.

To implement the Q-sorting procedure, four faculty members participated in an online questionnaire consisting of 66 items in eight constructs within the FICTA scale. The questionnaire provided the participants nine boxes representing eight constructs within the scale and an extra category, labeled as "does not match with any category". Respondents were directed to classify items into these nine categories by drag and drop procedure. Only two items were found to mismatch with their corresponding categories by two participants. Those two items were dropped, whereas the remaining 64 items, which were correctly classified by all four participants, were retained. The items which were removed at this stage, from the provisional scale, are listed in Appendix B.

Retrospective Interviewing

The present study used cognitive interviewing to finalize survey questions before the tool was formally pilot tested. Cognitive interviewing is considered an essential part of developing a survey instrument (Haeger, Lambert, Kinzie, & Gieser, 2012). It is intended "to identify and analyze sources of response error in survey questionnaires by focusing on the cognitive processes respondents use to answer questions on a survey or questionnaire" (Haeger et al., 2012, p.3), more specifically to assess the soundness of the survey questions. I preferred retrospective method over think aloud technique because it allows evaluating the survey in a way respondents naturally read the questionnaire. To serve this purpose, this study employed retrospective technique suggested by Dillman and Redline (2004). The respondents were first asked to complete the survey questionnaire naturally as they would do it alone, ignoring the (online) presence of cognitive interviewer (the researcher). While they were completing the questionnaire, I observed the answering process, noting if the respondent looked confused at any point, flipped pages back and forth, or made any correction, and other noticeable indicators of problems. After they had completed the questionnaire, I asked them questions about their understanding of items, any format problem, and their behavior elicited while they were completing the questionnaire, including hesitation or confusion.

The whole procedure of retrospective interviewing was implemented with four participants, where two participants completed the self-administered paper survey and two participants completed the online version of the survey. Except some questions regarding the mode of the survey, cognitive probing made to the two types of participants was the same. A few problems associated with the survey were identified during the process which are discussed here.

In order to measure faculty's physical access to ICT, the question stem was initially phrased as: "Which of the following do you have at your disposal? Check all that apply," followed by a checklist of digital devices and resources where participants were supposed to mark the devices they have at home and/or at university. Two out of four participants showed their confusion about the word "disposal." As the question stem was not clear to them, it was decided to rephrase it as "Which of the following do you have access at your home or at university? Check all that apply". For this part of the questionnaire, it was also noticed that once the participants read and understood the question stem, they were very quick to answer all items within this part. It probably occurred due to the nature and format of the question, as it was very simple and straightforward, and it did not require much cognitive effort.

The participants' perplexity about the term "network resources" was also observed at multiple points in the questionnaire, including in question stems and in items about motivation and skills access. This issue was explicitly pointed out by two participants when they were asked to mention any terms that were confusing to them. For instance, one of the participants said, "Does the network resource mean the Internet, or you are referring to an intranet resources such as networked peripheral devices, or file storage?" Although network resources is a broader term and denotes resources available on the Internet or within a local/private network established in an organization, it was decided to change the term to "the Internet", because it is the most important and widely accessed network. Considering the target population, it was hoped that the change implemented would make targeted items easier to understand and answer.

This exercise also allowed estimating the time required to complete the questionnaire on paper and online. It was noticed that there was no significant difference in the time taken by participants completing the questionnaire in two different modes. On average, the four participants took 17 minutes to complete the questionnaire which also included six demographic items. Considering the participants' feedback on length of the questionnaire, it was felt appropriate to review the questionnaire once again and truncate it a bit if possible. This review resulted in removal of only one item, leaving a 63-item scale (see Table 1 for the complete listing of items) for formal pilot testing with the potential participants of the study.

Table 1.

63-item FICTA scale

Physical Access
1. Desktop computer
2. Laptop computer
3. Broadband/DSL Internet
4. USB Flash drive (memory stick)
5. Smartphone (cell phone with Internet functionality)
6. iPad/Tablet
7. Webcam
8. Printer
9. Office Software Suit (e.g., Microsoft Office, Open Office)
10. Photo editing software (e.g. Adobe Photoshop, Corel Paint)
11. Video editing software (e.g. iMovie, Movie Maker)
12. Statistical Software (e.g., SPSS, SAS)
13. Learning Management System (e.g., Blackboard, eCampus)
Endogenous Motivational Access
1. Using the Internet can provide me with information that would lead to better decisions.
2. Using ICT will be of no benefit to me.
3. Using computer and Internet can improve my work performance.
4. Using Computer and Internet seem to be enjoyable.
5. Using computers and other digital technologies fits into my work style.
Exogenous Motivational Access
1. Seeing other teachers using Computer and the Internet inspires me.
2. I want to use ICT because my superiors expect me to use it.
3. I wish to use computer and the Internet because my students think that I should use them.
4. I am interested to adopt digital technologies because my university provides enough technology support.
5. I have enough time to learn and use digital technology.
Operational Skills Access
1. I feel comfortable in creating and editing a text file in a word processing program.
2. It is easy for me to create a computer presentation.
3. I feel difficulty to change some basic computer settings (wallpaper, time/date, sounds etc.).
4. I can save images and text from the website on the hard disk.
5. I feel confident to download programs from the Internet.
6. I can send an attachment with an email.
7. I know enough about transferring files from hard disk to a USB flash drive and vice versa.
8. I can use spreadsheets to compute basic formula (e.g., sum, average, percentage).
Informational Skills Access
1. I always know what search terms to use when searching the Internet.
2. I can use advance search options to reach my required information.
3. I feel confident to evaluate the sources of the information found on the Internet.
4. I feel comfortable to synthesize online information.
5. It is easy for me to retrieve a Website on the Internet.
6. On the Internet, I often do not find what I am looking for.
7. I can easily choose from search results.
Strategic Skills Access
1. I can make a choice by consulting the Internet.
2. I can reach my intended goal while using the Internet.
3. On the Internet, it is easy for me to work toward a specific goal.
4. I can gain benefits from using computer and the Internet.
5. Using various ICT tools, I feel confident in achieving my goals.
6. I feel confident in making important decisions with the help of the Internet.
General Usage Access

1. I search the information of my interest on the Internet.
2. I use ICT to support my research activities.
3. I use emails as one of the primary means of communication.
4. I make voice/video calls via the Internet.
5. I create letters, reports and/or papers on computer.
6. I prepare presentations on computer.
7. I store and manipulate data in a spreadsheet program.
8. I maintain my bank account online.
9. I use digital technologies to watch movies or television programs.

Instructional Usage Access

1. I use ICT for communication about assignments among students.
2. I use ICT for enhancing students' content learning.
3. I create a test, quiz, or assignment using computer.
4. I use ICT for facilitating students' group work.
5. I use ICT to improve students' problem solving skills.
6. I use digital technologies for the delivery of my instruction.
7. I use digital technologies to communicate with students.
8. I prepare learning materials using computer and Internet resources.
9. I develop critical thinking skills among students with the help of ICT.
10. I use ICT to encourage peer-feedback among my students.

Pilot-testing

Pilot testing of an instrument is multi-purpose: to make sure that the level of language used in the survey items is suitable and understandable to the potential participants; to determine whether the questions are understood as intended; and to know whether the sequence of items is logical (Andres, 2012). The 63-item FICTA scale acquired after the retrospective interviewing was formally pilot tested with faculty from public and private sector universities of Pakistan. In total 29 faculty members participated in the pilot test of the developed instrument. Six of them completed a self-administered paper survey whereas 23 participants submitted their responses through the online version of the survey hosted at Qualtrics.com. Two of the participants who submitted their survey online, answered only first few items. Therefore, their entries were not included in any analysis.

Pilot testing respondents included 18 males (67%) and 9 (33%) females. The participants came from various disciplines: arts and humanities (N=4), business education (N=2), engineering and technology (N=6), physical sciences (N=5), and social sciences (N=10). 17 (62%) of the faculty participants were teaching at public sector universities whereas 10 (38%) of the respondents were employed by private sector universities or degree awarding institutes.

The participants belonged to three age-ranges, 30 years or less, 31 to 40 years, and 41 to 50 years. Most of the participants (58%) were between 31 and 40 years of age, 23% respondents were between 41 and 50 years of age, and 19 % of the participants were 30 years old or younger. In terms of teaching experience, most of the respondents (43%) had 6 to 10 year of teaching experience, 40% were 11-15 years experienced, and 17% of the participants had 0 to 5 years of teaching experience.

Reliability Analysis

Confirmation of the validity and reliability of the instrument is a prerequisite for assuring the integrity of research findings (DeVon et al., 2007). A reliability test is strongly recommended in order to confirm the internal consistency of the scales. It determines how well the items on a scale fit together conceptually (DeVon et al., 2007). Cronbach's alpha coefficient is the most widely used statistical technique to examine internal consistency of the scale. Internal consistency reliability analysis of the 63-item FICTA scale resulted in a Cronbach's coefficient α of .863 for the total scale, and the coefficient α for the eight constructs ranged from .659 to .919.

Research Procedure and Data Collection

On the very first step of this research study, I requested Higher Education (HEC) of Pakistan to grant permission for data collection from potential participants in universities/HEIs of Pakistan. HEC Pakistan issued a letter of permission for data collection that also certified that the proposed research would not affect cultural mores/codes of the potential participants. Such letter was a requirement for West Virginia University (WVU)'s Institutional Review Board (IRB) to approve the research protocol for data collection.

The primary and initial mode of contact with the potential participants, to invite them for participation in the study, was administered through postal mail. Survey questionnaires along with prepaid postage were directly mailed to those potential participants whose contact details were available. In cases where lists/contact details of participants were not readily available, survey questionnaires were mailed to the heads of HEIs/colleges in the selected universities with a request to circulate them among faculty in their respective college/department. After two weeks of the dispatch of survey questionnaires, reminder postcards were sent to the potential participants.

My personal observation and experience with another survey study in Pakistan indicated that faculty from Pakistan are not very positive to respond to survey studies in most of the cases. Also, some of my colleagues and experienced researchers in social science have suggested that multiple means of data collection should be used for this study, because mail-out only surveys are not expected to result in a high response rate. Punch (2003) also suggests that although self-administered questionnaires are often distributed by mail, sometimes other methods are also used. The choice of data collection strategy should be realistic in the circumstances of the study (Punch, 2003). As such, to improve the participants' response rate, in addition to the mail-out surveys, the data were gathered through personal visits to research locations, and meeting potential participants in public academic events e.g., seminars, conferences (when and where possible during researcher's two month stay in Pakistan for data collection).

Data Analysis

This section elaborates the procedures and statistical techniques that were employed to analyze the data. The present study employed a quantitative survey instrument to collect the data.

Section one of the survey included some demographic items about the potential participants. Section two used the 63-item FICTA scale to measure faculty's access to ICT.

On the completion of data collection, the collected data were cleaned and prepared for data analysis. Data cleaning denotes to the fixing up of the data set before the analysis itself begins (Punch, 2003). For data cleaning and preparation, survey responses were proofread, decisions about unclear responses were made, and survey responses were entered into the computer to perform various statistical operations and tests. SPSS (Statistical Package for Social Sciences) was used for all statistical analysis of the data, in order to assess the reliability of the data collected and to answer proposed research questions.

The main statistical analysis for this study was performed employing the logical three-step framework: summarizing and reducing data, descriptive level analysis, and relationship analysis (Punch, 2003). As each dimension of ICT access in the present study was measured through a series of items related to that particular dimension/sub-scale; on the first stage, these item responses for each dimension/sub-scale were aggregated into a new composite variable, reflecting respondent's score for that particular construct. This procedure allowed to summarize the data set to a great extent, helping to avoid dealing with a large number of variables, and to make further analysis simpler.

The next stage of analysis comprised of descriptive analysis of all main variables including demographic variables for the whole sample and for important sub-groups within the sample. This mainly included means, standard deviations, and frequency distributions. The results of descriptive analysis provided answer to the first research question.

Finally, bivariate relationships between the variables of interest were performed, in order to answer the remaining two research questions. The second question sought to determine whether a statistically significant difference exists in participants' access to ICT with respect to their personal and positional categories. A multiple linear regression analysis using enter (simultaneous) was performed to answer this question and test the following four hypotheses:

H_{2a}: There is a statistically significant difference in faculty's access to ICT with respect to their age. Particularly, younger faculty have higher usage access levels than older faculty.

H_{2b}: There is a statistically significant difference in faculty's access to ICT with respect to their gender. Particularly, female faculty members have a lower skills access level than their male counterparts.

H_{2c}: There is a statistically significant difference in faculty's access to ICT with respect to the type of university where they teach. Particularly, faculty of public sector universities have lower level of physical access than faculty of private sector universities.

H_{2d}: There is a statistically significant difference in faculty's access to ICT with respect to their academic disciplines. Particularly, faculty of science and technology subjects have higher level of physical access than faculty of arts, and humanities subjects.

To test the aforementioned four hypotheses, a composite variable, *ICT access,* was created by computing the sum of individual respondent's score for each dimension of ICT access (*motivational access, physical access, skills access, and usage access*). A multiple linear regression using enter method was used with age, gender, university type, and academic discipline as independent (predictor) variables, and ICT access as dependent (outcome) variable. Further, the same analysis was performed to evaluate the relationship of the above mentioned personal and positional categories with each specific level of ICT access (motivational, physical, skills, and usage access).

Academic discipline, one of the potential predictor variables for regression analysis, was originally recorded as a categorical variable with eight categories representing eight disciplines: 1=Agriculture and veterinary sciences, 2=arts and humanities, 3=biological and medical sciences, 4=business education, 5=engineering and technology, 6=physical sciences, 7=social sciences, and 8=other disciplines which did not fit in the first seven categories. Categorical variables with more than two groups involve extraordinary consideration in regression analysis because, unlike continuous variables, they are not qualified to be used as predictor variables just as they are (Chen, Ender, Mitchell, & Wells, 2003). They must be recoded, using an appropriate coding system, into a series of variables before they can be entered into the regression model.

Thus, academic discipline was recoded into seven new variables using deviation (effects) coding. Deviation coding compares the mean of the single group to the grand mean of the outcome variable (Chen et al., 2003). This coding scheme is especially useful when one is interested to examine differences of groups from the overall mean. Table 2 displays coding for the new variables computed.

Table 2

Coding of Comparison Variables for Academic Discipline

	C1	C2	C3	C4	C5	C6	C7
Agriculture & Veterinary (1)	1	0	0	0	0	0	0
Arts and Humanities (2)	0	1	0	0	0	0	0
Biological Sciences (3)	0	0	1	0	0	0	0
Business Education (4)	0	0	0	1	0	0	0
Engineering & Technology (5)	0	0	0	0	1	0	0
Physical Sciences (6)	0	0	0	0	0	1	0
Social Sciences (7)	0	0	0	0	0	0	1
Other Disciplines (8)	-1	-1	-1	-1	-1	-1	-1

In order to address the third question, a multiple linear regression analysis using hierarchical method was conducted to examine the significant relationship (if any) of participants' use of ICT to support their instructional practices with other levels of ICT access. The analysis was performed in two blocks, based on van Dijk's (2005) model and his assertion that the gap in the first two levels of ICT access (motivational and physical access) is closing while widening in the last two levels (skills and usage access). The instructional usage access was entered as the outcome variable. Endogenous motivational access, exogenous motivational access, physical access at home, and physical access at university were entered as independent variables in the first block; operational skills access, informational skills access, strategic skills access, and general usage access were entered as independent variables in the second block.

Chapter 4: ANALYSIS AND FINDINGS

This chapter describes the analyses conducted in order to answer the research questions and test the research hypotheses stated earlier. The first section provides basic information about the sample. The second section presents the results of the analysis performed to confirm the factor structure of the sub-constructs within the scale (which could not be performed during the piloting of the instrument due to small number of sample size). Then, descriptive statistics for the main variables corresponding to the research questions are presented. Next, the results of analyses which provide answers to the research questions proposed for the present study are presented one by one. Finally, the chapter concludes with a summary of analysis and findings.

Descriptive Statistics for the Sample

Three hundred and twenty-two (322) faculty participants teaching in HEC-recognized public and private sector universities in Pakistan completed the survey. Given that the research study is aimed to elicit “big picture” of Pakistani faculty’s access to information and communication technology, it is very important to know the characteristics of the respondents. The survey questionnaire contained items to gather some demographic information about the sample. These items included age, gender, teaching position, teaching experience, academic discipline, and the type of university.

Participants’ age was measured as a continuous variable, which asked them to record their age in years. Based on this continuous variable, a new ordinal variable was computed to generate Table 3 that highlights the distribution of the respondents by age. Faculty’s ages ranged from 27 to 57 years. The average age of the respondents was 38.58 years old. The majority of the respondents (59.3%) were between 31 and 40 years old. Only twelve of the participants were older than 50 years. Figure 5 depicts age distribution of the participants using a bar chart.

Table 3

Distribution of the Participants by Age

Age Groups	Frequency	Percent	Valid Percent	Cumulative Percent
26-30 years	21	6.5%	6.6%	6.6%
31-35 years	102	31.7%	31.9%	38.4%
36-40 years	89	27.6%	27.8%	66.3%
41-45 years	64	19.9%	20.0%	86.3%
46-50 years	32	9.9%	10.0%	96.3%
51-55 years	8	2.5%	2.5%	98.8%
55-60 years	4	1.2%	1.3%	100%
Total	320	99.4%	100%	

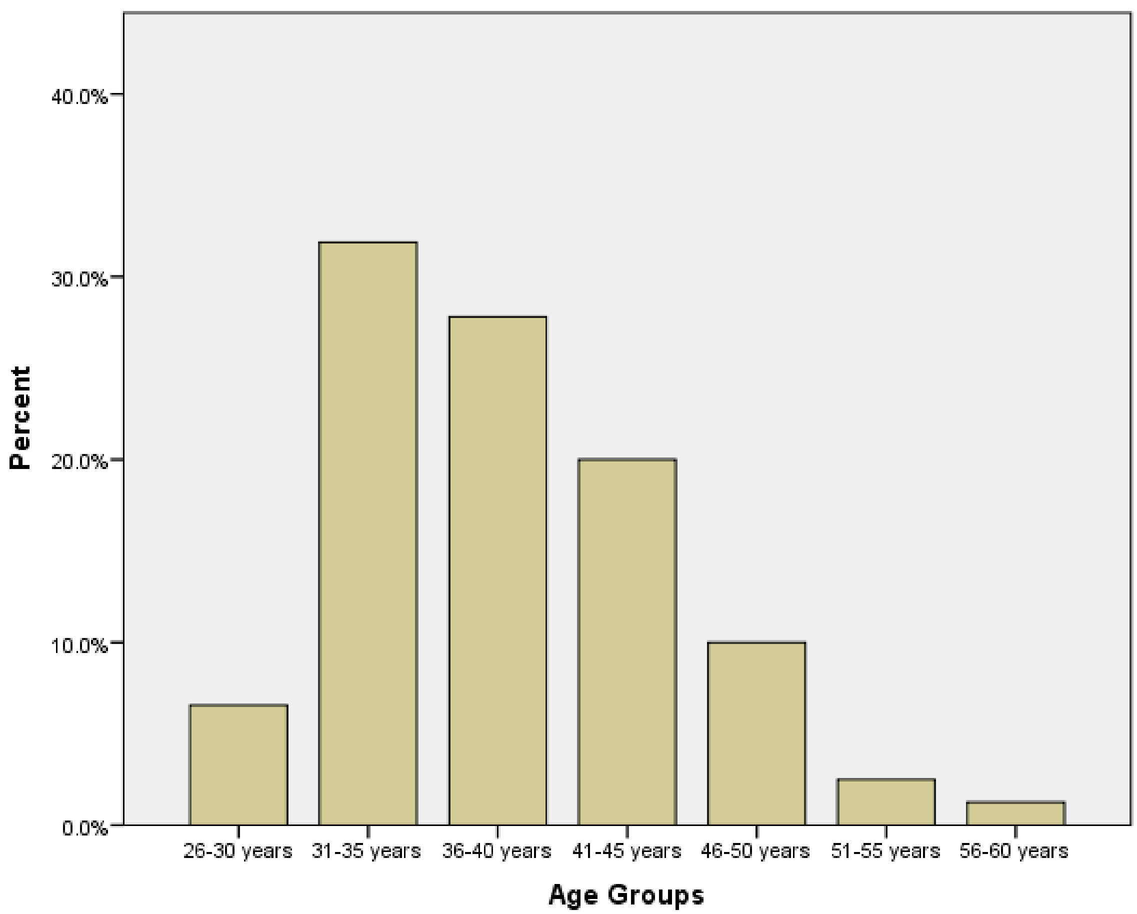

Figure 5. Distribution of the Participants by Age

Respondent's gender was measured as a dichotomous variable, and was measured as male (1) and female (2). As Figure 6 indicates, the number of male participants was about double (66.5%) of the female participants (33.5%).

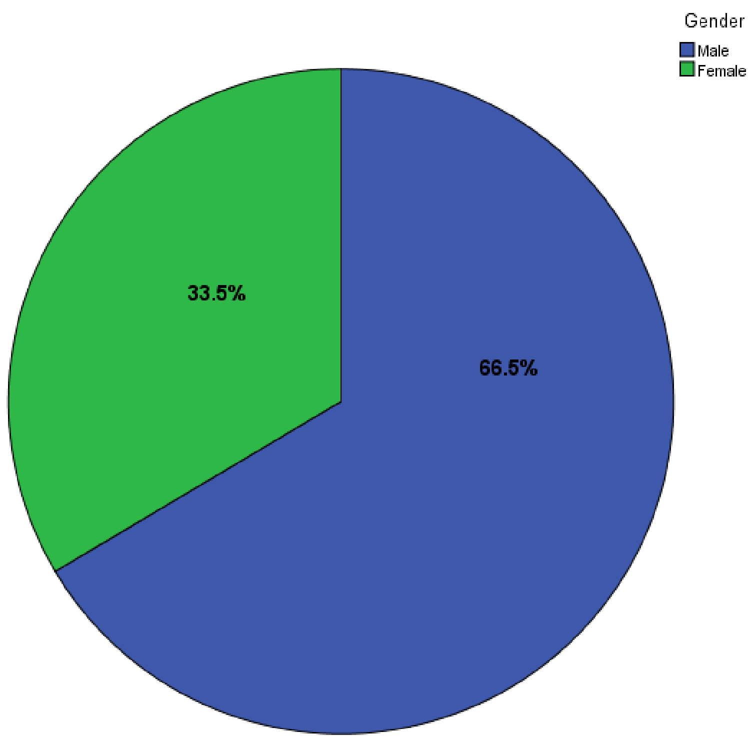

Figure 6. Distribution of the Participants by Gender

The variable type of university was used to record participants' type of university where they teach. This variable was coded dichotomously as public sector (1) and private sector (2). Public sector indicates the universities that are funded and administered by the government. On the other hand, private sector indicates universities that are not funded and administered by the government. As Figure 7 represents, most of the participants in the present study (about seventy percent) belonged to public sector universities/HEIs.

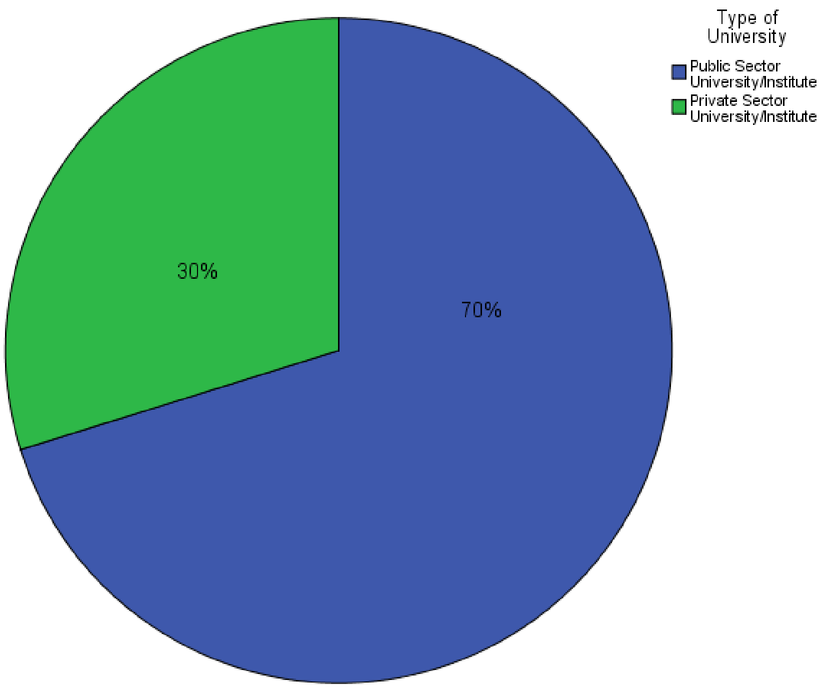

Figure 7. Distribution of the Participants by University Type

The variable Teaching Experience was used to measure participants' teaching experience in years. This variable was used as an ordinal variable, codes as 1 (0 to 5 years) to 6 (more than 25 years), with higher value reflecting more years of experience. Majority of the respondents (n=218, 98.8) reported to have experience between 0 and 20 years. Only four participants (1.2%) reported to have teaching experience of more than 21 years. Figure 8 provides a bar chart representation of the distribution of the participants by their teaching experiences in years.

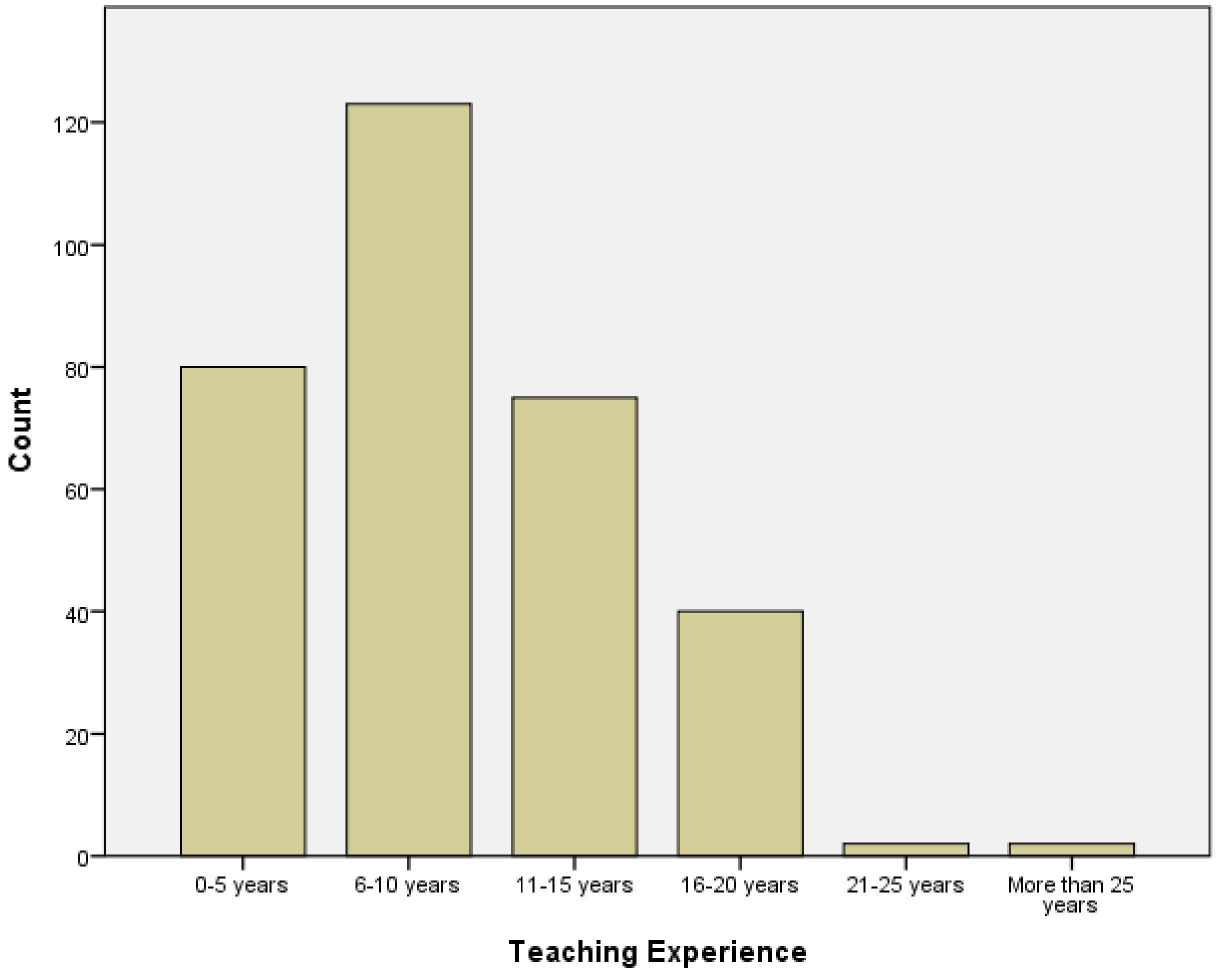

Figure 8. Distribution of the Participants by Teaching Experience

The participants were asked to report their designated post through the variable Teaching Position, coded as a categorical variable. As Figure 9 indicates, most of the participants were either Lecturer/Instructor or Assistant Professor. Only 11 of the participants were holding the position of Professor. Under-representation of the potential participants occupying higher teaching positions i.e., professor, shows that they might be busier in their teaching and academic positions than the participants working in junior positions. Or, it might have occurred because they might not have felt “to do” with this research study.

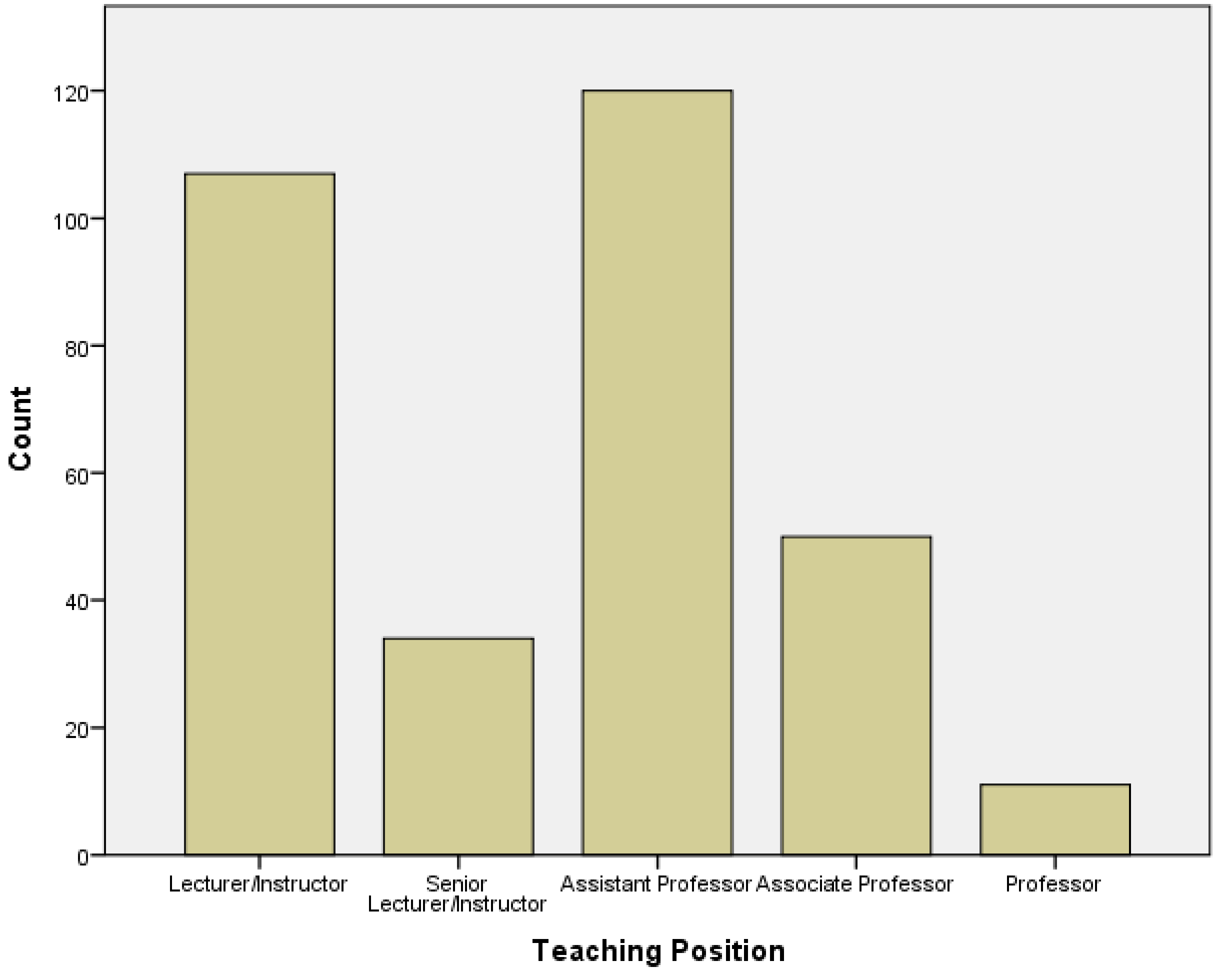

Figure 9. Distribution of the Participants by Teaching Position

The variable Academic Discipline, coded as a categorical variable, was used to record participants' field/subject of teaching. The Participants came from a mix of academic disciplines including agriculture and veterinary, arts and humanities, biological and medical sciences, business education, engineering and technology, physical sciences, and social sciences (see Figure 10 for the distribution of participants by their academic discipline).

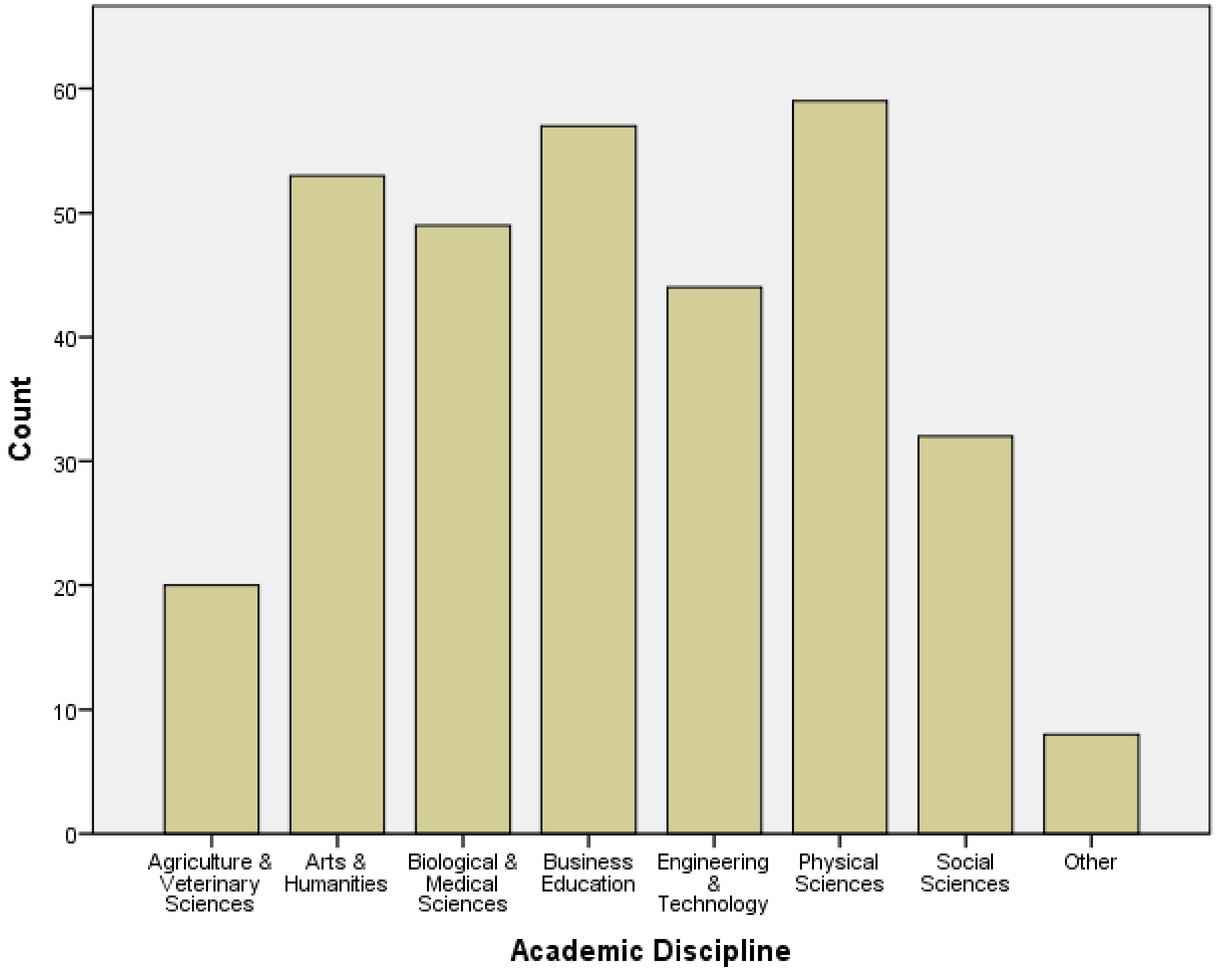

Figure 10. Distribution of the Participants by Academic Discipline

Table 4 summarizes the basic information about the participants, showing the frequencies, percentages, and mean for the demographic variables.

Table 4.

Descriptive Statistics for Demographic Variables

Variable	Description	Coding	Distribution
Age	Age in years	Continuous variable	Mean=38.58
Gender	Gender of participants	Male=1 Female=2	214 (66.5%) 108 (33.5%)
Type of university	Type of university participant teach in	Public Sector=1 Private Sector=2	226 (70%) 96 (30%)
Teaching Experience	Participant's teaching experience in years	0 to 5 years=1 6 to 10 years=2 11 to 15 years=3 16 to 20 years=4 21 to 25 years=5 More than 25 years=6	80 (24.8%) 123 (38.2%) 75 (23.3%) 40 (12.4%) 2 (0.6%) 2 (0.6%)
Teaching Position	Participant's teaching position	Lecturer/Instructor=1 Senior Lecturer/Instructor=2 Assistant Professor=3 Associate Professor=4 Professor=5	107 (33.2%) 34 (10.6%) 120 (37.3%) 50 (15.5%) 11 (3.4%)
Academic Discipline	Participant's field/subject of teaching	Agriculture & Veterinary=1 Arts & Humanities=2 Biological & Medical Sciences=3 Business Education=4 Engineering & Technology=5 Physical Sciences=6 Social Sciences=7 Other Disciplines=8	20 (6.2%) 53 (16.5%) 49 (15.2%) 57 (17.7%) 44 (13.7%) 59 (18.3%) 32 (9.9%) 8 (2.5%)

The Confirmation of the Factor Structure

Because one important significance of the present study is to confirm the factor structure of the sub-constructs focused within the FICTA scale, the results of the analysis performed for this purpose are considered supplementary findings of the present study. A principal component analysis (PCA) with varimax rotation was applied to the collected data to confirm various sub-constructs within the FICTA scale discussed in earlier sections of this report. This analysis included all 50 items within seven sub-constructs including endogenous motivation, exogenous motivation, operational skills, informational skills, strategic skills, general usage, and instructional usage. However, 13 items measuring physical access were not included in the analysis due to their different format i.e., checklist items that can only record two values (‘yes’ or ‘no’) rather than Likert scale with five points items on the rest of sub-constructs.

Initially, PCA revealed twelve components with eigenvalues of 1.0 or more. Factor loadings did not show meaningful groupings of few items. A closer look on the scree plot supported my assumption for seven components. So I decided to go for a seven factor solution.

On the second step, PCA using varimax rotation forcing a seven factor solution was performed. A minimum item loading of 0.4 was specified in this step which resulted in a seven component solution with most meaningful item groupings (see Table 5). However, six items (Item# 18, 23, 31, 37, 52, and 56) with loadings less than 0.4 did not load on any component. Their lower loadings indicate that they may have been ambiguous to participants, resulting in a lack of a pattern in participant responses. Therefore they were removed from the scale, leaving 44 items for the seven sub-constructs and 57 items (including 13 items for physical access) for the whole scale with eight sub-constructs.

Table 5.

Factor Structure of the FICTA scale

Item	Operational Skills	Instructional Usage	Informational Skills	General Usage	Strategic Skills	Exogenous Motivation	Endogenous Motivation
#14.							.724
#15.							.823
#16.							.777
#17.							.763
#18.*							
#19.						.842	
#20.						.826	
#21.						.835	
#22.						.809	
#23.*							
#24.	.626						
#25.	.709						
#26.	.774						
#27.	.756						
#28.	.682						
#29.	.757						
#30.	.746						
#31.*							
#32.			.672				
#33.			.662				
#34.			.735				
#35.			.551				
#36.			.723				
#37.*							
#38.			.588				
#39.					.684		
#40.					.743		
#41.					.689		
#42.					.729		
#43.					.718		
#44.					.656		
#45.				.537			
#46.				.677			
#47.				.591			
#48.				.675			
#49.				.706			
#50.				.632			
#51.				.683			
#52.*							
#53.				.570			
#54.		.531					
#55.		.674					
#56.*							
#57.		.601					
#58.		.758					
#59.		.569					
#60.		.620					
#61.		.434					
#62.		.636					
#63.		.666					

Note. Loadings from a Principal Component Analysis with Varimax rotation. Items having inadequate loadings are highlighted with a '*' with their numbers.

a. Rotation converged in 7 iterations.

Though the process of factor-confirmation led to removal of six items with low loadings from the scale, it did not cause removal of any essential content from the scale. DeVon et al. (2007) recommends keeping the instrument as concise as possible without yielding needed content for increased reliability of the tool. Most factor loadings on the remaining items were high (i.e., > 0.6), and the lowest loadings were adequate enough to be included in the factor. Dropping six items helped to shorten the scale which also resulted in the increased reliability of the scale (see Table 6), leaving the enhanced version of the FICTA scale consisting on eight sub-constructs with 57 items (see Table 7). All the analysis described in the following sections of this report is based on the enhanced version of the 57-item FICTA scale.

Table 6.

Cronbach's Alpha for the FICTA scale (N=322)

Construct	Cronbach's Alpha
Physical access	.680
Endogenous motivation	.806
Exogenous motivation	.881
Operational Skills	.885
Informational Skills	.853
Strategic Skills	.820
General Usage	.800
Instructional Usage	.815
Overall scale	.868

The reliability test demonstrated that the 57-item FICTA scale had excellent reliability (α=.868). Seven out of eight constructs of FICTA scale also showed very good internal consistency with Cronbach's alpha ranging from .800 to .885 (see Table 6). The only construct that did not show outstanding reliability was physical access (α=.680).

The low reliability of the physical access could be because of its format, i.e., checklist of items, rather than a Likert scale as used in other seven constructs of the scale. Most of the devices listed in the construct of physical access are complementary to each other. However, some devices may be considered redundant to each other. For example, desktop computer, laptop, and tablet have almost similar functions. Similarly, an individual might have access to web cam as a separate device or as a built-in part of a modern laptop or tablet. Although removal of any item within the construct of physical access did not help to increase the reliability of the construct with the current data, it would be worthwhile to ponder how the list of devices can be improved in future studies. Addition of some Likert scale items, to the checklist of items in the construct, also may help to increase the reliability of the construct.

Table 7.

The 57-item FICTA scale (α=.868)

Physical Access (α=.680)
1. Desktop computer
2. Laptop computer
3. Broadband/DSL Internet
4. USB Flash drive (memory stick)
5. Smartphone (cell phone with Internet functionality)
6. iPad/Tablet
7. Webcam
8. Printer
9. Office Software Suit (e.g., Microsoft Office, Open Office)
10. Photo editing software (e.g. Adobe Photoshop, Corel Paint)
11. Video editing software (e.g. iMovie, Movie Maker)
12. Statistical Software (e.g., SPSS, SAS)
13. Learning Management System (e.g., Blackboard, eCampus)
Endogenous Motivational Access (α=.806)
14. Using the Internet can provide me with information that would lead to better decisions.
15. Using ICT will be of no benefit to me.
16. Using computer and Internet can improve my work performance.
17. Using Computer and the Internet seem to be enjoyable.
Exogenous Motivational Access (α=.881)
18. Seeing other teachers using Computer and the Internet inspires me.
19. I want to use ICT because my superiors expect me to use it.

20. I wish to use computer and the Internet because my students think that I should use them.
21. I am interested to adopt digital technologies because my university provides enough technology support.
Operational Skills Access (α=.885)
22. I feel comfortable in creating and editing a text file in a word processing program.
23. It is easy for me to create a computer presentation.
24. I feel difficulty to change some basic computer settings (wallpaper, time/date, sounds etc.).
25. I can save images and text from the website on the hard disk.
26. I feel confident to download programs from the Internet.
27. I can send an attachment with an email.
28. I know enough about transferring files from hard disk to a USB flash drive and vice versa.
Informational Skills Access (α=.853)
29. I always know what search terms to use when searching the Internet.
30. I can use advance search options to reach my required information.
31. I feel confident to evaluate the sources of the information found on the Internet.
32. I feel comfortable to synthesize online information.
33. It is easy for me to retrieve a Website on the Internet.
34. I can easily choose from search results.
Strategic Skills Access (α=.820)
35. I can make a choice by consulting the Internet.
36. I can reach my intended goal while using the Internet.
37. On the Internet, it is easy for me to work toward a specific goal.
38. I can gain benefits from using computer and the Internet.
39. Using various ICT tools, I feel confident in achieving my goals.
40. I feel confident in making important decisions with the help of the Internet.
General Usage Access (α=.800)
41. I search the information of my interest on the Internet.
42. I use ICT to support my research activities.
43. I use emails as one of the primary means of communication.
44. I make voice/video calls via the Internet.
45. I create letters, reports and/or papers on computer.
46. I prepare presentations on computer.
47. I store and manipulate data in a spreadsheet program.
48. I use digital technologies to watch movies or television programs.
Instructional Usage Access (α=.815)
49. I use ICT for communication about assignments among students.
50. I use ICT for enhancing students' content learning.
51. I use ICT for facilitating students' group work.
52. I use ICT to improve students' problem solving skills.
53. I use digital technologies for the delivery of my instruction.
54. I use digital technologies to communicate with students.
55. I prepare learning materials using computer and internet resources.
56. I develop critical thinking skills among students with the help of ICT.
57. I use ICT to encourage peer-feedback among my students.

Analysis of the Proposed Research Questions

In this research study, I attempted to draw a big picture of Pakistani faculty's access to information and communication technology, in terms of their access to ICT at four levels: motivational, physical, skills, and usage level. The study also aimed to explore the relationship of faculty's instructional usage of digital technologies with other levels of ICT access. That is, the study sought answers to three specific research questions discussed in Chapter 1. Following sections discuss the analysis for the proposed research questions one by one.

Research Question 1

What is Pakistani faculty's access to digital technologies at the four levels (motivational, physical, skills, and usage level)?

In order to examine faculty's access to ICT, various descriptive statistics, including frequency distributions and measures of central tendency, were employed to summarize participants' responses. At first, the results of participants' ICT access for each of the four levels (motivational, physical, skills, and usage level) are discussed. Then, the results of participants' overall ICT access are presented.

Motivational access. Participants' motivational access to ICT was measured by focusing on endogenous as well as exogenous motivations. These two constructs were measured through a series of items formatted on a 5-point Likert scale (ranging from 1= strongly disagree to 5= strongly agree). Participants' score for each type of motivation was created by computing the average of participant's responses to each item in the sub-scale. The possible score values ranged between 1 and 5 where a higher score indicates a higher level of motivation.

Table 8.

Descriptive Statistics for the Motivational Access

Characteristics	Group	Min	Max	Mean	Std. Dev.
Gender	Male	1.88	4.88	3.877	.553
	Female	2.38	4.88	3.649	.564
Age	26-30 years	2.75	4.75	3.809	.610
	31-35 years	2.50	4.88	3.887	.546
	36-40 years	2.38	4.88	3.789	.603
	41-45 years	1.88	4.88	3.628	.510
	46-50 years	3.00	4.75	3.918	.567
	51-55 years	2.88	4.75	3.781	.604
	56-60 years	3.38	4.00	3.666	.314
Type of university	Public Sector	2.25	4.88	3.731	.560
	Private Sector	1.88	4.88	3.831	.576
Academic Discipline	Agriculture & Veterinary	3.38	4.75	4.243	.400
	Arts & Humanities	2.75	4.88	3.945	.617
	Biological & Medical Sciences	2.38	4.75	3.654	.476
	Business Education	1.88	4.88	3.451	.567
	Engineering & Technology	2.88	4.88	3.933	.527
	Physical Sciences	2.63	4.75	3.730	.460
	Social Sciences	2.75	4.88	3.992	.470
Teaching Position	Lecturer/Instructor	2.75	4.88	3.872	.546
	Senior Lecturer/Instructor	2.63	4.88	3.856	.596
	Assistant Professor	1.88	4.88	3.731	.564
	Associate Professor	2.25	4.75	3.795	.572
	Professor	2.88	4.75	3.708	.673
Overall		1.88	4.88	3.8002	.56463

Results showed that Pakistani faculty were motivated to adopt ICT more endogenously (M=4.222, SD=0.537) than exogenously (M=3.380, SD=0.923). A paired sample t-test indicated that the differences in the two types of motivation were significant [$t(320)=15.00$, $p < 0.01$]. The score for participants overall motivation ranged from 1.88 to 4.88. The average score of respondents' overall motivation was 3.800 (SD=0.565), which suggest faculty's high motivation to adopt digital technologies. Table 8 shows descriptive statistics for respondents' motivational access by their gender, age, type of university, academic discipline, and teaching position.

The male participants were found to have higher score (M=3.877, SD=.553) for their motivational access to ICT than their female counterparts (M=3.649, SD=.564). Similarly, motivational score for the participants from public sector universities (M=3.831, SD=.560) was higher than for the participants from private sector universities (M=3.731, SD=.576).

As Table 8 indicates, the faculty holding junior teaching positions showed higher motivation than faculty holding senior positions. However, a one way between subjects ANOVA indicated that there was no significant effect of teaching position on faculty's motivational access [$F(4, 316) = 1.067$, $p > .05$]. Results also indicated small differences in faculty's motivational access to ICT in respect of their academic disciplines (see Table 8 for details).

Physical access. Faculty's physical access to ICT was measured through a checklist comprised of various digital devices, software etc. Respondents were asked to report whether they had access to the devices given in the list at home and on campus. Table 9 presents the percentages of faculty who reported to have physical access to various ICT devices and services at home or at university.

Table 9.

Percent of the Participants' Physical Access to ICT Devices and Services

Group	Have at home	Have at university	Don't have
Desktop computer	69.2	73.9	6.2
Laptop computer	26.5	15.4	68.4
Broadband/DSL Internet	41.4	35.3	31.5
USB Flash drive (memory stick)	55.0	14.3	42.1
Smartphone (cell phone with Internet functionality)	42.9	37.0	44.6
iPad/Tablet	28.1	7.8	68.0
Webcam	54.3	17.8	35.3
Printer	44.4	77.3	16.2
Office Software Suit	77.0	79.5	4.6
Photo editing software	48.8	39.9	45.1
Video editing software	22.4	16.8	88.2
Statistical Software (e.g., SPSS, SAS)	25.5	43.7	71.0
Learning Management System	14.9	17.4	78.7

Two separate indexes were computed to reflect participants' score for their physical access to ICT at their home and at their respective university. Each device listed in the checklist carried a weightage of 1 point. The possible point values for score of physical access at home and university separately ranged from 1 to 13. But, the participant's score was converted to the scale of 5 points for the convenience of understanding and interpretation of results, like participants' score for other levels of ICT access.

Table 10.

Descriptive Statistics for the Physical Access

Characteristics	Group	Min	Max	Mean	Std. Dev.
Gender	Male	.77	4.42	2.573	.700
	Female	1.15	4.42	2.642	.713
Age	26-30 years	1.35	3.46	2.756	.630
	31-35 years	.77	4.42	2.747	.812
	36-40 years	1.15	4.42	2.545	.664
	41-45 years	1.15	3.65	2.470	.473
	46-50 years	.77	3.65	2.476	.782
	51-55 years	1.15	4.23	2.331	.904
	56-60 years	2.31	3.27	2.548	.480
Type of university	Public Sector	.77	4.42	2.313	.581
	Private Sector	2.12	4.42	3.253	.495
Academic Discipline	Agriculture & Veterinary	2.31	3.46	2.942	.299
	Arts & Humanities	.77	3.46	2.122	.730
	Biological & Medical Sciences	1.54	3.46	2.467	.428
	Business Education	1.54	3.65	2.830	.409
	Engineering & Technology	1.54	3.08	2.355	.400
	Physical Sciences	1.54	4.42	3.309	.745
	Social Sciences	1.15	3.27	2.151	.524
Teaching Position	Lecturer/Instructor	.77	4.42	2.714	.797
	Senior Lecturer/Instructor	1.35	3.85	2.624	.594
	Assistant Professor	1.15	4.23	2.532	.605
	Associate Professor	.77	4.42	2.523	.786
	Professor	1.15	3.27	2.384	.581
Overall		.77	4.42	2.5971	.70217

Results showed that the mean score for Pakistani faculty's overall physical access to ICT was 2.597 (SD=.702), indicating faculty had limited access to variety of ICT devices and services. The score ranged from .77 to 4.42. Faculty's physical access was slightly better at homes (M=2.670, SD=.849) than on campus (M=2.528, SD=.889). A paired sample t-test indicated that the differences in faculty's physical access at home and university were statistically significant [$t(321)=-2.496$, $p < 0.01$]. Table 10 presents descriptive statistics for participants' physical access to ICT by their demographic characteristics.

As Table 10 shows, the female participants reported to have slightly better physical access to ICT (M=2.642, SD=.713) than their male counterparts (M=2.573, SD=.700). Likewise, most of the younger participants recorded better physical access than the older participants. Physical access score for the participants from private sector universities (M=3.253, SD=.495) was significantly higher than the score for the participants from public sector universities (M=2.313, SD=.581). The score for faculty's physical access by their teaching positions varied without a clear pattern (see Table 10 for details). A one-way between subjects ANOVA indicated that these differences were statistically significant [$F(4,316)=3.426$, $p<.05$].

Results also indicated that faculty of physical sciences (M=3.309 ,SD=.745) and business education (M=2.830 ,SD=.409) had better physical access to ICT than faculty of arts and humanities (M=2.122 ,SD=.730), agriculture and veterinary (M=2.942 ,SD=.299), engineering and technology (M=2.355, SD=.400), biological and medical sciences (M=2.467 ,SD=.428), and social sciences (M=2.151 ,SD=.524).

Skills access. Skills access was measured focusing on three types of skills: operational skills, informational skills, and strategic skills. Three separate indexes were computed by computing the average of participant's response for each item in the relevant sub-scale, showing each participant's score for his/her three types of skills access. For each index, the minimum score possible was 1 and the maximum score possible was 5. The results indicated that participants' skills level for the three types of skills access differed very slightly, with the mean score of 3.990 (SD=.584) for operational skills, 3.904 (SD=.549) for informational skills, and 3.8447 (SD=.572) for strategic skills.

Further, a composite variable, skills access, was created by computing the average of participant's score for three kinds of skills: operational, informational, and strategic skills, reflecting each participant's score for his or her overall skills access.

Results showed that the mean score for Pakistani faculty's overall skills access was 3.913 (SD=.451), indicating faculty had moderate level skills access. The score ranged from 2.68 to 4.94. Table 11 shows descriptive statistics for participants' overall skills access by their demographic characteristics.

As Table 11 shows, male (M=3.905, SD=.451) and female (M=3.928, SD=.455) participants reported to have almost same level of skills access. Most of the younger participants recorded to have better skills access than the older participants. ICT skills of faculty from private sector universities (M=4.329, SD=.315) was significantly higher than the skills of faculty from public sector universities (M=3.737, SD=.380). Results showed that ICT skills of faculty of agriculture and veterinary (M=4.030, SD=.411) and business education (M=4.075, SD=.500) was little higher than skills of faculty of arts and humanities (M=3.834, SD=.364), biological and medical sciences (M=3.913, SD=.495), engineering and technology (M=3.974, SD=.451), physical sciences (M=3.887 ,SD=.462), and social sciences (M=3.663 ,SD=.358).

Table 11.

Descriptive Statistics for the Skills Access

Characteristics	Group	Min	Max	Mean	Std. Dev.
Gender	Male	2.68	4.94	3.905	.451
	Female	2.87	4.79	3.928	.455
Age	26-30 years	3.29	4.94	4.169	.354
	31-35 years	2.89	4.79	4.155	.406
	36-40 years	2.94	4.89	3.914	.416
	41-45 years	2.90	4.79	3.669	.346
	46-50 years	2.87	4.63	3.605	.371
	51-55 years	2.68	4.02	3.349	.446
	56-60 years	3.48	4.42	3.944	.514
Type of university	Public Sector	2.68	4.79	3.737	.380
	Private Sector	3.34	4.94	4.329	.315
Academic Discipline	Agriculture & Veterinary	3.19	4.94	4.030	.411
	Arts & Humanities	2.87	4.63	3.834	.364
	Biological & Medical Sciences	2.89	4.79	3.913	.495
	Business Education	2.94	4.89	4.075	.500
	Engineering & Technology	2.68	4.79	3.974	.451
	Physical Sciences	2.90	4.67	3.887	.462
	Social Sciences	3.06	4.59	3.663	.358
	Others	3.46	4.15	3.858	.226
Teaching Position	Lecturer/Instructor	2.89	4.94	4.068	.405
	Senior Lecturer/Instructor	2.94	4.89	4.089	.484
	Assistant Professor	2.90	4.79	3.811	.416
	Associate Professor	2.87	4.79	3.719	.432
	Professor	2.68	4.61	3.849	.636
Overall		2.68	4.94	3.913	.451

Results also indicated that faculty's overall skills access differed in respect of their teaching positions [$F(4,316)=9.148$, $p<.01$]. Lecturers' (M=4.068, SD=.405) and senior lecturers' (M=4.089, SD=.484) skills access was relatively higher than that of assistant professors (M=3.811, SD=.416), associate professors (M=3.719, SD=.432), and professors (M=3.849, SD=.636).

Usage access. Usage access was measured focusing on two types of usage access: general usage access and instructional usage access. Two separate indexes were computed by computing the average of participant's response for each item in the relevant sub-scale, showing each participant's score for his/her two types of usage access. For each index, the minimum score possible was 1 and the maximum score possible was 5. The results showed that faculty's general usage access (M=3.687, SD=.549) was better than their instructional usage access (M=3.308, SD=.616); [$t(321)=9.802$, $p<.05$].

Further, a composite variable, usage access, was created by computing the average of participant's score for two kinds of usage access. Results indicated that the mean score for Pakistani faculty's overall usage access was 3.496 (SD=.467), suggesting the faculty had moderate level of usage access. The score ranged from 2.19 to 4.53. Table 12 highlights descriptive statistics for participants' overall usage access by their demographic characteristics.

As Table 12 shows, male participants' usage access was slightly higher (M=3.560, SD=.446) than female participants (M=3.366, SD=.487). Most of the younger faculty recorded to have higher usage access than the older participants. Usage access of faculty from private sector universities (M=3.609, SD=.374) was slightly higher than the usage access of faculty from public sector universities (M=3.446, SD=.497).

Table 12.

Descriptive Statistics for the Usage Access

Characteristics	Group	Min	Max	Mean	Std. Dev.
Gender	Male	2.36	4.53	3.560	.446
	Female	2.19	4.31	3.366	.487
Age	26-30 years	2.65	4.20	3.717	.361
	31-35 years	2.58	4.53	3.791	.332
	36-40 years	2.38	4.48	3.475	.405
	41-45 years	2.37	4.06	3.198	.363
	46-50 years	2.19	4.35	3.216	.549
	51-55 years	2.25	3.93	3.047	.655
	56-60 years	2.44	3.82	3.206	.630
Type of university	Public Sector	2.19	4.53	3.446	.497
	Private Sector	2.59	4.35	3.609	.374
Academic Discipline	Agriculture & Veterinary	3.23	4.48	3.938	.341
	Arts & Humanities	2.53	4.06	3.411	.431
	Biological & Medical Sciences	2.75	4.47	3.663	.371
	Business Education	2.71	4.35	3.579	.339
	Engineering & Technology	3.09	4.42	3.722	.323
	Physical Sciences	2.59	4.53	3.406	.396
	Social Sciences	2.19	4.00	2.914	.542
	Others	2.51	3.70	3.114	.524
Teaching Position	Lecturer/Instructor	2.58	4.53	3.779	.331
	Senior Lecturer/Instructor	2.55	4.42	3.516	.485
	Assistant Professor	2.25	4.25	3.306	.408
	Associate Professor	2.19	4.35	3.370	.550
	Professor	2.44	3.82	3.272	.489
Overall		2.19	4.53	3.496	.467

Results showed that usage access of faculty of agriculture and veterinary (M=3.938, SD=.341) was relatively higher than usage access of faculty of arts and humanities (M=3.411, SD=.431), biological and medical sciences (M=3.663, SD=.371), business education (M=3.579, SD=.339), engineering and technology (M=3.722, SD=.323), physical sciences (M=3.406 ,SD=.396), and social sciences (M=2.914 ,SD=.542). Results also indicated small differences in faculty's usage access in respect of teaching positions (see Table 12 for details). A one-way between subjects ANOVA indicated that these differences were statistically significant [$F(4,316)=19.670$, $p<.01$]

ICT access. ICT access reflects participants' overall access to information and communication technology including their access to motivational, physical, skills, and usage access. This variable was created by computing the average of participant's score for motivational access, physical access, skills access, and usage access. Results indicated that the mean score for Pakistani faculty's overall ICT access was 3.448 (SD=.316), suggesting that the faculty had low level of ICT access. The score ranged from 2.77 to 4.21. Table 13 highlights descriptive statistics for participants' overall ICT access by their demographic characteristics.

Male participants' overall ICT access was slightly higher (M=3.472, SD=.312) than female participants (M=3.399, SD=.325). Most of the younger faculty had higher ICT access than the older participants. ICT access of faculty from private sector universities (M=3.729, SD=.266) was significantly higher than the ICT access of faculty from public sector universities (M=3.326, SD=.255).

Table 13.

Descriptive Statistics for the Overall ICT Access

Characteristics	Group	Min	Max	Mean	Std. Dev.
Gender	Male	2.77	4.21	3.472	.312
	Female	2.87	4.20	3.399	.325
Age	26-30 years	2.98	4.10	3.622	.317
	31-35 years	2.91	4.21	3.658	.295
	36-40 years	2.96	4.12	3.429	.265
	41-45 years	2.89	3.63	3.219	.168
	46-50 years	2.77	4.01	3.278	.272
	51-55 years	2.87	3.77	3.127	.293
	56-60 years	3.06	3.54	3.293	.243
Type of university	Public Sector	2.77	4.10	3.326	.255
	Private Sector	2.97	4.21	3.729	.266
Academic Discipline	Agriculture & Veterinary	3.30	4.17	3.819	.259
	Arts & Humanities	2.91	4.08	3.351	.315
	Biological & Medical Sciences	3.10	3.89	3.430	.185
	Business Education	2.89	3.93	3.494	.270
	Engineering & Technology	2.90	4.03	3.490	.212
	Physical Sciences	2.98	4.21	3.530	.379
	Social Sciences	2.77	3.95	3.175	.308
	Others	3.03	3.55	3.253	.214
Teaching Position	Lecturer/Instructor	2.91	4.21	3.622	.315
	Senior Lecturer/Instructor	3.02	4.12	3.523	.311
	Assistant Professor	2.87	4.05	3.326	.242
	Associate Professor	2.77	4.06	3.354	.321
	Professor	2.90	3.72	3.282	.265
Overall		2.77	4.21	3.448	.316

Results suggested that ICT access of faculty of agriculture and veterinary (M=3.819, SD=.259) was relatively higher than ICT access of faculty of arts and humanities (M=3.351, SD=.315), biological and medical sciences (M=3.430, SD=.185), business education (M=3.494, SD=.270), engineering and technology (M=3.490, SD=.212), physical sciences (M=3.530 ,SD=.379), and social sciences (M=3.175 ,SD=.308). Results also indicated small but statistically significant differences in faculty's overall ICT access in respect to their teaching positions [F(4,312)=17.226, p<.01], suggesting junior faculty had relatively higher ICT access than senior faculty (see Table 13 for details).

Table 14 provides a summary of the descriptive statistics for the main variables of FICTA scale.

Table 14.

Descriptive Statistics for the Main Variables of FICTA scale

	N	Minimum	Maximum	Mean	Std. Deviation
Physical Access	321	.77	4.42	2.5971	.71328
At Home	322	1.15	4.62	2.6708	.84924
At University	321	.00	4.62	2.5282	.88924
Motivational Access	321	1.88	4.88	3.8002	.56463
Endogenous Motivation	322	2.25	5.00	4.2220	.53717
Exogenous Motivation	321	1.00	5.00	3.3801	.92345
Skills Access	321	2.68	4.94	3.9135	.45107
Operational Skills	321	2.57	5.00	3.9907	.58410
Informational Skills	322	2.50	5.00	3.9048	.54946
Strategic Skills	322	2.50	5.00	3.8447	.57287
Usage Access	321	2.19	4.53	3.4967	.46772
General Usage	321	2.25	4.75	3.6877	.54987

Instructional Usage	322	1.67	4.56	3.3085	.61680
ICT Access	317	2.77	4.21	3.4482	.31692

Research Question 2

How does faculty's ICT access differ with respect to their personal (age and gender) and positional categories (university type and academic discipline)?

In order to evaluate how well the faculty's personal and positional categories predict their ICT access, a standard multiple regression was performed (Field, 2009). A standard multiple regression (also referred to forced entry method) allows to figure out how much unique variance in the outcome variable each of the predictor variables explains. In this analysis, the outcome variable was ICT access where higher score indicates higher level of participants' ICT access. The predictor variables included age, gender, university type, and seven deviation (effect) variables created to denote academic discipline (see Data Analysis section in Chapter 3 for details). Age was measured as a continuous variable while gender (0=male, and 1=female) and university type (0=public sector university, and 1= private sector university) were recorded as dichotomous variable (see Table 14 for descriptive statistics of these variables).

An analysis of standard residuals was performed, which showed that the data contained one outlier. After removal of the case with outlier, re-examination of the residual values showed that the data contained no outliers (Std. Residual Min = -2.865, Std. Residual Max = 2.699). The histogram of standardized residuals and the normal P-P plot of standardized residuals indicated that the data contained approximately normally distributed errors. The data also met the assumption of independent errors (Durbin-Watson value = 2.298). Collinearity statistics (tolerance and VIF values) suggested that multicollinearity was not a concern in the data. The examination of the scatterplot of standardized residuals indicated that the data met the assumptions of homogeneity of variance and linearity. The data also met the assumption of non-zero variances.

Using the standard (enter) method, the regression model explained a significant amount of the variance in the faculty's overall score for ICT access (R^2 =.569, $R^2_{Adjusted}$ = .555, F(10,304)=40.100, p<.001). The R-square value indicated that the 10 predictors entered (where seven variables actually denoted a single variable – academic discipline) collectively explained about 57% of the total variance in ICT access (see Table 15).

A post hoc power analysis was performed in the software G*Power 3.1.9.2 (Faul, Erdfelder, Axel, & Lang, 2009). The sample size of 314 was used with 10 predictor variables and alpha level $p < .05$ for this analyses. The post hoc analyses indicated the statistical power of .999 for detecting a moderate effect size (f^2=.15). Thus, there was more than adequate statistical power (i.e., power * .80) at the moderate effect size level.

As Table 15 shows, seven out of ten predictors entered in the regression model have significant standardized regression weights, indicating that each of these variables is making a significant unique contribution to prediction of faculty's score for ICT access. The age, having a significant standardized regression weight (Beta = -.304, t = -7.134, p<.001), shows that it was a significant predictor of faculty's ICT access. It indicated that there were statistically significant differences in the faculty's access to ICT with respect to their age. The sign of the regression weights indicates the direction of prediction. The Beta for age showed that age was negatively associated with faculty's ICT access, indicating the older faculty members had lower level of ICT access than the younger faculty had.

Table 15. *Multiple Regression Results Predicting ICT Access (N=314)*

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	B	Std. Error	Beta	
(Constant)	3.978	.089		***44.624
Age	-.016	.002	-.304	***-7.134
Gender	-.074	.032	-.111	*-2.292
University Type	.338	.032	.489	***10.648
Agriculture & Veterinary	.257	.047	.235	***5.499
Arts and Humanities	-.043	.030	-.056	-1.442
Biological Sciences	-.006	.033	-.007	-.175
Business Education	-.079	.032	-.106	*-2.468
Engineering & Technology	.067	.034	.081	*1.988
Physical Sciences	.053	.029	.072	1.852
Social Sciences	-.120	.040	-.132	**-3.032
R^2	.569			
Adjusted R^2	.555			
F	***40.100			

*p<.05, **p<.01, ***p<.001

The standardized regression weight of the gender (Beta = -.111, t = -2.292, p<.05) showed that gender was also a significant predictor of faculty's ICT access, indicating that there were statistically significant differences in faculty's access to ICT with respect to their gender. The Beta for gender showed that gender (0=male and 1=female) was negatively associated with faculty's ICT access. In other words, female faculty had lower level of ICT access than their male counter parts had.

Similarly, the standardized regression weight of university type (Beta = .489, t = 10.648, p<.001) showed that university type was also a significant predictor of faculty's ICT access, indicating that there were statistically significant differences in faculty's access to ICT with respect to their university type. The Beta for university type showed that the type of university (0=public sector and 1=private sector) was positively associated with faculty's ICT access, suggesting that faculty at private sector universities had higher levels of ICT access than their counterparts at public sector universities had.

Among deviation (effect) variables denoting academic disciplines entered in the regression model, four of the predictors had significant standardized regression weights (agriculture and veterinary sciences, Beta=.235, t=5.499, $p<.001$; business education, Beta=-.106, t=-2.468, $p<.05$; engineering and technology, Beta=.081, t=1.988, $p<.05$; social sciences, Beta=-.132, t=-3.032, $p<.01$). Arts and humanities, biological sciences, and physical sciences did not significantly contribute to the prediction model.

As four of the seven academic disciplines had significant regression weights, it suggested that there were statistically significant differences in faculty's overall ICT access with respect to their academic disciplines. These deviation (effect) variables denote deviation of mean for their given discipline from the overall mean. The positive standardized regression weights for agriculture and veterinary, and engineering and technology showed that faculty associated with these disciplines had significantly higher overall ICT access than the faculty in other disciplines. Similarly, the negative standardized regression weights for business education and social sciences indicated that faculty associated with these disciplines had significantly lower overall ICT access than the faculty in other disciplines.

The same analysis (multiple regression) was repeated to evaluate how well faculty's personal and positional categories predict each of the four levels of their ICT access: motivational access, physical access, skills access, and usage access. As there were major differences in the faculty's endogenous and exogenous motivational access. The analysis was performed with the two types of motivational access separately rather with overall motivational access.

With endogenous motivational access as the outcome variable, the regression model predicting faculty's endogenous motivational access with all ten predictors produced $R^2 = .139$, $F(10, 309) = 4.995$, $p < .001$. As Table 16 shows, three out of ten predictors entered in the regression model had significant standardized regression weights, indicating each of these variables was making a significant unique contribution to prediction of faculty's endogenous motivational access.

Table 16. *Multiple Regression Results Predicting Endogenous Motivational Access (N=316)*

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	B	Std. Error	Beta	
(Constant)	4.992	.258		***19.372
Age	-.013	.005	-.150	*-2.523
Gender	-.041	.077	-.036	-.531
University Type	-.144	.075	-.122	-1.925
Agriculture & Veterinary	-.007	.109	-.004	-.062
Arts and Humanities	.045	.071	.035	.633
Biological Sciences	-.148	.079	-.109	-1.874
Business Education	.166	.076	.131	*2.186
Engineering & Technology	.311	.079	.224	***3.956
Physical Sciences	.111	.068	.089	1.634
Social Sciences	.127	.095	.082	1.348
R^2	.139			
Adjusted R^2	.111			
F	***4.994			

*p<.05, **p<.01, ***p<.001

The standardized regression weight of the age (Beta = -.150, t = -2.523, p<.05) showed that age was a significant predictor of endogenous motivational access, indicating that there were statistically significant differences in faculty's endogenous motivational access to ICT with respect to their age. The Beta for age showed that age was negatively associated with endogenous motivational access. It indicated that younger faculty participants had higher score for endogenous motivational access than older participants, after controlling for the other variables in the model. The gender and university type did not predict endogenous motivational access significantly, indicating that participants' score for endogenous motivational access did not have statistically significant differences in respect to their gender and the type of university (public sector or private sector) where they teach.

Among deviation (effect) variables denoting academic disciplines entered in the regression model, only two out of the seven academic disciplines had significant standardized regression weights (business education, Beta=-.131, t=-2.186, $p<.05$; engineering and technology, Beta=.224, t=3.956, $p<.001$). Agriculture and veterinary, arts and humanities, biological sciences, physical sciences, and social sciences did not significantly contribute to the prediction model.

As two of the seven academic disciplines had significant regression weights, it suggested that there were statistically significant differences in faculty's endogenous motivational access with respect to their academic disciplines. The positive standardized regression weights for business education, and engineering and technology showed that faculty associated with these disciplines had significantly higher endogenous motivational access to ICT than the faculty in other disciplines.

In the same way, the regression model predicting faculty's exogenous motivational access with all ten predictors produced $R^2 = .264$, $F(10, 308) = 11.052$, $p < .001$. As Table 17 shows, six out of ten predictors entered in the regression model had significant standardized regression weights, indicating each of these variables was making a significant unique contribution to the prediction of faculty's exogenous motivational access.

The standardized regression weight of gender (Beta = -.395, $t = -6.321$, $p<.001$) showed that gender was a significant predictor of exogenous motivational access, indicating that there were statistically significant differences in faculty's exogenous motivational access to ICT with respect to their gender. The Beta for gender (0=male, 1=female) showed that gender was negatively associated with exogenous motivational access. It indicated that male faculty participants had higher score for exogenous motivational access than their female counterparts, after controlling for the other variables in the model.

Table 17. *Multiple Regression Results Predicting Exogenous Motivational Access (N=316)*

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	B	Std. Error	Beta	
(Constant)	4.133	.414		***9.977
Age	-.001	.008	-.009	-.170
Gender	-.774	.123	-.395	***-6.321
University Type	.362	.119	.180	**3.048
Agriculture & Veterinary	.389	.173	.124	*2.247
Arts and Humanities	.208	.113	.093	1.840
Biological Sciences	-.042	.125	-.018	-.337
Business Education	-.980	.120	-.450	***-8.136
Engineering & Technology	-.450	.126	-.187	***-3.569
Physical Sciences	-.202	.108	-.094	-1.869
Social Sciences	.781	.150	.293	***5.194
R^2	.264			
Adjusted R^2	.240			
F	***11.052			

*p<.05, **p<.01, ***p<.001

Similarly, the standardized regression weight of university type (Beta = .180, t = 3.048, p<.01) showed that university type also was a significant predictor of exogenous motivational access, indicating that there were statistically significant differences in faculty's exogenous motivational access with respect to the type of university where they teach. The Beta for university type (0=public sector, 1=private sector) showed that university type was positively associated with exogenous motivational access. It indicated that the faculty participants working in private sector universities had higher score for exogenous motivational access than their counterparts working in public sector universities. Age, however, did not predict exogenous motivational access significantly, indicating that participants' scores for exogenous motivational access did not have statistically significant differences in respect to their age.

Among deviation (effect) variables denoting academic disciplines entered in the regression model, four out of the seven academic disciplines had significant standardized regression weights (agriculture and veterinary, Beta=.124, *t*=2.247, p<.05; business education, Beta=-.450, *t*=-8.136, p<.001; engineering and technology, Beta=-.187, *t*=-3.569, p<.001; social sciences, Beta=.293, *t*=5.194, p<.001). Arts and humanities, biological sciences, and physical sciences did not significantly contribute to the prediction model.

As four of the seven academic disciplines had significant regression weights, it suggested that there were statistically significant differences in faculty's exogenous motivational access with respect to their academic disciplines. The positive standardized regression weights for agriculture and veterinary, and social sciences showed that faculty associated with these disciplines had significantly higher exogenous motivational access to ICT than the faculty in other disciplines. Similarly, the negative regression weights for business education, and engineering and technology showed that faculty associated with these disciplines had significantly lower exogenous motivational access than the faculty in other disciplines.

With physical access as the outcome variable, the regression model explained a significant amount of the variance in the faculty's physical access to ICT (R^2 =.520, $R^2_{Adjusted}$ = .505, F(10,308)=33.407, p<.001)). The R-square value indicated that the 10 predictors entered (including seven dummy variables denoting a single variable – academic discipline) collectively explained about 52% of the total variance in faculty's score for motivational access.

Table 18. *Multiple Regression Results Predicting Physical Access (N=314)*

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	B	Std. Error	Beta	
(Constant)	2.419	.208		***11.654
Age	-.004	.005	-.032	-.717
Gender	.165	.077	.109	2.144
University Type	.731	.074	.469	***9.821
Agriculture & Veterinary	.596	.108	.245	***5.518
Arts and Humanities	-.263	.071	-.152	***-3.717
Biological Sciences	-.091	.078	-.051	-1.166
Business Education	.170	.075	.101	*2.265
Engineering & Technology	-.019	.078	-.010	-.238
Physical Sciences	.459	.068	.274	***6.733
Social Sciences	-.345	.094	-.167	***-3.673
R^2	.520			
Adjusted R^2	505			
F	***33.407			

*p<.05, **p<.01, ***p<.001

As can be seen in Table 18, six out of ten predictors entered in the regression model had significant standardized regression weights, indicating each of these variables was making a significant unique contribution to prediction of faculty's score for physical access. The university type, having a significant standardized regression weight (Beta = .469, t = 9.821, p<.001), showed that it was a significant predictor of faculty's physical access. It indicated that there were statistically significant differences in faculty's access to ICT with respect to their university type. The Beta for university type showed that university type (0=public sector and 1= private sector) was positively associated with physical access, supporting the Hypothesis$_{2c}$ that faculty of public sector universities had a lower level of physical access than faculty of private sector universities. Both the age (Beta = -.032, t = -.717, p>.05) and gender (Beta = .109, t = 2.144, p>.05) failed to contribute to the regression model significantly, indicating that faculty's physical access to ICT did not statistically differ in respect to their age and gender.

Further, five of the academic disciplines had significant standardized regression weights (agriculture and veterinary, Beta=.245, t=5.518, p<.001; arts and humanities, Beta=-.152, t=-3.717, p<.01; business education, Beta=.101, t=2.265, p<.05; physical sciences, Beta=.274, t=6.733, p<.01; social sciences, Beta=-.167, t=-3.673, p<.01). Biological sciences, and engineering and technology did not significantly contribute to the prediction model.

As five of the seven academic disciplines have significant regression weights, it suggested that there were statistically significant differences in faculty's physical access to ICT with respect to their academic disciplines. The positive standardized regression weights for agriculture and veterinary, business education, and physical sciences showed that faculty associated with these disciplines had significantly higher physical access to ICT than the faculty in other disciplines. Similarly, the negative standardized regression weights for arts and humanities, and social sciences indicated that faculty associated with these disciplines had significantly lower physical access than the faculty in other disciplines.

The results indicated that agriculture and veterinary, and physical sciences (both belonging to the broad category of science and technology) were significantly related with higher level of physical access, and arts and humanities were significantly related with lower level of physical access. However, other disciplines of science and technology (biological sciences, and engineering and technology) were not significantly related with higher level of physical access. These results, in overall, partially supported Hypothesis_{2d} that the faculty of science and technology subjects had higher level of physical access than faculty of arts, and humanities subjects.

Likewise, with skills access as the outcome variable, the regression model explained a significant amount of the variance in the faculty's skills access to ICT (R^2 =.467, $R^2_{Adjusted}$ = .450, F(10,308)=26.972, p<.001). The R-square value indicated that the 10 predictors entered (including seven dummy variables denoting a single variable – academic discipline) collectively explained about 47% of the total variance in faculty's score for skills access.

Table 19. *Multiple Regression Results Predicting Skills Access (N=314)*

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	B	Std. Error	Beta	
(Constant)	4.586	.138		***33.193
Age	-.021	.003	-.291	***-6.236
Gender	.003	.051	.003	.062
University Type	.502	.050	.509	***10.125
Agriculture & Veterinary	.004	.072	.002	.051
Arts and Humanities	-.018	.047	-.016	-.378
Biological Sciences	-.024	.052	-.021	-.451
Business Education	.005	.050	.005	.108
Engineering & Technology	.143	.052	.122	**2.734
Physical Sciences	-.073	.045	-.069	-1.617
Social Sciences	-.085	.063	-.065	-1.358
R^2	.467			
Adjusted R^2	.450			
F	***26.972			

*p<.05, **p<.01, ***p<.001

As Table 19 shows, only three out of the ten predictors entered in the regression model had significant standardized regression weights, indicating each of these variables was making a significant unique contribution to prediction of faculty's score for skills access. The age, having a significant standardized regression weight (Beta = -.291, t = -6.236, p<.001), showed that it was a significant predictor of skills. It indicated that there were statistically significant differences in faculty's skills access with respect to their age. The Beta for age showed that age was negatively associated with skills access, indicating the older faculty members had lower level of skills access than the younger faculty had.

Likewise, the standardized regression weight of university type (Beta = .509, t = 10.125, p<.001) showed that university type was also a significant predictor of skills access, indicating that there were statistically significant differences in faculty's skills access with respect to their university type. The Beta for university type showed that the type of university (0=public sector and 1=private sector) was positively associated with skills access, suggesting that faculty at private sector universities had higher levels of skills access than their counterparts at public sector universities.

The gender (Beta = .003, t = .062, p>.05), however, did not significantly predict skills access, indicating that there were no statistically significant differences in faculty's skills access with respect to their gender. It did not support Hypothesis$_{2b}$ that female faculty members had a lower skills access level than their male counterparts.

Additionally, only one of the seven academic disciplines, engineering and technology (Beta=.122, t=2.734, p<.01), had significant regression weight. The positive standardized regression weights for engineering and technology showed that faculty associated with this discipline had significantly higher skills access than the faculty in other disciplines.

Finally, with usage access as the outcome variable, the regression model explained a significant amount of the variance in the faculty's usage access to ICT (R^2 =.418, $R^2_{Adjusted}$ = .400, F(10,308)=22.162, p<.001). The R-square value indicated that the 10 predictors entered (including seven dummy variables denoting a single variable – academic discipline) collectively explained about 42% of the total variance in faculty's score for usage access.

Table 20. *Multiple Regression Results Predicting Usage Access (N=316)*

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	B	Std. Error	Beta	
(Constant)	4.555	.150		***30.342
Age	-.028	.004	-.368	***-7.517
Gender	-.053	.055	-.053	-.963
University Type	-.005	.054	-.005	-.089
Agriculture & Veterinary	.347	.078	.218	***4.451
Arts and Humanities	-.044	.051	-.039	-.865
Biological Sciences	.167	.057	.141	**2.952
Business Education	.089	.055	.080	1.619
Engineering & Technology	.229	.056	.190	***4.070
Physical Sciences	-.041	.049	-.037	-.832
Social Sciences	-.418	.068	-.309	***-6.174
R^2	.418			
Adjusted R^2	.400			
F	***22.162			

*p<.05, **p<.01, ***p<.001

As can be seen in Table 20, five out of the ten predictors entered in the regression model had significant standardized regression weights, indicating each of these variables was making a significant unique contribution to the prediction of usage access. The standardized regression weight of the age (Beta = -.368, t = -7.517, p<.001) showed that age was a significant predictor of usage access, indicating that there were statistically significant differences in faculty’s usage access with respect to their age. The Beta for age showed that age was negatively associated with usage access. It indicated that younger faculty participants had higher score for usage access than their older faculty, after controlling for the other variables in the model. It supported Hypothesis$_{2a}$ that younger faculty had a higher usage access level than older faculty had.

The gender (Beta = -.053, *t* = -.963, p>.05) and university type (Beta = -.005, *t* = -.089, p>.05) did not predict usage access significantly, indicating that participants’ scores for usage access did not have statistically significant differences in respect to their gender and the type of university.

Further, four of the seven academic disciplines had significant regression weights (agriculture and veterinary, Beta=.218, *t*=4.451, p<.001; biological sciences, Beta=.141, *t*=2.952, p<.01; engineering and technology, Beta=.190, *t*=4.070, p<.001; social sciences, Beta=-.309, *t*=-6.174, p<.001), suggesting that there were statistically significant differences in faculty's usage with respect to their academic disciplines. The positive standardized regression weights for agriculture and veterinary, biological sciences, and engineering and technology showed that faculty associated with these disciplines had significantly higher usage access than the faculty in other disciplines had. Similarly, the negative standardized regression weights for social sciences indicated that faculty associated with this discipline had significantly lower usage access than the faculty in other disciplines had.

Table 21 provides a summary of regression results predicting overall ICT access, motivational access, physical access, skills access, and usage access.

Table 21. *Summary of Regression Results Predicting ICT Access, Motivational Access, Physical Access, Skills Access, and Usage Access*

DVs	Predictors									
	Age	Gender	Uni. type	Agri. & Veterin.	Arts & Human.	Bio. Sciences	Business Education	Eng.& Tech	Physical Sciences	Social Sciences
ICT access, R^2=.569	*** -.304	* -.111	*** .489	*** .235			* -.106	* .081		** -.132
Endogenous Motivational access, R^2=.139	* -.150						* .131	*** .221		
Exogenous Motivational access, R^2=.264		*** -.395	** .180	* .124			*** -.450	*** -.187		*** .293
Physical access, R^2=.520			*** .469	*** .245	*** -.152		* .101		*** .274	*** -.167
Skill access, R^2=.467	*** -.291		*** .509					** .122		
Usage access, R^2=.418	*** -.368			*** .218		** .141		*** .190		*** -.309

*p<.05, **p<.01, ***p<.001

Research Question 3

How does faculty's use of ICT to support their instructional practices relate to their motivational access, physical access, skill access, and general usage access?

In order to understand the relationship between faculty's instructional use of ICT and their other levels of ICT access, a hierarchical regression analysis was performed. Table 22 presents the results of the hierarchical regression analysis, displaying two regression models predicting faculty's instructional usage of ICT.

In the first model, Endogenous Motivational Access and Physical Access at University significantly predicted faculty's Instructional Usage of ICT (Adjusted R^2=.196, F (4,313)=20.348, p<.001). Exogenous Motivational Access and Physical Access at Home did not significantly predict Instructional Usage of ICT. In second model, Operational Skills Access, Informational Skills Access, Strategic Skills Access, and General Usage Access were added to the regression model. Only General Usage Access significantly contributed to the prediction model, with the adjusted R^2 increasing to .221 [F (8, 309)=12.220, p<0.001]. Model 2 resulted in a minor increment (.025) in the adjusted R^2.

The results of the regression analysis (Model 2) indicated that the faculty who had higher score for endogenous motivation, physical access at university, and general usage access, were utilizing ICT to support their instructional practices.

The analysis of standard residuals confirmed that the data contained no outliers (Std. Residual Min = -2.362, Std. Residual Max = 2.043). The histogram of standardized residuals and the normal P-P plot of standardized residuals showed that their distribution was acceptably normal. The Durbin-Watson value (2.109) confirmed that the assumption of independent errors was met. There were no multicollinearity issue beyond what would be theoretically anticipated

(Endogenous Motivational Access, Tolerance = .916, VIF = 1.091; Physical Access at University, Tolerance = .661, VIF = 1.513; General Usage Access, Tolerance=.875, VIF=1.143). Also, the examination of the scatterplot of standardized residuals indicated that the data met the assumptions of homogeneity of variance and linearity.

Table 22. *Hierarchical Regression Results Predicting Instructional Usage Access (N =317)*

	Model 1				*Model 2*			
Variables	*B*	*SE*	*β*	*t*	*B*	*SE*	*β*	*T*
(Constant)	1.874	.306		***6.129	1.344	.418		**3.212
Endogenous Motivational Access	.206	.060	.180	**3.453	.215	.059	.188	***3.621
Exogenous Motivational Access	.047	.034	.070	1.361	.038	.034	.057	1.110
Physical Access at University	.285	.038	.413	***7.596	.233	.042	.338	***5.542
Physical Access at Home	.001	.040	.001	.026	.012	.040	.016	5.542
Operational Skills Access					.067	.065	.063	1.018
Informational skills Access					.066	.063	.059	1.052
Strategic Skills Access					.109	.072	.102	1.507
General Usage Access					.182	.059	.163	**3.070
R	.454				.490			
R^2	.206				.240			
Adjusted R^2	.196				.221			
Adjusted R^2 *change*	.196				.025			
F	***20.348				***12.220			

*p<.05, **p<.01, ***p<.001

Chapter 5: DISCUSSION, RECOMMENDATIONS, AND CONCLUSIONS

The purpose of the present study was to examine Pakistani faculty's access to ICT at their motivational, physical, skills, and usage levels; and to determine if the faculty's access to ICT is significantly different due to their personal (age, gender) and positional (academic discipline, type of university) categories. The study also aimed to explore the relationship of faculty's instructional usage of digital technologies with other levels of ICT access. The sample included higher education faculty teaching at HEC recognized public and private sector universities of Sindh, Pakistan. Data, collected through survey research design, were analyzed through quantitative analysis.

The first section of this chapter presents a discussion of research findings with theoretical and practical implications. The second section provides recommendations for future research. The chapter ends with conclusion of the study.

Discussion of Research Findings

A Broad View of Pakistani Faculty's ICT Access

The results of the present study provided a broad view of Pakistani faculty's access to information and communication technologies. The results showed that faculty's overall ICT access was minimal with mean score of 3.448, while the maximum possible score was 5. Despite the emphasis on ICT utilization in educational policies of Pakistan, and large investments by higher education commission to initiate various ICT based projects, the low extent of faculty's ICT access is a misfortune. This suggests that Pakistani faculty are not utilizing information and communication technologies effectively to maximize their participation, through teaching and research, in the society.

When comparing the respondents' score for the four levels of ICT access, it was shown that their score for skills access (M=3.913) was the highest followed by the score for motivational access (M=3.800) and usage access (M=3.496) respectively. The score for physical access (M=2.597) was at the lower end. This sequence of the intensity with the four levels of ICT access is contradicting with what van Dijk (2005) has suggested in his arguments while proposing the model of successive kinds of access to digital technologies. Particularly, higher skills and usage access along with lower level of physical access do not seem to be very compatible with each other.

Participants were found to have relatively high motivation to adopt and utilize computers, the Internet, and other digital devices and services. An examination of faculty's mean scores for endogenous motivational access and exogenous motivational access indicated a clear distinction between the levels of respondents' motivation to adopt ICT. They were more motivated to adopt such technologies because of their own perceptions and attitudes that are internally constructed, rather than being based on external sources such as availability of material resources, time, and social or cultural influence.

The findings from this study showed that Pakistani faculty's physical access to ICT is very poor, suggesting they do not have access to adequate levels of ICT infrastructure. Because physical access is an essential condition for growth of the obligatory skills to practice digital technologies (van Dijk, 2005), Pakistani faculty's inadequate level of physical access to ICT is alarming. Separate indexes for respondents' physical access to various ICT devices and services suggested that they have better physical access at home than at their universities.

It was also revealed that a significant number of faculty lack adequate access to basic ICT devices and services. About 31.5% of the faculty did not have a broadband or DSL Internet connection at their home and university. The Internet serves as the backbone of information and communication technologies. Also, without this basic facility, it is almost impossible for faculty to benefit themselves from various facilities offered by HEC as well as other open access digital contents available online. Therefore, the primary recommendation of the present study, in this regard, is to provide a reliable and high speed Internet facility to all universities particularly to the public sector universities.

Faculty’s overall skills access to ICT was of moderate level. The means of the separate indexes for the three types of skills access (operational, informational, and skills access) were in the order (from highest to lowest) as suggested by the model of successive kinds of access to digital technologies (van Dijk, 2005). They had highest score for operational skills, followed by informational skills and strategic skills respectively.

The findings from the present study indicated that Pakistani faculty’s usage access is of moderate level. Results revealed that faculty utilize computers, the Internet, and other ICTs more for their general purposes i.e., tasks associated with everyday life other than instructional practices. Their use of ICT to support their instructional practices such as planning and preparation of instruction, delivering learning content, enhancing teaching-learning process, and assessing students’ learning, was relatively low.

Provision of adequate ICT access to the faculty is the first and most crucial requirement for the technological adoption in higher education of a country. The current level of ICT access by higher education faculty in Pakistan poses great challenges in adoption of technological innovations in higher education of Pakistan. Faculty's low level of ICT access also suggests that most of the faculty members are not in a convenient position to highly benefit from ICT based initiatives taken by HEC such as national digital library program, national video conferencing network, virtual education program of Pakistan, and other similar projects.

As the broader view of Pakistani faculty's ICT access imply that their access level is not good enough, there is need to take necessary actions to increase their ICT access. In this regard, two primary steps can be taken: 1) improvement and expansion of ICT infrastructure on campus particularly at public sector universities, and 2) training of faculty to develop their competency with utilization of various ICTs. Access to adequate ICT infrastructure and increased digital skills may significantly contribute to their usage access in return.

Above discussed findings from this study entail strong implications for the policy makers, and administrators of HEIs in the country to draft relevant and necessary plans of action that help promote technological transformation in higher education of Pakistan.

Digital Divide regarding Personal and Positional Categories

This study also investigated digital divide among the faculty participants in respect of their personal and positional categories including age, gender, university type, and academic discipline. Regression analysis indicated that the university type is the most influencing predictor variable to predict faculty's access to ICT. The results of the analysis confirmed the research hypothesis that there is a statistically significant difference in faculty's access to ICT with respect to the type of university where they teach. Particularly, the ICT access of faculty of public sector universities is lower than that of faculty of private sector universities. These findings confirm the general perceptions prevailing in Pakistan, and are consistent with what Burnip (2006) found in his study with school teachers.

The gap in faculty's ICT access, between those who work at public sector and private sector universities was also prominent in the physical access and skills access, suggesting that the faculty at public sector universities have poor physical access to ICT devices and services, and that they are less competent than their counterparts at private sector universities in utilization of digital technologies. Lower skills access by the faculty at public sector universities suggests that there are limited professional development opportunities in the area of ICT proficiency for the faculty.

The study makes two recommendations in order to remove the gaps identified between faculty of public and private sector universities, regarding their ICT access. Firstly, considering the potential lack of funding at public sector universities, it is recommended to establish a shared modern ICT lab in each department/college of every public sector university if each and every faculty member cannot be provided with a laptop and other ICT devices and services at individual level. This shared lab must be equipped with latest reliable hardware, high bandwidth Internet connection, and necessary software relevant to teachers. Further, each department of the college should have a laptop loan facility for faculty members to meet their need of utilizing ICT in classrooms or any place other than the ICT lab.

Secondly, this study recommends that professional development programs should be arranged to boost digital skills of the faculty. These programs should be focused on two aspects: proficiency to use ICT equipment and services, and training on how to use ICT to support and enhance instructional and scholarly practices. Increased skills access may motivate them toward instructional usage of ICT in addition to their use of ICT for general purposes.

The findings from this study also confirmed the hypothesis that there is a statistically significant difference in faculty's access to ICT with respect to their age. In addition to faculty's overall ICT access, age was significantly negatively associated with skills and usage access to ICT, indicating that younger faculty have higher skills access, and they utilize ICT more than older faculty. Thunman and Persson (2013) also found that younger teachers are more inclined to use computers for audio-visual aid in their teaching. Similarly, Soomro, Yousuf Zai, and Jafri (2015) found that higher education faculty from lower age groups are more competent with Web 2.0 technologies.

Regarding digital divide with respect to gender differences, this study found significant gender differences in faculty's overall ICT access and in their motivational access. Female faculty were found to have less overall ICT access, and were less inclined to adopt digital technologies. Though previous studies suggested that females are at a disadvantage relative to males in learning computers skills, and more male students use computers at home and university than female students (Cooper, 2006; Mahmood, 2009), this study did not find significant gender differences at physical, skills, and usage access to ICT.

This study also evaluated the relationship of academic discipline, a relatively new variable regarding ICT access, with faculty's access to information and communication technologies. The results of the present study showed that there are significant differences in faculty's access to ICT. Academic disciplines under the broader category of science and technology were found to be significantly associated with a higher level of overall ICT access. On the other hand, business education and social sciences predicted ICT access in negative direction, suggesting that faculty associated with these disciplines have significantly lower levels of overall ICT access.

The role of academic disciplines was more noticeable in physical access. The findings suggested that faculty associated with science disciplines including agriculture and veterinary, and physical sciences had higher level of physical access to digital technologies, whereas faculty working in social sciences, and arts and humanities had lower levels of physical access to ICT. These findings, in some manner, support Pakistani people's perceptions that digital technologies is the congenital domain of people associated with science and technology disciplines. These findings are partially consistent with what Mahmood (2009) found in a survey study with students. Mahmood found differences in students' computer access at university among three groups. Students from science and technology and social sciences disciplines had significantly more computer access at university than students from arts and humanities disciplines. He argued that the identified digital gap was due to policy preferences aiming to develop science and technology with more funding while ignoring humanities.

Relationship of Instructional Usage Access with Other Dimensions of ICT Access

This dissertation also attempted to explore the relationship between faculty's instructional usage of ICT and other dimensions of ICT access including physical, motivational, skills, and general usage access to ICT. The findings from this study showed that the participants' physical access to ICT at university, endogenous motivation to adopt such technologies, and utilization of ICT for general purposes significantly predicted instructional usage of ICT. None of the other dimensions of ICT access, including exogenous motivation or any of the three types of skills access, was found to be a significant indicator of faculty's utilization of ICT to support their instructional practices.

These findings suggest that faculty having better ICT infrastructure at their workplace are more inclined to adopt digital technologies to support various dimensions of their instruction such as planning and preparation, enhancing teaching-learning process, delivering content, and assessing students' learning. Having access to computers and the Internet in their office or campus lab appears to encourage them to utilize such technologies to support their primary professional responsibility. Likewise, the positive association of general usage access with instructional usage access implies that when faculty use digital technologies for their general tasks other than teaching, they may feel confident and get more ideas on how they should use technology for their teaching.

Relevance of Research findings with the Theoretical Framework

The findings of this study suggested that the sequence of faculty's intensity with the four levels of ICT access (motivational, physical, skills, and usage access) is not in full agreement with what van Dijk (2005) has suggested in his arguments while proposing the model of successive kinds of access to digital technologies. Particularly, higher skills and usage access along with lower level of physical access do not appear to be fully compatible with the order of succession of the four ICT access levels suggested by the model.

Van Dijk's (2005) multifaceted model of ICT access suggests that after acquiring sufficient physical access to various ICT devices, one develops his or her capabilities to use digital technologies. This assertion does not imply that once an individual has acquired sufficient physical access to ICT, he or she will develop the digital skills without his or her wish, intention, and efforts to learn digital skills. Further, it does not imply that the intensity with the skills access will be lesser than physical access. In the present study, the faculty's high motivation to adopt and use ICT's may have helped them to develop better skills to utilize digital technologies, despite their lower physical access to ICT. This supports the affirmation by Ghobadi and Ghobadi (2013) that motivation increases individuals' skills to utilize ICT. However, another reason, for the contradiction between the order of faculty's intensity and succession of the four access levels, may be that faculty respondents might not have reflected the true picture of their skills and usage access due to the social desirability of giving positive responses, by portraying a positive picture of their digital skills.

Ghobadi and Ghobadi (2013) have argued that van Dijk's (2005) multifaceted model of ICT access is somewhat static, as it does not clarify the interrelations between different levels of ICT access as well as how these levels interact with each other and shape digital divide as a whole. According to them, the four access levels are not independent concepts but they are formed as a consequence of complex dynamic interplay with each other. The present study provides a limited understanding of the relationships among the different levels of ICT access. Detailed explanations on the causal processes among the four levels and how each level interacts with others is beyond the scope of this study. To dig deeper into how the four levels of ICT access interacts with each other, future research that tests the four types of ICT access simultaneously, by employing path analysis and structural equation modeling, may help to better understand how they together shape the digital divide.

Additionally, although van Dijk (2010) has affirmed that the digital gap at motivational and physical levels have diminished, and the differences have moved to skills and usage access in the last years, the findings of the present study are contradictory to his assertions. The results from the present study suggest that the gap exists at all four levels of faculty's ICT access, including physical and skills access. Even the divide was much bigger in physical access, especially in respect of faculty's positional category of university type. Therefore, it will be realistic to say that gap in Pakistani faculty's physical access to ICT is far from being vanished. Give these points, policies dealing with digital divide in higher education of Pakistan must focus measures to alleviate all four types of ICT gaps including motivational, physical, skills, and usage access gaps.

Limitations and Delimitations of the Study

Some limitations and delimitations exist regarding any generalizations based on the findings of the study. Choices that are within the control of the researcher to mark confines around the research (e.g., location of the research) are termed delimitations of research; whereas boundaries that are beyond the control of the researcher are called limitations of research (Andres, 2012).

The primary limitation of the present study is that its findings are fully based on self-reported data. The accuracy and validity of the findings are congruent with participants' correct understanding of the survey items and their honest response to these items. Faculty might have been reluctant to report the true picture of their digital skills especially in cases where participants have weak skills. The digital skills of individuals can better be assessed with performance tests. However, the research involving performance tests requires a great deal of time and funds, which makes such investigations difficult to be conducted especially with a large population.

Another limitation was that the data were gathered through a quantitative survey, the FICTA scale, which consists of only close-ended questions. That means the survey did not allow the respondents to write their own responses/options. Further, though the participant institutions were selected purposefully, the potential participants within these institutions were selected on a sample of convenience. Although the sampling procedure attempted to represent all characteristics of the target population, there is no assurance that the accessed sample exactly represented the target population because the participants were selected from only one province of Pakistan. Therefore, caution is suggested for any generalizations based on the findings of the study.

Directions for Future Research

Although the present study has produced valuable information on Pakistani faculty's access to ICT, it is a starting point for future research to have further understanding on the issue of digital divide in educational settings. This study explored faculty's physical access to ICT, their motivation to adopt such technologies, their capabilities to utilize digital technologies, and their actual usage of ICT to support their instructional as well general practices. The inquiry of digital divide can be expanded by investigating digital divide among teachers of other settings including primary, secondary, and college (post-secondary) teachers.

Higher education faculty's professional responsibilities include two main areas: teaching and research. The present study was limited to examine faculty's usage access to ICT focusing on general and teaching usage. However, faculty's ICT usage to support their scholarly practices was not addressed in the study. Future study with the emphasis on faculty's ICT usage for scholarly activities would overcome this limitation.

This study concentrated on the role of personal and positional categories affecting the digital divide among faculty but it did not address other barriers that prevent faculty from adoption and utilization of ICT. Future research can continue to contribute toward further understanding on the digital gap that arises from those barriers such as lack of professional development opportunities in ICT utilization, and issue of power shortage in the country. An investigation with a qualitative approach may provide in-depth understanding on this issue.

Further, in understanding the issue of digital divide in educational settings, students' access to information and communication technologies is as significant as teachers' access. Therefore, future studies involving students as the unit of analysis are worth investigating to enhance our understanding on digital divide in educational settings. Another path for investigation that opens from the present study is the opportunity to evaluate and field test the FICTA scale with target populations of similar as well as different geographic settings other than Pakistan.

Conclusions

The present study provided a broader view of Pakistani faculty's access to information and communication technologies at motivational, physical, skills, and usage access. The results showed that faculty's overall ICT access is minimal. Though their motivation, and skills access to ICT are moderate, they are low at physical access to various ICT, particularly at public sector universities. Regarding usage access, faculty's utilization of ICT to support their instructional practices is very low.

The present study found that ICT access was not universal among Pakistani Faculty, highlighting the existence of digital divide among them. Faculty's access levels to ICT varied with respect to their personal and positional categories including age, gender, university type, and academic disciplines. The digital gap between faculty of public sector and private sector universities was found to be more prominent, indicating that the faculty at public sector universities have lower access at physical, skills, and usage levels, as well as overall ICT access.

The present study also attempted to examine the relationship between faculty's instructional usage of ICT and other dimensions of ICT access. The findings indicated that faculty's physical access to ICT at university, their endogenous motivational access, and their general usage access to ICT are positively associated with their instructional usage of ICT.

This study is an initial and significant contribution to the literature by portraying a big picture of Pakistani faculty's motivation to adopt digital technologies, their physical access to various ICTs, their digital skills, and actual use of such technologies by them. The findings and information gained from this research study provide valuable implications for plans of action for professional development of faculty and other ICT initiatives in higher education of Pakistan. The findings of the study are also helpful to other researchers in further understanding which demographic variables predict digital gap among higher education faculty.

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Appendix A: List of HEC Recognized Universities in the province of Sindh Pakistan

Public Sector:

1. Dawood College of Engineering & Technology, Karachi
2. Pakistan Naval Academy, Karachi
3. Benazir Bhutto Shaheed University Lyari, Karachi
4. DOW University of Health Sciences, Karachi
5. Institute of Business Administration, Karachi
6. Jinnah Sindh Medical University
7. Liaquat University of Medical and Health Sciences, Jamshoro Sindh.
8. Mehran University of Engineering & Technology, Jamshoro
9. NED University of Engineering & Technology, Karachi
10. Peoples University of Medical and Health Sciences for Women, Nawabshah (Shaheed Benazirabad)
11. Quaid-e-Awam University of Engineering, Sciences & Technology, Nawabshah
12. Shah Abdul Latif University, Khairpur
13. Shahaeed Mohtarma Benazir Bhutto Medical University, Larkana
14. Sindh Agriculture University, Tandojam
15. Sukkur Institute of Business Administration, Sukkur.
16. Sindh Madresatul Islam University, Karachi.
17. Shaheed Benazir Bhutto University Shaheed Benazirabad
18. University of Karachi, Karachi
19. University of Sindh, Jamshoro

Private Sector:

1. Aga Khan University, Karachi
2. Baqai Medical University, Karachi
3. Commecs Institute of Business & Emerging Sciences, Karachi
4. Dadabhoy Institute of Higher Education, Karachi
5. DHA Suffa University, Karachi
6. Greenwich University, Karachi
7. Hamdard University, Karachi
8. Habib University, Karachi
9. Indus University, Karachi
10. Indus Valley School of Art and Architecture, Karachi
11. Institute of Business Management, Karachi
12. Institute of Business and Technology, Karachi
13. Iqra University, Karachi
14. Isra University, Hyderabad
15. Jinnah University for Women, Karachi
16. Karachi Institute of Economics & Technology, Karachi
17. KASB Institute of Technology, Karachi
18. Karachi School for Business & Leadership
19. Muhammad Ali Jinnah University, Karachi
20. Newport Institute of Communications & Economics, Karachi
21. Preston Institute of Management, Science and Technology, Karachi
22. Preston University, Karachi
23. Shaheed Zulfikar Ali Bhutto Institute of Sc. & Technology (SZABIST), Karachi
24. Shaheed Benazir Bhutto City University, Karachi
25. Sir Syed University of Engg. & Technology, Karachi
26. Sindh Institute of Medical Sciences, Karachi
27. Textile Institute of Pakistan, Karachi
28. The Nazeer Hussain University, Karachi
29. Zia-ud-Din University, Karachi
30. Shaheed Benazir Bhutto Dewan University, Karachi

Appendix B: List of items removed from the 74-item provisional scale

a. In the result of content validation

1. Digital camera (Physical Access)
2. Using computer and the Internet to support teaching-learning process is a good idea. (Endogenous Motivational Access)
3. Learning to operate computer and the Internet is easy for me. (Endogenous Motivational Access)
4. I am likely to use computer and the Internet because my co-teachers wish me to do so. (Exogenous Motivational Access)
5. I am comfortable in installing an application program on my computer. (Operational Skills)
6. It is easy for me to use information about a specific subject from multiple sites. (Informational Skills)
7. I do not feel difficulty in handling files on my computer. (Informational Skills)
8. I do not really care where information on the Internet comes from. (Informational Skills)

b. In the result of discriminant validity

9. I was attracted to digital technologies when I read in an article that using ICT improves teaching. (Exogenous Motivational Access)
10. The Internet sometimes saves me money. (Strategic Skills)

c. In the result of retrospective cognitive interview

11. Using computer and the Internet is pleasant. (Endogenous Motivational Access)

Appendix C: Letter of permission by HEC Pakistan to conduct research

Higher Education Commission

H-9, Islamabad (Pakistan), Phone: (0092-51)90408036, Fax: (0092-51)90408038, E-mail: jkhan@hec.gov.pk

Project Director

No: 1-8/HEC/HRD/2014

Dated: December 17th, 2014

Subject: **Letter for Permission to Conduct Research**

I, Jehanzeb Khan, Project Director, grant permission for Kamal Ahmed Soomro to conduct his study entitled Pakistani Faculty's access to Information and Communication Technologies at (Universities/Higher education institution). I also understand that the research will not affect the cultural mores/codes of participants

Yours Sincerely,

Jehanzeb Khan

Project Director

Appendix D: Cover Letter

West Virginia University
COLLEGE OF EDUCATION AND HUMAN SERVICES

Pakistani Faculty' Access to Information & Communication Technologies

Dear participant,

You are requested to take part in this research project that investigates digital divide among Pakistani faculty in terms of their access to information and communication technologies (ICT). This research study is conducted in partial fulfillment of the requirement to my doctoral dissertation, under the supervision of my advisor Dr. Ugur Kale in the Department of Learning Sciences and Human Development at West Virginia University. The findings of the study will be helpful to see the overall picture of the faculty's access to ICT in Pakistan, which can be used by policy makers to build plans of action to adopt technological transformation in higher education, and to map necessary strategies for professional development of the faculty in the country.

Your participation in this project is greatly appreciated and will take approximately 20 minutes to complete a questionnaire. Your involvement in this project will be kept as confidential as possible. All data will be reported in the aggregate. You must be 18 years of age or older to participate.

This is an anonymous study and you will not be asked any information that should lead back to your identity as a participant. Your participation is completely voluntary. You may skip any question that you do not wish to answer and you may discontinue at any time. West Virginia University's Institutional Review Board acknowledgement of this project is on file (Protocol# 1412511777).

Should you have any questions about this letter or the research project, please feel free to contact Kamal Soomro at (333) 2647994 or by e-mail at kasoomro@mix.wvu.edu.

Thank you for your time and consideration.

Sincerely,

Kamal A. Soomro
Doctoral Candidate, Instructional Design & Technology Program

Appendix E: Survey Questionnaire

Pakistani Faculty' Access to Information & Communication Technologies
Survey Questionnaire

1. What is your gender?

☐ Male ☐ Female

2. How old are you?

☐ 30 years or younger ☐ 31-40 years
☐ 41-50 years ☐ 51 years or more

3. Please select your relevant academic discipline:

☐ Agriculture & Veterinary Sciences ☐ Arts & Humanities
☐ Biological & Medical Sciences ☐ Business Education
☐ Engineering & Technology ☐ Physical Sciences
☐ Social Sciences ☐ Other ______________________

4. Where do you teach?

☐ Public Sector University ☐ Private Sector University

5. How long have you been teaching?

☐ 0-5 years. ☐ 6-10 years
☐ 11-15 years ☐ 16-20 years
☐ 21-25 years ☐ More than 25 years

6. Please select your teaching position?

☐ Lecturer/Instructor ☐ Senior Lecturer/Senior Instructor
☐ Assistant Professor ☐ Associate Professor
☐ Professor

Q7. Which of the following do you have access at your home or at university? Check all that apply.

	I have at home	I have at university
Desktop computer	☐	☐
Laptop computer	☐	☐
Broadband/DSL internet	☐	☐
USB Flash drive (memory stick)	☐	☐
Smartphone (cell phone internet functionality)	☐	☐
iPad/Tablet	☐	☐
Webcam	☐	☐
Printer	☐	☐
Office Software Suit (e.g., Microsoft Office, Open Office)	☐	☐
Photo editing software (e.g. Adobe Photoshop, Corel Paint)	☐	☐
Video editing software (e.g. iMovie, Movie Maker)	☐	☐
Statistical Software (e.g., SPSS, SAS)	☐	☐
Learning Management System (e.g., Blackboard, eCampus)	☐	☐

Q8. Following statements measure your *Endogenous Motivation* to adopt digital technologies.

Endogenous motivation refers to the desire that originates from the inside of you, and is not directly affected by external sources. Please indicate your level of agreement with these statements (0=Strongly disagree, 1=Disagree, 2=Neutral, 3=Agree, 4=Strongly agree).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Using the Internet can provide me with information that would lead to better decisions.	☐	☐	☐	☐	☐
Using ICT will be of no benefit to me.	☐	☐	☐	☐	☐
Using computer and Internet can improve my work performance.	☐	☐	☐	☐	☐
Using Computer and the Internet seem to be enjoyable.	☐	☐	☐	☐	☐
Using computers and other digital technologies fits into my work style.	☐	☐	☐	☐	☐

Q9. Following statements measure your *Exogenous Motivation* to adopt digital technologies. Exogenous motivation is the desire that originates from the outside sources including social influence, time, and material resources. Please indicate your level of agreement with these statements (0=Strongly disagree, 1=Disagree, 2=Neutral, 3=Agree, and 4=Strongly agree).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Seeing other teachers using Computer and the Internet inspires me.	☐	☐	☐	☐	☐
I want to use ICT because my superiors expect me to use it.	☐	☐	☐	☐	☐
I wish to use computer and the Internet because my students think that I should use them.	☐	☐	☐	☐	☐
I am interested to adopt digital technologies because my university provides enough technology support.	☐	☐	☐	☐	☐
I have enough time to learn and use digital technology.	☐	☐	☐	☐	☐

Q10. Following statements estimate your abilities to operate digital devices such as computer, and the Internet. Please indicate your level of agreement with these statements (0=Strongly disagree, 1=Disagree, 2=Neutral, 3=Agree, and 4=Strongly agree).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I feel comfortable in creating and editing a text file in a word processing program.	☐	☐	☐	☐	☐
It is easy for me to create a computer presentation.	☐	☐	☐	☐	☐
I feel difficulty to change some basic computer settings (wallpaper, time/date, sounds etc.).	☐	☐	☐	☐	☐
I can save images and text from the website on the hard disk.	☐	☐	☐	☐	☐
I feel confident to download programs from the internet.	☐	☐	☐	☐	☐
I can send an attachment with an email.	☐	☐	☐	☐	☐
I know enough about transferring files from hard disk to a USB flash drive and vice versa.	☐	☐	☐	☐	☐
I can use spreadsheets to compute basic formula (e.g., sum, average, percentage).	☐	☐	☐	☐	☐

Q11. Following statements estimate your abilities to search, select, and evaluate information using computer, and the Internet. Please indicate your level of agreement with these statements (0=Strongly disagree, 1=Disagree, 2=Neutral, 3=Agree, 4=Strongly agree).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I always know what search terms to use when searching the internet.	☐	☐	☐	☐	☐
I can use advance search options to reach my required information.	☐	☐	☐	☐	☐
I feel confident to evaluate the sources of the information found on the Internet.	☐	☐	☐	☐	☐
I feel comfortable to synthesize online information.	☐	☐	☐	☐	☐
It is easy for me to retrieve a Website on the Internet.	☐	☐	☐	☐	☐
On the internet, I often do not find what I am looking for.	☐	☐	☐	☐	☐
I can easily choose from search results.	☐	☐	☐	☐	☐

Q12. Following statements estimate your abilities to use computer and the Internet in reaching your goals. Please indicate your level of agreement with these statements (0=Strongly disagree, 1=Disagree, 2=Neutral, 3=Agree, 4=Strongly agree).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I can make a choice by consulting the Internet.	☐	☐	☐	☐	☐
I can reach my intended goal while using the Internet.	☐	☐	☐	☐	☐
On the Internet, it is easy for me to work toward a specific goal.	☐	☐	☐	☐	☐
I can gain benefits from using computer and the Internet.	☐	☐	☐	☐	☐
Using various ICT tools, I feel confident in achieving my goals.	☐	☐	☐	☐	☐
I feel confident in making important decisions with the help of the Internet.	☐	☐	☐	☐	☐

Q13. Please indicate how often (0=Never, 1=Rarely, 2=Not often, 3=Somewhat often, 4=Very often) do you engage with the activities mentioned in the following statements.

	Never	Rarely	Not Often	Somewhat Often	Very Often
I search the information of my interest on the Internet.	☐	☐	☐	☐	☐
I use ICT to support my research activities.	☐	☐	☐	☐	☐
I use emails as one of the primary means of communication.	☐	☐	☐	☐	☐
I make voice/video calls via the Internet.	☐	☐	☐	☐	☐
I create letters, reports and/or papers on computer.	☐	☐	☐	☐	☐
I prepare presentations on computer.	☐	☐	☐	☐	☐
I store and manipulate data in a spreadsheet program.	☐	☐	☐	☐	☐
I maintain my bank account online.	☐	☐	☐	☐	☐
I use digital technologies to watch movies or television programs.	☐	☐	☐	☐	☐

Q14. Please indicate how often (0=Never, 1=Rarely, 2=Not often, 3=Somewhat often, 4=Very often) do you engage with the following activities to support your instructional practices.

	Never	Rarely	Not Often	Somewhat Often	Very Often
I use ICT for communication about assignments among students.	☐	☐	☐	☐	☐
I use ICT for enhancing students' content learning.	☐	☐	☐	☐	☐
I create a test, quiz, or assignment using computer.	☐	☐	☐	☐	☐
I use ICT for facilitating students' group work.	☐	☐	☐	☐	☐
I use ICT to improve students' problem solving skills.	☐	☐	☐	☐	☐
I use digital technologies for the delivery of my instruction.	☐	☐	☐	☐	☐
I use digital technologies to communicate with students.	☐	☐	☐	☐	☐
I prepare learning materials using computer and internet resources.	☐	☐	☐	☐	☐
I develop critical thinking skills among students with the help of ICT.	☐	☐	☐	☐	☐
I use ICT to encourage peer-feedback among my students.	☐	☐	☐	☐	☐

THANK YOU FOR PARTICIPATION

Curriculum Vitae

Kamal Ahmed Soomro
E-mail: kasoomro@mix.wvu.edu

EDUCATION

WEST VIRGINIA UNIVERSITY — ***Morgantown, WV (USA)***
Doctor of Education (Ed.D.), Instructional Design & Technology — Dec 2015

Research Areas:
- Digital divide in educational settings
- Utilization of latest technologies by pre-service and in-service teachers
- Students' learning with technology in developing countries

MEHRAN UNIVERSITY OF ENGINEERING & TECHNOLOGY (MUET) — ***Jamshoro (Pakistan)***
Post Graduate Diploma (P.G.D), Science and Technology in Policy — 2011

UNIVERSITY OF SINDH — ***Jamshoro (Pakistan)***
Master of Education (M.Ed.), — 2008

ALLAMA IQBAL OPEN UNIVERSITY — ***Islamabad (Pakistan)***
Bachelor of Education (B.Ed.), — 2007

UNIVERSITY OF SINDH — ***Jamshoro (Pakistan)***
Bachelor of Computer Science (B.C.S), — 2003

COMPUTER SKILLS

Experienced in IBM compatible computing platforms
- IBM compatible Softwares: Microsoft Office (Word, Excel, PowerPoint),
- Experienced with the Web 2.0 social and instrumental applications
- Experienced with modern learning management systems (eCampus/BlackBoard, MOODLE)
- Designing apps for multiple platforms (Windows, Apple, iOS, Android) with LiveCode
- Knowledge of HTML/DHTML & Web Designing
- Programming experience in Visual Basic and C++

WORK EXPERIENCE

DEPARTMENT OF DISTANCE, CONTINUING & COMPUTER EDUCATION, UOS — ***Hyderabad (Pakistan)***
Visiting Lecturer — Jun, 2010 – July, 2012
- Teaching courses of B.Ed/M.Ed at Department of Distance, Continuing & Computer Education, Faculty of Education, University of Sindh as a visiting faculty.

ALLAMA IQBAL OPEN UNIVERSITY (AIOU) **_Islamabad (Pakistan)_**
Part-time Tutor Jan, 2010 – July, 2012

- Teaching courses of B.Ed through distance education system.

EDUCATION & LITERACY DEPARTMENT, GOVT. OF SINDH **_Hyderabad (Pakistan)_**
I.T/Computer Science Teacher May, 2006 – July, 2012

- Teaching/Training of Information Technology related courses to staff and students of Inter Level.
- Additional Assignments:
- Worked as Focal Person District Hyderabad for I.T Education Project Govt: of Sindh Phase-I. Being Focal Person involved in establishment of I.T/Computer Science Labs in different districts of Sindh.
- Technical Member for the Inspection Committee of Computer Equipment formed by D.C.O Hyderabad and Project Director I.T Education.

PUBLICATIONS (REFEREED JOURNAL ARTICLES)

- Soomro, K. A., Yousuf Zai, S., & Jafri, I. H. (2015). Competence and Usage of Web 2.0 Technologies by Higher Education Faculty. *Educational Media International*.

- Soomro, K. A., Kale, U., & Yousuf Zai, S. (2014). Pre-service teachers’ and teacher-educators’ experiences and attitudes toward using social networking sites for collaborative learning. *Educational Media International, 51(4),* 1-17.

- Arain, A. A., Jafri, S. I. H., Zai, S. Y., & Soomro, K. A. (2013). Education as gender equalizer: overcoming youth unemployment in Pakistan. *Journal of Education and Practice, 4(27),* 28-34.

- Jafri, I. H., Zai, S. Y., Arain, A. A., & Soomro, K. A. (2013). English Background as the Predictors for Students’ Speaking Skills in Pakistan. *Journal of Education and Practice, 4(20),* 30-35.

REFEREED CONFERENCE PRESENTATIONS

- Kuznetsova, N., & Soomro, K. A. (2015). Students’ out-of-class Web 2.0 practices in foreign language learning. *6th International Conference on Foreign Language Education and Technology (FLEAT VI)* hosted by Harvard University, August 2015, Boston, MA.

- Zai, S. Y., & Soomro, K. A. (2015). Examining the latent structure of the teachers’ Sense of Efficacy scale. *Annual meeting of the American Educational Research Association*, April 2015, Chicago, IL.

- Soomro, K. A., Kale, U., & Zai, S. Y. (2014). SNS (Social Networking Site) As a Tool for Collaborative Learning. *Annual meeting of the American Educational Research Association,* April 2014, Philadelphia, PA.

HONORS

- **USAID Scholarship Award**
  Full scholarship award for doctoral studies in the United States for the academic years 2012-16

- **Sally DeLaughter Waston Award**
  Tuition Scholarship awarded by West Virginia University, USA for the academic year 2013-14.

- **Sally DeLaughter Waston Research Award**
  Tuition Scholarship awarded by West Virginia University, USA for the academic year 2014-15.

PROFESSIONAL AFFILIATIONS

- **2013 – Present:** American Educational Research Association (AERA)
  Division C: Learning and Instruction
  Division K: Teaching and Teacher Education
  Special Interest Groups: Science and Technology, Advanced Technologies for Learning, Program Evaluation

- **2012 – Present**: West Virginia University - CEHS Alumni Association

- **2015 – Present**: International Association for Language Learning Technology (IALLT)

COMMUNITY SERVICE/VOLUNTEER EXPERIENCE

- **2010 – Present:** Voluntarily provide guidance and counseling for indigenous and foreign scholarship opportunities of higher education to male and female undergraduates of Sindh.

- **April 2012:** Conducted a four-day workshop on "Integrating Information and Communication Technologies (ICT) in Education" for high school teachers and administrators in Islamabad through a TEA-ILEP Small Grants Award (a program of the U.S. Department of State, implemented by IREX.).