CHAPTER 1: INTRODUCTION

This chapter describes a problem facing international development projects that focus on information and communication technologies (ICTs) in less developed nations. It begins with an introduction to the importance of researching actions taken to address the lack of access and use of ICTs in less developed nations. The problem is grounded in the diffusion of innovations (DOI) theory as conceptualized by Rogers (2003). A discussion of the pertinent components of the DOI theory as well as how these components will be used to examine this problem is included. The chapter concludes with the research questions used to guide this study.

Possible futures for less developed nations not able to address their standing in the global digital divide include political instability (Afele; 2003; Wilson, 2004), increased poverty (Servon, 2002; Wong, 2001), increased marginalization (Servon, 2002; Tiene, 2002), and decreased democratic participation (Cullen, 2001). As less developed nations attempt to address the digital divide and shift to participate in the knowledge and innovation economy, international development educators and international development policy makers will be better served by gaining a more robust understanding of the advantages and disadvantages of implementing innovative uses of ICTs. To better facilitate sustainability, scalability, or spread of technological innovations in less developed nations, there is a need to better understand how stakeholders adopt ICT innovations. Development project managers, funding agents, governments, and policy makers would gain from a better conceptualization of the factors involved in an individuals' choice to adopt ICT innovations in less developed nations.

Original field research focused on the diffusion of ICT innovations via international development projects would greatly add to the limited body of knowledge on this topic. By testing Rogers' model of the diffusion of innovations theory, the current study examined the factors involved in teacher trainers' choice to adopt ICT skills taught through a United Nations Educational, Scientific and Cultural Organization (UNESCO) sponsored ICT in education project in Cambodia. A thorough description of the project and the ICT skills taught to the teacher trainers can be found in Appendix A.

Problem Statement

The global digital divide separates communities, societies, states, and nations in regard to access, knowledge, and use of ICTs (Afele, 2003; Chinn & Fairlie, 2004; Dordick & Wang, 1993; Fink & Kenny, 2003; Foulger, 2002; Hachigian & Wu, 2003; James, 1999; Mossberger, Tolbert, & Stansbury, 2003; Rodriguez & Wilson, 2000; Servon, 2002; Tiene, 2002; Tinio, 2003; Wilson, 2004; Wong, 2001; Xiaoming & Kay, 2004). ICTs include telecommunication technologies and digital technologies such as computers and software. ICTs generally include technologies that allow for the processing, storing, and sharing of digital information. Rodriguez and Wilson (2000) defined ICTs to be a "set of activities which facilitate by electronic means the processing, transmission and display of information" (p. 10). These activities center on ICT indicators used by the Organization for Economic Co-operation and Development (OECD, 2007). These ICT indicators include: Internet connectivity, mobile telephone technologies; computers, television broadcasting technologies, landline telephone infrastructure, ICT-related occupations, ICT-related revenues, ICT patents,

telecommunication firms, and contributions of ICT investments to growth of the gross domestic product (GDP).

The digital divide is important to understand globally, but it is arguably more useful to understand the digital divide at the grassroots level. Afele (2003) and Wilson (2004) posited this understanding under the umbrella of peace, security, and prosperity. Afele stated that ICTs can empower local groups by allowing marginalized communities to contribute to "global knowledge and foster global peace and security" (p. 5). Afele claimed that processing and using information for creating knowledge, sharing lessons learned, and innovating at the local level can give marginalized societies opportunities to be empowered and contribute to the "wealth of global knowledge" thus fostering peace and security (p. 5). Wilson (2004) supported this claim by linking marginalization at the local level with conflicts of politics, economics, nationalism, and terrorism.

The push to incorporate ICTs in international development projects serving less developed nations has become increasingly evident in the recent years. Farrell and Wachholz (2003) edited a UNESCO publication entitled, *Meta-Survey on the Use of Technologies in Education in Asia and the Pacific 2003-2004*. This report detailed how the number of ICT in education projects has increased throughout the less developed world. Among many others, projects described by these authors included:

- Mexico's Telesecundaria uses television, print, and the Internet to support classroom learning.
- Radio Sagarmatha in Nepal where a host reads the content of web pages over the radio.

- Schoolnets are groups of schools that use ICTs to support education and are present in countries such as Africa, India, Cambodia, the Philippines, and Thailand.
- World Links for Development started as a World Bank project and is now an independent non-profit entity that aims to work with Ministries of Education to develop national schoolnets with a focus on teacher development.
- The Association of Southeast Asian Nations (ASEAN) SchoolNet is a UNESCO project aimed to strengthen ICT use in schools throughout the ASEAN region.
- Numerous open and distance education projects such as the Namibian College for Open Learning and India's National Open School, aim to alleviate the traditional barriers to higher education.
- The Global Development Learning Network is a worldwide partnership of non-government organizations (NGOs), distance learning centers, and both private and public organizations aimed at "providing cost-effective, fast, and high-impact alternatives to traditional meetings and courses, enabling people around the world to connect with each other without having to travel" (p. 21).
- The Learning Center Program in Vietnam seeks to empower students and teachers by developing locally relevant uses of ICTs.
- A partnership between Coca-Cola Company and the United Nations Development Programme (UNDP) called the E-Learning Initiative which

> supports Malaysia's vision of becoming a knowledge and innovation society.

The sheer number of ICT in education projects deployed in less developed nations as well as the uncertainty of when and how ICTs are adopted by project participants give credence to the need to better understand the ICT innovation adoption process from the participants' point of view. Farrell and Wachholz (2003) stressed the need for more research to answer "questions related to the conditions that need to be met in order to ensure that adoption [of ICTs] adds value to current practice" (p. 27).

Gaining an understanding about how ICT innovations are diffused at the grassroots level will allow policymakers, governments, and funding agencies to construct more effective and efficient responses to social problems such as poverty and inequality (Servon, 2002). Wilson (2004) found it is important to understand and address how ICT innovations are diffused at the local level to avoid repeating mistakes of the past. "Leaders who fail to seize ICT opportunities may produce the same results as leaders who failed to build factories or railroads in the early stages of the industrial revolution" (p. 5). The UNDP (2001) claimed that "today's technological transformations hinge on each country's ability to unleash the creativity of its people, enabling them to master technology, to innovate and to adapt technology to their own needs and opportunities" (p. 79). Therefore, for future prosperity it is important researchers and international policy makers achieve a greater understanding of the challenges involved in adopting ICT innovations in less developed nations.

While focusing on the digital divide, a point of interest for some researchers is incorporating ICTs in the education system of less developed nations. Tiene (2002) stated

"one of the most unfortunate by-products of the digital divide is its negative impact on educational efforts throughout the developing world" (p. 211). Less developed nations that do not use ICTs in their education systems are falling further behind in the digital divide and in their national development due to their inaction or the ineffectiveness of their current actions. Not effectively adopting ICT in the education system of less developed nations has the potential of increasing disparity levels both within and across nations. Tinio (2003) found that key challenges to integrating ICTs in education systems of less developed nations are broadly categorized as policy, infrastructure, capacity building, language and content, cost, and expectations.

Afele (2003) pointed out the necessity to understand the ICT needs at the local level in less developed nations. Afele noted that "further bridging the digital divide may be contingent upon the impact that the introduction of IT [information technology] causes in these communities" (p. 12). Afele claimed that gaining an understanding of the impact of ICT initiatives may help to increase food production, improve health care, improve education, develop skills, and integrate the local economy into the global economy.

Tinio (2003) concluded that most development projects have neglected the issue of sustainability of ICT in education initiatives. To increase sustainability, Tinio called for increased attention to: financing of ICT projects at the school level; obtaining community level buy-in; enabling ICT in education projects that are resistant to political change; and choosing effective long-term technologies. Accenture, the Markle Foundation, and the UNDP (2001) published a report on the Digital Opportunity Initiative. This initiative aims to identify the roles ICTs have in sustainable economic development. This report noted that ICT for development projects should:

- be driven by the demands of the users;
- be developed with sustainability, scalability, or the ability to spread in mind;
- be sensitive to local needs, conditions, and limitations; and
- connect the stakeholders' interests with the goals of the ICT project.

Some researchers have claimed that the costs are too prohibitive to fund ICT innovations in less developed nations. Some researchers have concluded that funding ICT projects is an irrational tool for development. Dixit (2004) insisted that ICTs should be secondary to improving nutrition, textbooks, and erecting school buildings. Ngwainmbi (1999) argued that NGOs are inconsistent in funding development projects. This inconsistency harms the communities' ICT capacity building efforts. In response to such criticisms, Cawthera (2002) conducted a case study in Zimbabwe and South Africa to determine the actual costs of ICT in education in these two less developed nations. Cawthera found the annual cost of the ICT per student user varied between US$10-US$644 with US$20-US$30 being the norm; the cost per computer over five years varied between US$1000-$10,000; and the actual regular users as a percentage of total possible users varied between 3%-111% with 20%-30% being the norm (p. 6). Cawthera suggested "the best way to reduce unit costs and increase provision is to extend usage" (p. 6). Cawthera claimed that high usage can be achieved in rural areas if projects are "carefully monitored and evaluated" to respond to issues of robustness as well as sustainability (p. 37). Cawthera's findings point to the need for more research focused on how ICT innovations are diffused in an effort to increase use, sustainability, scalability, or spread.

As a program of the World Bank, *Info*Dev (2005) published a report detailing what is known and what is not known about ICT in education of less developed nations. The report focused on impact, evaluation, equity, costs, current projects, ICT tools, teachers, curriculum, policy issues, and school-level issues. *Info*Dev found that "very little is known about just how (and how often) ICTs are used" in less developed nations (p. 30). Additionally, *Info*Dev found more research needs to be conducted in an effort to address questions involving ICT access, use, and impact.

The aim of the current study is to add to the limited body of knowledge that centers on less developed nations and the factors affecting the diffusion of ICTs by focusing on participants of an ICT in education project. Cambodia is an ideal case in point because it is a devastatingly poor nation that recently implemented an ICT in education policy (MoEYS, 2004a). The present study is an analytical case study that explores the innovation diffusion experiences of teacher trainers who participated in an ICT development project in the nation of Cambodia. The UNESCO (2006b) sponsored *Establishing the Effective Use of ICTs in Education for All in Cambodia* project is an ideal focus because it attempted to prepare teacher trainers at the local level in the effective use of ICT in education in addition to providing ICT access to teacher trainers and teacher trainees in both formal and non-formal settings. Appendix A gives an in-depth description of this project. The following section discusses how the ICT adoption process is conceptualized and contextualized to the current research.

Conceptual Framework

The *Establishing Effective Use of ICT in Education for All in Cambodia* project "is based on the premise that the innovation and appropriate use of ICT can help reach

those excluded from learning and improve the quality of learning and quality of life for all" (UNESCO, 2006a, p. 1). The goals of this project were to:

- provide ICT training to teacher trainers and lecturers in all teacher training colleges (TTCs) and the Royal University of Phnom Penh, curriculum specialists, and book editors;
- provide ICT access to 1,000 primary and secondary school teachers;
- provide ICT access to a minimum of 5,000 children and youth in both formal and non-formal programs; and
- establish the National ICT-based Clearing House.

The present study analyzed the factors involved in the teacher trainers' choice to adopt the skills gained through the ICT training. The innovation researched in the current study was the skills and knowledge the teacher trainers obtained through participating in this UNESCO project. These skills include how to use hardware such as computers, printers, scanners, digital cameras, and digital recorders as well as software such as Word, Excel, PowerPoint, the Internet, and Internet-based email. Although the physical ICTs, which include the computers, peripherals and infrastructure, are required to use the skills, these ICTs are not the innovation. Physical ICTs in the current study were viewed as tools in which to use the innovation. The conceptual framework was based on Rogers' model of the diffusion of innovations theory.

Rogers' model of the diffusion of innovations is based on the work of Ryan and Gross (1943) who studied farmers' adoption of hybrid seed technology in two Iowan communities. Since this study, the DOI theory and Rogers' model of this theory have spread across many disciplines. Meyer (2004) estimated that since the Ryan and Gross

study, thousands of innovation diffusion studies have been conducted in the fields of sociology, education, communication, marketing, and public health.

Rogers (2003) defined diffusion to be the "process by which (1) *innovation* (2) is *communicated* through certain *channels* (3) *over time* (4) among the members of a *social system* [author's emphasis]" (p. 11). Rogers (2003) defined an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 12). Rogers defined adoption as "a decision to make full use of an innovation as the best course of action available" (p. 473). Juxtaposing these concepts, the Rogers' model seeks to explain the processes in which ideas, practices, or objects are communicated and thereby adopted by members of a particular society. The research problem explored through the current study is: *In the context of a less developed nation, to what extent does a person's perceptions about the ICT innovation account for the person's willingness to adopt the ICT innovation?*

Rogers (2003) wrote that scholars who have focused their research on the diffusion of innovations have traditionally attempted to answer how early adopters differ from later adopters. Rogers further stated there are five attributes that impact a person's choice to adopt an innovation: relative advantage, compatibility, complexity, trialability, and observability. Rogers calls these five attributes, *perceived attributes of innovations*. Other authors have expanded attributes and called them *perceived characteristics of innovations* (PCIs) (see esp. Chiasson & Lovato, 2001; Moore & Benbasat, 1991; Tornatzky & Klein, 1982; Zhu & He, 2002). Moore and Benbasat (1991) expanded Rogers' (2003) five factors into eight PCIs which include: relative advantage, image, compatibility, ease of use, visibility, results demonstratability, trialability, and

voluntariness of use. These innovation attributes are perceptual, not objective realities. This subjective perception was central to the current study since the focus was on the views of the participants in regard to their process of the adoption of the innovation. The eight PCIs are detailed in Table 1.

Table 1

Description of the Perceived Characteristics of Innovations

PCI	Description
Relative Advantage	• Degree to which an innovation is perceived as a better idea • Measured by economics, social factors, convenience, and satisfaction
Image	• Degree to which using the innovation enhances how one appears to one's peers
Compatibility	• Degree of perceived consistency with "existing values, past experiences, and needs of potential adopters" (Rogers, 2003, p. 15)
Ease of Use	• Perceived degree of difficulty with using the innovation
Visibility	• Degree to which the innovation is visible
Results Demonstratability	• Degree to which one can see results of using the innovation
Trialability	• Degree with which the innovation can be experimented or practiced
Voluntariness	• Degree to which using the innovation is voluntary

Note. Based on Rogers, E.M. (2003) *Diffusion of Innovations* (5th ed). New York, NY: Free Press and Moore, G.C. & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research,* 2(3), 192-220.

The PCI of *relative advantage* describes "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p. 229). This advantage might be economic, cultural, or social. It is important to note that advantage is relative and thus it is advantageous in the eyes of the person confronted with the

innovation. Rogers noted that diffusion scholars have found relative advantage to be the strongest predictor of the adoption of an innovation.

Moore and Benbasat (1991) claimed *image*, or "the degree to which use of an innovation is perceived to enhance one's status in one's social system" is a unique aspect of innovation (p. 195). Rogers (2003) claimed image is a component of relative advantage. Moore and Benbasat however found image to be a unique characteristic.

The incompatibility of an innovation with socio-cultural values, previously introduced ideas and innovations, or a person's need for the innovation can hinder the adoption process. Rogers (2003) noted "the rate of adoption of a new idea is affected by the old idea that it supersedes" (p. 245). The degree to which an innovation meets the felt need of stakeholders is measured through the indicator of *compatibility*. Rogers claimed the innovation attribute of compatibility is less important in the decision to adopt an innovation in contrast to relative advantage.

Rogers (2003) claimed "complexity is the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 287). Rogers lists this element as being the third most important attribute in determining innovation adoption. Complexity can nonetheless be a main barrier of innovation adoption. Moore and Benbasat (1991) called this characteristic *ease of use*.

The degree to which an innovation is observable impacts its rate of adoption. In discussing computer technology, Rogers (2003) claimed that hardware is easier to adopt than software due to its nature of being physically observable. Innovations that are observable and easily communicated to others are more likely to be adopted. Moore and Benbasat (1991) divided Roger's concept of observability into two unique aspects:

visibility and *results demonstratability*. Visibility is the degree to which a person can see the innovation and results demonstratability is the degree to which a person can see results of using the innovation.

Rogers (2003) noted "if an innovation can be designed so as to be tried more easily, it will have a more rapid rate of adoption" (, p. 258). Rogers described how this characteristic gives individuals the opportunity to make meaning of the innovation in a safe environment. Moore and Benbasat (1991) defined this characteristic as *trialability*.

Moore and Benbasat (1991) added a new aspect to Rogers (2003) five attributes called *voluntariness* of use. Voluntariness is defined as "the degree to which use of the innovation is perceived as being voluntary, or of free will" (p. 195). Moore and Benbasat claimed that researchers must consider this element in a person's decision to adopt or to reject the innovation.

Rogers (2003) claimed that if an innovation is seen as having relative advantage, if it is compatible with existing norms, beliefs, and past experiences, if it has a relatively low level of complexity, if it can be experimented with, and use of the innovation has observable results, the rate of adoption will be increased. Moore and Benbasat (1991) further claimed that the rate of adoption also increases if use of the innovation is perceived as being mandatory, is tangibly visible, and if use of the innovation increases the user's stature and reputation. In the present study, the eight PCIs were measured and analyzed to better understand teacher trainers' decision-making process in the choice to adopt the ICT skills provided via the UNESCO project.

This study used five adoption decision categories. The categories are based on Rogers' (2003) model. In deciding what to do with an ICT innovation, participants may choose to:

1. adopt the innovation early;
2. adopt the innovation later;
3. reinvent the innovation, which is "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" (p. 180);
4. experience discontinuance or make the "decision to reject an innovation after having previously adopted" (p. 178); or
5. reject the innovation which is to make "a decision not to adopt an innovation" (p. 476).

Research Questions

The current study was designed to gather data to answer the following research questions:

1. Within the context of the UNESCO *Establishing the Effective Use of ICTs in Education for All in Cambodia* project, what was the degree of adoption of this ICT innovation by teacher trainers?
2. To what extent did the factors of relative advantage, compatibility, image, ease of use, visibility, results demonstratability, trialability, and voluntariness differentiate among teacher trainers who adopted early, adopted late, reinvented, discontinued use, or rejected the innovation?
3. What were the barriers to adopting this ICT innovation?

Country Context

Cambodia is located in Southeast Asia and borders Thailand, Laos, and Vietnam and has a small coastline along the Gulf of Thailand. The people of Cambodia are called the Khmer. The Khmer are among the first inhabitants in Southeast Asia and built a powerful empire that survived until the 15th century.

Cambodia is a nation that is struggling to rebuild after the atrocities of the Khmer Rouge. The Khmer Rouge, under the control of Pol Pot, was a totalitarian party that ruled the country from 1975-1979. This regime closed schools, factories, banks, and hospitals and outlawed religion in an attempt to build a utopian agrarian nation. Under this regime, an estimated 1.5 million people died through forced labor or were executed or starved. Khmers associated with the government, education, religion, wealth, or businesses were in essence exterminated. Today, the nation of Cambodia and its people are still going through the process of rebuilding.

Cambodia's technological infrastructure continues to be very low. Cambodia first appeared in the *Global Information Technology Report* in 2006-2007 and was ranked 104th out of 115 nations (Dutta, Lopez-Claros, & Mia, 2006). Other ASEAN nations' rankings included: Singapore, 2; Malaysia, 26, Thailand, 36; Indonesia, 68; the Philippines, 70; and Vietnam, 75. This report is based on the Networked Readiness Index (NRI). The NRI "signals broad trends, flags opportunities and deficits, and makes a unique contribution to the understanding of how nations are performing relative to one another with regard to their participation in the Networked World" (Kirkman, Osorio, & Sachs, 2002, p. 12). Cambodia's tumultuous past and low technological infrastructure continue to be huge hurdles to both social and economic development.

Limitations

The scope of the current study involves only teacher trainers who participated in the UNESCO *Establishing the Effective Use of ICTs in Education for All in Cambodia* project. Therefore a few limitations exist.

- The sampling was such that teacher trainers were chosen because they participated in this single project. No efforts were made by UNESCO to ensure randomness or equality of participants' past-ICT innovation exposure or to measure the degree to which they were positive about ICT innovations. UNESCO attempted to train all teacher trainers regardless of their prior knowledge.
- This study is limited in regard to generalizations since it is a study of one UNESCO project in one less developed nation. Lessons learned may be applicable to other less developed nations, but more research would need to be conducted to determine their usefulness. Research would need to be conducted on a broader scale to gain a better understanding of other efforts aimed to address Cambodia's digital divide.
- This study is limited to only the perceptions of individuals. The factors measured are perceptual and not subjective. Different individuals may define the measured constructs uniquely.
- The study is limited to only teacher trainers. The needs and perceptions of teacher trainees, secondary school teachers, administrators, and primary school teachers were not taken into account in this study. Additionally, the perceptions of the general public or the government were not measured.

Delimitations

Being cross-sectional, this research is limited in regard to measuring change. To effectively measure change, pre-innovation, during innovation, and post-innovation longitudinal data would need to be collected. Likewise, further research would need to be conducted to gain a better conceptualization of how this ICT innovation was or was not sustained past the single point in time as measured in the current research.

Bias is an additional delimitation. In conducting diffusion research it would be easy for the researcher to enter into the research with a pro-innovation bias. However, Rogers (2003) found "taking into account the people's perceptions of an innovation, rather than the technologists', is essential in overcoming the pro-innovation bias" (p. 109). The researcher aimed to overcome this pro-innovation bias by analyzing the data comparatively between multiple sites and between multiple project participants who experienced various levels of diffusion and non-diffusion of the ICT innovation. Additionally, by spending three months as an intern on this UNESCO project, the researcher was able to understand and internalize the perceptions of the teacher trainers.

Rogers (2003) claimed that to overcome this bias, researchers should not only investigate successful innovations, but also unsuccessful innovations. Rogers (2003) stated that "an innovation may be perceived somewhat differently by each adopter and modified to suit the individual's particular situation" (p. 115). This current study aimed to gain numerous participants' input about what occurred and why, thus giving credence to the individuals' perceptions.

This study was further limited by the fact that the researcher is not a native Khmer speaker. Through translations and member checking, many obstacles were overcome.

The method section below details how translators were used to maximize effectiveness and minimize distortions.