Providing ICT Skills to Teacher Trainers in Cambodia: Summary of Project Outputs and Achievements

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This study presents data on the outputs of an international development project called Establishing the Effective Use of ICTs in Education for All in Cambodia. A main component of this project was to teach all teacher trainers how to use basic ICTs. This article presents the achievements of the project juxtaposed with a study of the factors that either inhibited or motivated the teacher trainers' choice to adopt use of these ICT skills. This project was implemented by both UNESCO and the Cambodian Ministry of Education. Analyses were conducted on 379 surveys, 17 interviews, UNESCO project documents, and Cambodian Ministry of Education documents.

Key words: *ICT, teacher training, Cambodia, case study*

I. Introduction

Less developed nations not able to address their standing in the global digital divide may face political instability (Afele; 2003; Wilson, 2004), increased poverty (Servon, 2002; Wong, 2001), increased marginalization (Servon, 2002; Tiene, 2002), and decreased democratic participation (Cullen, 2001; Lau, Aboulhoson, Lin, & Atkin, 2008). As less developed nations attempt to close their digital divide and shift to participate in the knowledge and innovation economy, international development project managers and international development policy makers would be served by gaining an understanding of both the motivators and inhibitors to adopting the use of information and communication technologies (ICTs). To better facilitate sustainability, scalability, and spread of technological innovations in less developed nations, there is a need to better understand why stakeholders choose to adopt or not adopt these innovations. The present study presents data on the outputs of an ICT in education project as well as the perceptions of the end users about factors that either motivated or inhibited their continued use of ICT skills.

II. Review of the Literature

The global digital divide separates individuals, communities, states, and nations with regard to information access, knowledge sharing, and general use of digital technologies to connect and make meaning of information (Fink & Kenny, 2003; Hachigian & Wu, 2003; James, 1999, 2007; Lau et al., 2008; Mossberger, Tolbert, & Stansbury, 2003; Rodriguez & Wilson, 2000; Servon, 2002; Tiene, 2002; Tinio, 2003; Wilson, 2004; Wong, 2001; Xiaoming & Kay, 2004). The digital divide is important to understand globally at the macro level, but it is arguably more useful to understand the digital divide at the grassroots level. This is because the digital divide is not simply about access to the internet, but involves access to information and the ability of the end users to apply that information to create new knowledge. 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 to create knowledge,

share lessons learned, and innovate at the local level can give marginalized societies opportunities to become empowered and to 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 even terrorism.

Gaining an understanding about how ICT innovations are diffused at the grassroots level will allow policymakers, governments, and funding agencies in less developed countries to construct more effective and efficient responses to social problems such as poverty, inequality, and empowerment where ICTs can play a pivotal role (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 United Nations Development Programme (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 that researchers, program managers, and international policy makers achieve a greater understanding of what motivates and what inhibits end users' choice to adopt ICT innovations in less developed nations.

III. Project Summary

The *Establishing Effective Use of ICT in Education for All in Cambodia* project was "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 project was a joint venture between the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Cambodian Ministry of Education, Youth and Sport (MoEYS), and the Japanese government through the Japanese Funds-in-Trust. 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
- create a national ICT-based resource repository.

A. Project Outputs

Through the *Establishing the Effective Use of ICT in Education for All in Cambodi*a project, UNESCO and the MoEYS conducted various levels of training that reached a variety of stakeholders. The project was scaled up by building awareness, developing master teacher trainers, and increasing institutional capacity at the teacher trainer level while at the same time improving the carrying capacity of the infrastructure. Table 1 contrasts the original project objectives with the achieved results.

Through this project teacher trainers were taught 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. The training was primarily focused on the functionality of software and hardware. The training nonetheless included components of how these ICTs could be used in the field of education. Training included creating electronic lesson plans, electronic grade books, and educational PowerPoint presentations as well as locating digital resources to use in the

classroom. What follows is an analysis of the factors that either motivated or inhibited teacher trainers' choice to continue use of the ICT skills gained through the training. The continued use of the ICT skills is referred to as adoption of the ICT skills.

Table 1: UNESCO Project Objectives Compared to Achieved Results

Project Objective	Results Produced
Formulate a national policy and strategy on the effective use of ICT in education.	The MoEYS (2004) adopted and published *Policy and Strategy on Information and Communication Technology in Education in Cambodia.*
Establish the ICT in education network among all TTCs in the country.	Trained one master teacher trainers from each TTC as well as educational professionals within the MoEYS.
Improve ICT capacity for 600 teacher trainers, 50 curriculum specialists and curriculum developers, and 2,000 primary and secondary school teachers.	• Trained 526 teacher trainers. • Trained 28 teachers of English. • Trained teachers in 24 pilot secondary schools. • Facilitated the donation of 838 secondhand laptops and desktops. • Purchased 33 new desktop servers for the TTCs. • Published and printed 1,000 copies of *Guidebook on ICT in Teaching and Learning* for teacher trainees (UNESCO, 2006c). Distributed these to 26 TTCs and 24 pilot secondary schools. • Distributed 637 educational DVDs, VCDs, software programs, and CD-ROMs to 51 educational institutions in the country.
Establish the national clearinghouse and promote the production of local education content online.	• Created the virtual library that hosts more than 1,000 web pages. • Trained 25 teacher trainers on how to create their own institution's web page. • Trained 13 teacher trainers on computer maintenance and repair.
Provide access to ICT in education to thousands of deprived children and youth.	• Gave access to 5,030 deprived children via a mobile learning van. The van was equipped with 22 secondhand laptops, one new desktop, internet connectivity, four digital cameras, one television, one digital sound recorder, one generator, and a wide range of educational resources. • This mobile learning van was donated to the MoEYS in January 2006.

Source: UNESCO (2006b)

B. Conceptual Framework

Analysis of the teacher trainers' choice to adopt use of the ICT skills was based on the diffusion of innovations model developed by Rogers (2003). The adoption categories are based on this model. Rogers noted "instead of simply accepting or rejecting an innovation, potential adopters are on many occasions active participants in the adoption and diffusion process, struggling to give meaning to the new idea as the innovation is applied to their local context" (p. 187). Based on Rogers' model, the adoption categories include: early adopters, late adopters, teacher trainers who reinvented the innovation, teacher trainers who experienced discontinuance, and teacher trainers who rejected the innovation.

Motivating factors were based by Rogers' (2003) model of the diffusion of innovation as measured using a survey developed by Moore and Benbasat (1991). Table 2 describes the motivational factors measured in the survey.

Table 2: Description of Motivational Factors Measured

Motivational Factor	Description
Relative Advantage	Degree to which an innovation is perceived to be better than what is currently used
Image	Degree to which using the innovation increases one 's reputation
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 to which the innovation can be 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.

IV. Methods

A. Document Analysis

The researcher served as an intern at UNESCO in the Phnom Penh, Cambodia office on the *Effective Use of ICTs in Education for All in Cambodia* project. Through this internship the researcher had the opportunity to analyze project documents, formal reports, informal evaluations, and anecdotal evidence provided by project staff.

B. Survey

The survey used in the current study was a slightly altered version of a four-point scale, 25-item instrument developed by Moore and Benbasat (1991). This survey measures perceptions of users about adopting a given ICT innovation. Moore and Benbasat noted that although the questions for the instrument were tested for reliability and validity and were developed with respect to a particular ICT innovation (i.e., personal work stations) for a particular audience (i.e., U.S. university professionals)

it was nonetheless "believed that they could be easily reworded by substituting the names of different... innovations" (p. 211). The current study substituted the phrase 'ICT skills' for 'personal work stations.' This survey was selected for two reasons. First it was an instrument that has proven to be reliable and valid and applicable across fields. Second this instrument was developed to measure the characteristics of innovation adoption as described by Rogers (2003) and thus fits well into the conceptual framework of the current study.

Using Rogers (2003) framework, an ICT skill adoption category was determined for each teacher trainer based on responses from a set of five behavioral questions. Two additional open-ended questions were added to the survey. These questions were 'Please describe in detail an experience when you felt you used the ICT skills successfully' and 'Please describe in detail an experience when you have not been successful using the ICT skills.' The open-ended questions were used to better understand these adoption categories.

The original survey was translated into Khmer by a UNESCO staff member who served as the Khmer translator for the ICT in education project as well as on other development projects within the country. A second Khmer UNESCO coworker edited the translated survey. The first and second translators collaborated to create a third version of the translated survey. A third translator read the edited survey and made final grammar and spelling corrections without changing the meaning. The fourth translated survey was back translated into English by the original Khmer translator. The Khmer translator for the ICT in education project translated and helped code all returned surveys.

At the close of the project, the survey was disseminated to every teacher trainer in the country who participated in the ICT training (N=526). The return rate was 72% where 379 teacher trainers returned surveys. No incentives were given in the current study. It is however believed that the high return rate was achieved due to the request by the MoEYS representatives to complete and return the surveys.

C. Interviews

The researcher interviewed 17 teacher trainers at their respective TTCs. Questions asked dealt with further describing the motivators and inhibitors to adopting use of the ICT skills. The interviews were conducted with the assistance of a MoEYS representative as well as a hired Khmer translator. These teacher trainers were selected through convenience sampling.

D. Validity and Reliability

Reliability and validity were maximized by triangulating data from various sources: a quantitative survey; open-ended questions attached to the survey; interviews; document analyses; and onsite experiences. Content validity of the survey was addressed by the survey's original developers who noted "the method of developing the scales provides a high degree of confidence in their content and construct validity" (Moore & Benbasat, 1991, p. 210). Using three translators and multiple survey iterations as described above addressed the face validity of the translated survey. Inter-rater reliability was addressed by using the first Khmer translator to confirm and refine coding through an iterative process.

V. Results

It is important to note that Cambodia has 26 TTCs. Six Regional Teacher Training Centers (RTTCs) that trains lower secondary teachers; one National Institute of Education that trains upper secondary

school teachers; 18 Provincial Teacher Training Colleges (PTTCs) that trains primary school teachers; and one National Pre-School Teacher College that trains pre-school teachers. Through the *Establishing Effective Use of ICT in Education for All in Cambodia* project, ICT training was provided to nine groups of educators. What follows is a brief description of each of these groups and their respective training.

Group 1: ICT training was extended to 100 TTC representatives. One group of 50 people included 14 teaching and non-teaching staff from five TTCs and 36 people from departments within the MoEYS. The second group of 50 included representatives from various TTCs including directors, deputy directors, and teacher trainers from Takeo RTTC and Takeo PTTC in addition to local school heads in the Takeo area. Both groups attended a four-day training workshop on teaching and learning methodologies in primary schools and a one-day workshop on ICT awareness. The training workshops were intended to create an understanding of ICTs and interactive learning.

Group 2: Trained were 28 master teacher trainers who attended 96 hours of training on how to use Word, Excel, PowerPoint, the internet, and internet-based email. The training was based on training modules produced by UNESCO (2003). One master teacher trainer was chosen from each of the TTCs based on three criteria being that they had to: (1) be a teacher trainer; (2) have a good command of the English language; and (3) have a commitment to teaching and learning. The 28 master teacher trainers represented all of the TTCs in Cambodia. Thus, 18 teacher trainers were from the 18 PTTCs, six teacher trainers were from the six RTTCs, one teacher trainer was from the National Pre-School Training College, and one teacher trainer was from the National Institute of Education. The final two master teacher trainers were representatives from within the MoEYS.

Of these 28 master teacher trainers, 18 remained at their respective TTC to instruct and guide pre-service teachers and support teacher trainers in ICT-based pedagogy. The ten best master teacher trainers traveled throughout Cambodia and through a cascade training model became trainers of other teacher trainers in addition to trainers of the pilot upper secondary school teachers and the pilot lower secondary school teachers.

Group 3: Through a 5-day hands-on course, 28 teacher trainers were trained on basic website design. This group included: one teacher trainer from each of the 18 PTTCs; one teacher trainer from the six RTTCs; one teacher trainer from the National Institute of Education; one teacher trainer from the Pedagogical Research Department; and two teacher trainers from the MoEYS. Two of these teacher trainers were master teacher trainers. The other teacher trainers were chosen by the directors of the TTCs.

Groups 4 & 5: The ICT training was extended to 55 administrative staff members in various TTCs. Excluding the two MoEYS master trainers, 526 teacher trainers were trained on ICTs through this project. Teacher trainers at the National Institute of Education were excluded from this ICT training because this institution had an effective ICT curriculum in place and therefore the teacher trainers were not in need of additional ICT training. The ICT training was also extended to 13 secondary school teachers. Teachers at these secondary schools received the same 96 hours of training as the teacher trainers.

Training provided to the teacher trainers was based on an UNESCO (2003) produced training manual. Based on this training manual, UNESCO (2006c) published a textbook titled *Guidebook on ICT in Teaching and Learning.* UNESCO printed 1000 copies which were disseminated to the TTCs and the pilot secondary schools.

Group 6: Training on how to repair and maintain computers was provided to 13 teacher trainers through 56 hours of training. This group included the ten field master trainers in addition to two teacher trainers from the National Institute of Education and one person from the MoEYS. *Group 7.* A 5-day, hands-on training course on basic website design was provided to 28 teacher trainers. One teacher trainer from each of the 18 PTTCs, one teacher trainer from each of the six RTTCs, one teacher trainer from the National Institute of Education, three teacher trainer from the MoEYS were trained through this course. These 28 teacher trainers were selected by their respective TTC directors. Two of the teacher trainers in this group were master teacher trainers.

Group 8: Trained also were 28 teacher trainers of English. This group included 19 teacher trainers from the six RTTCs and nine teacher trainers of English from the National Institute of Education. This group did not include any master teacher trainers. The goal of this training was to familiarize the teacher trainers of English with the concept of using ICTs in their English language classrooms. The training was provided in partnership with the University Women's Association of Singapore.

Group 9: The final group trained on ICTs included 24 secondary school teachers. The secondary school teachers were trained by the ten field master teacher trainers. This training was conducted in three phases and was based on the 96-hour training manual used by the master teacher trainers as well as teacher trainers. Phase I training involved the integration of ICT skills in teaching and learning and focused on the use of Microsoft Office. Phase II training focused on how to use email and the internet for teaching and learning in addition to developing ICT-based achievement indicators. A Refresher Phase involved training on e-communication skills and e-library skills.

The first set of teachers trained included 12 teachers from 12 rural lower secondary schools. This set received 16 days of Phase I and Phase II training. The second set of teachers consisted of the six upper secondary school teachers mentioned above from six rural schools and six lower secondary school teachers from six rural schools. These 12 teachers attended seven days of Phase 1 training. All 24 teachers attended a 5-day refresher course. The 18 lower secondary school teachers attended an additional two days of training on survey implementation which immediately followed the 5-day Refresher Phase.

VI. Teacher Training Adoption Rates

Determining the adoption category was based on responses to the survey's five behavioral questions. Table 3 details the categorization of all teacher trainers in the study.

- Master trainers were the only teachers who could have adopted use of the ICT skills early. These trainers were the first to be introduced to this new innovation and where the first to be trained on how to use this innovation. These trainers were also the only teacher trainers who reported any prior use of ICT skills. All but six master teacher trainers reported adopting use of all ICT skills.
- Teacher trainers who reported using the ICT skills without change to how they were taught were labeled late adopters of the ICT skills. These teacher trainers were labeled as late adopters because they adopted use of the ICT skills later than the early adopters.
- Teacher trainers who reported that they currently used the ICT skills differently from how they were taught at the training were labeled as reinventors of the ICT skills. Examples of teacher trainers reinventing the skills included using different email services, finding shortcuts to Microsoft tools, using different internet browsers such as Mozilla Firefox versus Internet Explorer, and using the skills to earn university degrees.

- Teacher trainers who reported that they used the skills initially, but no longer used the ICT skills were labeled as had experienced discontinuance.
- Teacher trainers who reported they never used the ICT skills outside of the training were labeled as rejecters of the ICT skills.

In total 360 teacher trainers were placed in the five decision categories. Of the returned surveys, data from 19 were unusable. The survey results indicated that 7 out of 10 teacher trainers adopted use of the ICT skills to some degree.

Table 3: Total Respondents by Each Adoption Category

Adoption Category	Number of Surveys	Percentage of Teacher Trainers
Early	21	5.8%
Late	185	51.4%
Reinvent	46	12.8%
Discontinuance	58	16.1%
Reject	50	13.9%
Total	360	100%

VII. Motivators to Adopting the ICT Skills

Table 4 reports the means and standard deviations of each motivating factor compared across adopter groups. It was determined that the eight tested motivating factors did impact adoption. That is, teacher trainers were motivated to use the ICT skills if use of the skills were perceived to:

- be mandatory;
- offer advantages over previously used methods (e.g., grades were easier to compute in Excel versus by hand, lesson plans could be saved and used again in the future, lessons could include engaging digital resources; teachers could find applicable lesson plans and resources on the internet);
- increase one's image and reputation with one's peers (e.g., earn advanced degrees, earn money helping others with technology skills, viewed as being a better instructor by students);
- be compatible with how the individual liked to work (e.g., recording and submitting electronic grade reports, storing and submitting lesson plans);
- be easy to understand and use;
- produce results and outputs (e.g., lesson plans, Excel grade books, create engaging PowerPoint presentations, locate teaching resources on the internet);
- be observable by seeing others using the ICT skills (e.g., seeing peers using the ICTs); and
- be coupled with ongoing opportunities to practice using the skills (e.g., guided practice).

In general, early adopters reported the most agreement with these factors followed by late adopters and reinvent adopters. Teacher trainers who discontinued using the ICT skills or who totally rejected use of the ICT skills tended to report the least agreement with these factors. Richardson (2009a) provides a more elaborate discussion about this set of findings.

Table 4: Means and Standard Deviation of Adoption Categories Compared by Each Motivating Factor

Adoption Category	N	Mean / SD	Voluntariness	Relative Advantage	Image	Compatibility	Ease of Use	Results Demonstratability	Visibility	Trialability
Early	21	Mean	1.48	3.69	3.05	3.24	3.30	3.36	2.79	3.10
		SD	.49	.38	.53	.50	.57	.47	.49	.52
Late	181	Mean	1.73	3.39	3.13	3.06	2.85	2.85	2.55	2.93
		SD	.55	.44	.57	.55	.59	.61	.45	.44
Reinvent	46	Mean	1.62	3.27	3.21	3.04	2.85	2.95	2.75	3.04
		SD	.68	.52	.61	.62	.67	.62	.60	.77
Discontinuance	55	Mean	2.08	3.24	2.87	2.83	2.56	2.75	2.46	2.75
		SD	.64	.36	.42	.49	.61	.45	.42	.43
Reject	48	Mean	2.03	3.30	3.01	2.96	2.60	2.74	2.40	2.74
		SD	.70	.46	.46	.53	.73	.66	.53	.67

(Richardson, 2009a)

VIII. Inhibitors to Adopting the ICT Skills

Inhibitors to adopting use of the ICT skills were measured through interviews and open ended survey questions. Table 5 details the seven main inhibitors. Across all adoption groups, the lack of an adequate number of computers was the most pervasive inhibitor. Early adopters reported that broken computer and a lack of electricity in the TTCs were powerful inhibitors to adopting use of the ICT skills. Teacher trainers who rejected adoption or discontinued use of the ICT skills often reported that using the skills was too difficult and they were not given adequate guided practice opportunities to master the skills.

Table 5: Inhibitors to Adopting Use of the ICT Skills

Inhibitor	Early	Late	Reinvent	Discontinue	Reject
Repair	36.8%	12.7%	12.5%	14.3%	16.7%
Language barriers	5.3%	8.2%	3.1%	0%	8.3%
Lack of electricity	36.8%	9.0%	0%	5.7%	13.9%
Lack of computers	57.9%	27.6%	21.9%	22.9%	22.2%
Limited internet	10.5%	8.2%	12.5%	2.9%	8.3%
Difficult to use	26.3%	36.6%	40.6%	40.0%	36.1%
Lack of guided practice	21.1%	22.4%	12.5%	37.1%	41.7%

Adapted from Richardson (2009b)

IX. Conclusion

The current study presented an overview of data collected from a completed ICT in education project in Cambodia. It was found that the *Establishing the Effective Use of ICTs in Education for All in Cambodia* achieved more than originally intended and thus exceeded many of its original goals and objectives. By this measure, the project was a great success.

The current study measured perceptions to understand what motivates or inhibits the end user's choice to adopt a given ICT innovation. It was found that three out of ten teacher trainers did not adopt use of these ICT skills. Non-adoption in the current project was attributed to not being able to overcoming challenges such as broken computers, language issues, limited internet access, the complexity of using the skills, and a lack of ongoing support. Teacher trainers in the current study were more motivated to adopt the ICT skills if they thought use of these skills was mandated, increased their reputation, was compatible with the demands of their current job, was compatible with how they liked to get things done, was easy, if they could see tangible results, if they saw others using the skills, and if they were given opportunities to practice using the skills. The data about adoption rates demonstrated the project was equally successful.

The intent of the present study was to report on the achievements of this ICT in education project and to analyze the outputs based on end user adoption rates. Through systematically analyzing and triangulating the data, funders and project implementers are better informed about ICT adoption rates at the grassroots level. By analyzing the project outputs and triangulating the data with end user adoption rates, reporting results of development projects can give voice to an often silenced stakeholder. By robustly measuring success of ICT in education projects, we are better informed of inputs, processes, as well as outputs. Together these data increase the likelihood projects can be sustained, replicated, and scaled up. The data and method presented in the current article will be useful to policy makers, international development educators, and educational researchers as they continue to improve ICT in education initiatives in Cambodia specifically, and in less developed nations generally.

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