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## Conference Paper

Exploring the use of ICTs by measuring the perceived impact of ICTs by users: Analysis of nationally representative data from India, Pakistan, Bangladesh and Cambodia

22nd Biennial Conference of the International Telecommunications Society (ITS): "Beyond the Boundaries: Challenges for Business, Policy and Society", Seoul, Korea, 24th-27th June, 2018

## Provided in Cooperation with:

International Telecommunications Society (ITS)

*Suggested Citation:* Amarasinghe, Tharaka; Zainudeen, Ayesha; Senanayake, Laleema (2018): Exploring the use of ICTs by measuring the perceived impact of ICTs by users: Analysis of nationally representative data from India, Pakistan, Bangladesh and Cambodia, 22nd Biennial Conference of the International Telecommunications Society (ITS): "Beyond the Boundaries: Challenges for Business, Policy and Society", Seoul, Korea, 24th-27th June, 2018, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/190342>

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# Exploring the use of ICTs by measuring the perceived impact of ICTs by users: Analysis of nationally representative data from India, Pakistan, Bangladesh and Cambodia<sup>1</sup>

## Abstract

The research quantitatively identifies the effect of willingness to use ICT by measuring the perceived impact of ICTs by users in India, Pakistan, Bangladesh and Cambodia. The study attempts to model the relationship between the perceived impacts of access to mobile phones and the adoption of ICT services (including mobiles) using two approaches. First, following the approach used by de Silva et al., and others who find a positive relationship between perceived impacts and adoption, we model mobile phone adoption using a binary logistic approach. Finding that this relationship is not evident in the study countries in our research conducted in 2017, we further investigate the relationship by developing an index to assess ICT adoption and explore its relationship with the perceived impacts of mobile access using a multiple regression model. The multiple regression also shows that perceived impacts have only minimal influence on ICT adoption.

Keywords: ICT, adoption, mobile

## 1. Introduction

It is well accepted that access to and use of ICTs is a prerequisite to human development. Without connectivity, people, be it as consumers, workers or entrepreneurs, face barriers to participating in the economic and social networks that permeate modern societies (World Bank, 2016). ICT has been defined as a blend of technology and communication (World Bank, 2010). Be it a radio, television, phone, smartphone, computer or the Internet, the adoption of ICTs at the time of the introduction of technology is influenced by the perceived impact of the ICT by the users, or as Davis term it in the Technology Adoption Model (TAM), the *perceived usefulness* of the technology (1989). Previous studies have found links between mobile phone adoption and economic growth. Mobile phones have improved communication, social inclusion, economic activity and productivity in many sectors.<sup>2</sup> De Silva, Ratnadiwakara and Zainudeen (2009), following the approach taken by Chabossou, Stork, Stork, and Zahonogo (2009), studied the various influences and the interplay of these influences on mobile phone adoption by the poor in a selected set of countries in the emerging Asian region. As ICT contributes to development as a whole, we further study this phenomenon using a 2017 nationally representative dataset in four countries, three of which are also covered by de Silva et al. This research investigates the importance perceived impacts play on individual's adoption of mobile phones and ICTs. We explore the perceived impact of mobiles and ICTs by users and investigate the contribution of perceived impact for the take up of mobiles and ICT for their day-to-day life by studying ICT users and non-users in India, Pakistan, Bangladesh and Cambodia.

## 2. Theoretical background

Adoption literature comes from three schools of thought namely, diffusion, adoption and domestication (Pedersen and Ling, 2002). Based on adoption and domestication school of thought Van Biljon and Kotze (2008) has conceptualized mobile phone usage in technology acceptance model (TAM; Davis, 1989). This model includes perceived usefulness in a multi-dimensional setting looking at factors such as income, socio-cultural factors and gender. TAM includes a number of determining factors that influence mobile phone adoption and use. Specifically, social influence, perceived usefulness and perceived ease of use. The model also consists of mediating factors, such as personal factors, demographic factors and occupation and income. Over time, TAM has been updated and

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<sup>1</sup> This work was carried out with the help of a grant from the International Development Research Centre, Ottawa, Canada and the Department for International Development, UK.

<sup>2</sup> <https://www.gsma.com/publicpolicy/wp-content/uploads/2012/11/gsma-deloitte-impact-mobile-telephony-economic-growth.pdf>

modified, with the inclusion of additional factors and modification of existing ones. De Silva et al. (2009) incorporate the perceived usefulness through the inclusion of three indices based on how respondents view improvements in various aspects of their lives due to mobile access; namely, emergency, social and economic perceived benefit indices. They used a binary logistic (or Logit) model to identify the effect if perceived had any relationship with mobile phone adoption. Logit modeling uses exponential functions to allow for a dependent variable between 0 and 1 explaining the probability of adoption or discriminant analysis which classifies a set of observations into predefined classes are generally used. We follow this approach. Then, to identify the relationship between the ICT usage index developed and perceived usefulness, we use multiple linear regression analysis (MLR), which is adequate for these purposes and has been used in previous studies.<sup>3</sup> Multiple linear regression analysis is used as the “is a statistical tool for the investigation of relationships between variables” (Sykes, 1993, p. 1). It aims to establish the effect of independent variables on a dependent one (Tabachnick & Fidell, 2007)

### 3. Methodology, Data and Descriptive Statistics

The paper has used data gathered by nationally representative ICT access and use surveys with a margin of error +/- 3% at national level conducted in India, Pakistan, Bangladesh and Cambodia during Q3-4 in 2017. This survey covered 100% of age 15-65 population in these countries. It contained modules of household information, demographic information, income and expenditure, social activities, mobile phone use, no mobile use, Internet, non-Internet use, use of social media, non-use of social media, perceived impact of ICTs, e-Government, e-Commerce and online harassment. This survey has sample size of 11,000 individuals in all study countries. This study has used the module on perceived impact of ICTs.

**Table 1: Sample size and composition**

Country	Sample size	Urban	Rural	Margin of error (+/-)
India	5,000	2,160	2,840	3%
Bangladesh	2,000	800	1,200	3%
Pakistan	2,000	800	1,200	3%
Cambodia	2,000	800	1,200	3%

### 4. Statistical Model for Mobile Phone Adoption

#### 4.1 Logistic regression model for mobile adoption

Logit models tie the determining and mediating factors to the latent variable (i.e. mobile adoption) through contributions to the probability of the latent variable taking a value above or below a threshold that would lead to the observable outcome: adoption or not. Therefore, the logit model assigns a probability of adoption of mobile phones based on the various determining and mediating factors postulated in the theoretical model, where the probability of adoption (Y) is given by:

$$Probability(Y) = \frac{1}{1 + \exp(-\alpha - \sum_{i=1}^n \beta_i X_i)}$$

Where Y is mobile adoption and (a dichotomous variable taking the value 1 if the respondent owns a phone and 0 if the respondent does not) and  $X_i$  are the factors that impact such adoption (also referred to as determining and mediating factors or influential factors).  $\beta_i$  values are factor sensitivities of each

<sup>3</sup> <http://www.ccsenet.org/journal/index.php/ass/article/viewFile/10241/8756>

influential factor,  $X_i$ . Influential factors,  $X_i$ , can be quantitative or qualitative variables; dummy variables are used to represent the ‘states’ in case of qualitative variables. Logistic regression was used to model the mobile phone adoption.

#### 4.1 Multiple linear model

The multiple linear model is specified as follows:

$$y_i = \beta_0 + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \dots + \beta_{p-1} x_{i,p-1} + \epsilon_i$$

Multiple linear regression was used to model the usage and adoption of ICT.

### 5.0 Findings

The influential variables,  $X_i$ , used in the study as well as their expected signs are given below in Table 2.

**Table 2: Influential variables for the models**

Variable	Expected sign	Model	Remarks
Gender	-	Both	Male =0, female =1
Age	-	Both	Age of the individual
Ln(Monthly individual income) <sup>4</sup>	+	Both	Natural log of the monthly personal income; lack of income is key barrier to adoption (socioeconomic)
Primary	+	Both	Yes = 1, no=0
Secondary	+	Both	Yes = 1, no=1
Tertiary	+	Both	Yes = 1, no=2
Number of top five contacts having a mobile phone	+	Both	The more people in one's close network with phones, greater will be the social (social-economic-business) pressure to adopt (social influence; social pressure)
Number of top five contacts having an email account	+	MLR	The more people in one's close network with email usage (directly linked to Internet), greater will be the social (social-economic-business) pressure to adopt (social influence; social pressure)
Number of top five contacts have used social media	+	MLR	The more people in one's close network use social, greater will be the social (social-economic-business) pressure to adopt (social influence; social pressure)
Economic Perceived Benefits Index (PBI)	+	Both	The perceived benefits of mobile phone usage Little or no improvement = 0, Somewhat improvement=1 & Quite or greatly improvement =2
Knowledge PBI	+	Both	
Emergency PBI	+	Both	
Social PBI	+	Both	
They cause people to become divided, socially politically, etc.	-	Both	The perceived benefits of mobile phone and ICT usage. Agree =2, Neutral =1 & Disagree = 0

<sup>4</sup> Natural log of monthly income better explains the impact of monthly income on mobile adoption.

People get addicted to using them	-	Both	
Children are exposed to inappropriate content	-	Both	
Private information can be seen by others through the mobile and Internet	-	Both	
Availability of a fixed line telephone at home		Both	Yes = 1, no=2
Availability of electricity		Both	Yes = 1, no=2
Availability of a TV		Both	Yes = 1, no=2
Availability of a radio		Both	Yes = 1, no=2
India			Country dummy for India
Bangladesh			Country dummy for Bangladesh
Cambodia			Country dummy for Cambodia
Pakistan			Country dummy for Pakistan

The influential variables are self-explanatory and the expected signs are logical. Country dummies capture the unique characteristics in each country such as culture, perception, different needs etc. de Silva, Ratnadiwakara and Zainudeen (2009) developed a logit model for mobile adoption for the ‘bottom of the pyramid’ (BOP, the lower income market segment) in Bangladesh, Pakistan, Sri Lanka, Philippines and Thailand using data collected from the BOP in 2008. Emergency, social and economic perceived benefits indices were significant in their model and gave positive coefficients to mobile phone adoption. We ran a similar model to our data set to see whether similar findings were evident in the current context.

The logistic regression model of mobile phone adoption using the same variables as de Silva 2009. The Nagelkerke R Square for this model is .263 which implies a moderate fit of the model.

**Table 3: Logistic regression model on the mobile phone adoption using same variables used in de Silva 2009.**

Variable	Mobile phone adoption		
	Coefficient	Odds ratio	P-value
Gender	-.772	.462	0.000*
Age	.015	1.016	0.000*
Ln(Monthly individual income)	.316	1.371	0.000*
Primary education	.634	1.885	0.000*
Secondary education	.570	1.768	0.000*
Tertiary education	1.439	4.217	0.000*
Number of top five contacts having a mobile phone	.254	1.289	0.000*
Impact on economy			.665
Impact on economy (1) (Somewhat improved)	.109	1.115	.433

Impact on economy (2) (Improved greatly)	-.023	.977	.865
Impact on ability to contact in emergency			.375
Impact on ability to contact in emergency (1) (Somewhat improved)	-.061	.941	.675
Impact on ability to contact in emergency (2) (Improved greatly)	.127	1.136	.387
Impact on social interaction			.226
Impact on social interaction (1) (Somewhat improved)	.161	1.175	.285
Impact on social interaction (2) (Improved greatly)	-.078	.925	.593
Availability of a fixed line telephone at home	1.223	3.398	0.000*
Availability of electricity	.096	1.101	.599
Availability of TV	.386	1.471	0.000*
Availability of a radio	.528	1.696	0.001*
India			0.000*
Bangladesh	.575	1.777	0.000*
Cambodia	1.235	3.438	0.000*
Pakistan	-.780	.459	0.000*
Constant	-1.344	.261	0.000*

Note: \* significant at 95%

Starting with the gender variable in the model, odds of female mobile adoption is 46% less than odds of male mobile adoption. When the age increases the odds of mobile phone adoption increases slightly. When the education level of the individuals increase, the odds of mobile adoption increases. If the individuals education level is tertiary the odds of mobile adoption is 4 times than non-educated person. Income increases the probability of adoption, with the natural log of monthly personal income having an odds ratio of 1.371. Odds of adopting a mobile phone increases by 29% when 1 of the closest contacts owns mobile phones.

As per the model, availability of electricity was not significant in the mobile phone adoption. However, other variables related to household access to ICT devices such as fixed line telephone, television and radio show positive coefficients in the mobile phone adoption model. But unlike de Silva et al (2009) all perceived impact variables were not significant in this model. Possible reasons for this might be the target group of the 2009 study was BOP population but in the 2017 study the target group is all economic segments of the population. Alternatively, as the previous study was conducted almost a decade ago, with time the influence of perceived impacts on mobile phone adoption may have become less significant.

To further analyze the question, we included additional variables related to perceived impacts of ICTs. As the previous study captured economic, emergency and social PBI, we introduced knowledge PBI to the model as a perceived benefit. As there were no negative impacts were captured in the previous study, negative impacts were introduced in our study such as, '[Mobiles] cause people to become divided, socially politically, etc.,' 'people get addicted to using them,' 'children are exposed to inappropriate content' and 'private information can be seen by others through the mobile and Internet.'

**Table 4: Perceived impact of ICT variables and code used for the models**

	Variable	Variable name in the model	Actual response	Recoded response
De Silva, 2009	Your economic/financial status or well being	Impact on economy	No change	1 Little or no improvement
			A little improved	
			Somewhat improved	Somewhat improvement
			Quite improved	3 Quite or greatly improvement
			Improved greatly	
			Improved greatly	
De Silva, 2009	Your ability to act or contact others in an emergency	Impact on ability to contact in emergency	No change	1 Little or no improvement
			A little improved	
			Somewhat improved	Somewhat improvement
			Quite improved	3 Quite or greatly improvement
			Improved greatly	
De Silva, 2009	Your social and familial relations and relationships	Impact on social interaction	No change	1 Little or no improvement
			A little improved	
			Somewhat improved	Somewhat improvement
			Quite improved	3 Quite or greatly improvement
			Improved greatly	
New variable	Your level of knowledge and skills	Impact on knowledge	No change	1 Little or no improvement
			A little improved	
			Somewhat improved	Somewhat improvement
			Quite improved	3 Quite or greatly improvement
			Improved greatly	
New variable	They cause people to become divided, socially politically, etc.	They cause people to become divided, socially politically, etc.	Not at all agree	0 Disagree
			Somewhat disagree	
			Neither disagree/agree	1 Neutral
			Somewhat agree	2 Agree
			Strongly agree	

New variable	People get addicted to using them	People get addicted to using them	Not at all agree	0 Disagree
			Somewhat disagree	
			Neither disagree/agree	1 Neutral
			Somewhat agree	2 Agree
			Strongly agree	
New variable	Children are exposed to inappropriate content	Children are exposed to inappropriate content	Not at all agree	0 Disagree
			Somewhat disagree	
			Neither disagree/agree	1 Neutral
			Somewhat agree	2 Agree
			Strongly agree	
New variable	Private information can be seen by others through the mobile and Internet	Private information can be seen by others through the mobile and Internet	Not at all agree	0 Disagree
			Somewhat disagree	
			Neither disagree/agree	1 Neutral
			Somewhat agree	2 Agree
			Strongly agree	

Adding these five new perceived impact variables did not improved the fit of the model. All the variables related to perceived impacts were not significant in this logistic regression model as well. Nagelkerke R Square for this model is .259. Other coefficients are similar to the previous model.

**Table 5: Logistic regression model with introduced variables**

Variable	Mobile phone adoption		
	Coefficient	Ods ratio	P-value
Gender	-.796	.451	0.000 *
Age	.018	1.018	0.000 *
Ln(Monthly individual income)	.325	1.384	0.000 *
Primary education	.650	1.915	0.000 *
Secondary education	.521	1.684	0.002 *
Tertiary education	1.337	3.809	0.000 *
Number of top five contacts having a mobile phone	.256	1.292	0.000

			*
Impact on economy			.599
Impact on economy (1) (Somewhat improved)	-.002	.998	.989
Impact on economy (2) (Improved greatly)	-.162	.851	.345
Impact on knowledge			.180
Impact on knowledge (1) (Somewhat improved)	.118	1.125	.448
Impact on knowledge (2) (Improved greatly)	.331	1.392	.066
Impact on ability to contact in emergency			.661
Impact on ability to contact in emergency (1) (Somewhat improved)	-.070	.932	.682
Impact on ability to contact in emergency (2) (Improved greatly)	.075	1.078	.667
Impact on social interaction			.131
Impact on social interaction (1) (Somewhat improved)	.330	1.391	.064
Impact on social interaction (2) (Improved greatly)	.063	1.065	.717
They cause people to become divided, socially politically, etc.			.574
They cause people to become divided, socially politically, etc. (1) (Neutral)	.066	1.068	.689
They cause people to become divided, socially politically, etc. (2) (Disagree)	-.108	.898	.480
People get addicted to using them			.313
People get addicted to using them (1) (Neutral)	.257	1.294	.129
People get addicted to using them (2) (Disagree)	.112	1.118	.505
Children are exposed to inappropriate content			.605
Children are exposed to inappropriate content (1) (Neutral)	.134	1.144	.423
Children are exposed to inappropriate content (2) (Disagree)	.134	1.143	.404
Private information can be seen by others through the mobile and Internet			.183
Private information can be seen by others through the mobile and Internet (1) (Neutral)	-.048	.953	.772
Private information can be seen by others through the mobile and Internet (2) (Disagree)	.276	1.318	.107
Availability of a fixed line telephone at home	1.259	3.523	0.001 *
Availability of electricity	.001	1.001	.996
Availability of TV	.441	1.554	0.000 *
Availability of a radio	.493	1.638	0.006 *
India			0.000 *
Bangladesh	.709	2.032	0.000 *
Cambodia	1.242	3.464	0.000 *
Pakistan	-.790	.454	0.000 *
Constant	-1.713	.180	0.000

			*
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As perceived impacts does not influence mobile phone adoption, we then explored whether they influence the ICT usage of individuals. Two new variables, “Number of top five contacts having an email account” and “Number of top five contacts have used social media” were considered as predictor variables for ICT usage. Those will represent the social influence on Internet usage and social media usage.

An index was formed to indicate the level of usage of individuals based on following variables

**Table 6: Variables used to create the ICT usage index**

Variable	Weight
Mobile phone ownership	Owners =1, non owners =0
Feature phone ownership	Owners =1, non owners =0
Smartphone ownership	Owners =2, non owners =0
For how long the individual used the mobile phone	Number of years divided by the average number of year for the respective country
App installation on mobile	App installed by themselves =2, App installed with the help of others =1, No app installed =0
Mobile app usage	App used =1, not used =0
Non mobile phone owners using mobile phone in last 3 months	Used =1, not used =0
Internet usage	Used =1, not used =0
For how long the individual used the Internet	Number of years divided by the average number of year for the respective country
Social media usage	Used =1, not used =0
For how long the individual used the social media	Number of years divided by the average number of year for the respective country
Platform usage	Used =1, not used =0

The summation of above variable was divided by the maximum score of the index of each country to derive the index. The index will range from 0 to 1 where 0 will indicate individuals with no ICT usage and 1 will indicate the heaviest users of ICT for the respective countries based on the variables mentioned above.

**Table 7: Summery statistics of the ICT usage index**

Country	Mean	Standard Deviation
Bangladesh	.18	.17
Cambodia	.26	.25
Pakistan	.16	.20
India	.16	.18

As per the above table the index shows that the distribution of the index variable is somewhat similar in the South Asian countries but it is relatively high in Cambodia with a larger standard deviation. As the developed index is a scale variable which can be used as an indicator for the ICT usage of

individuals multiple linear regression model was used for the analysis. The derived index will serve as the dependent variable in the multiple linear regression model.

Four multiple linear regression models were developed for each study country. The model fit for these four models are shown in the below table.

**Table 8: R squared values of the models.**

	Bangladesh	Cambodia	Pakistan	India
Adjusted R Square	.485	.497	.619	.514

Two models have more than 50% of R squared value while other 2 have R squared values closer to 50% which indicates a good fit.

**Table 9: Multiple linear regression model**

Variable	Bangladesh		Cambodia		Pakistan		India	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	.017	.790	.224	0.011*	.023	.645	.046	.247
Gender	-.025	.201	-.052	0.000*	-.015	.334	-.054	0.000*
Age	-.001	.206	-.003	0.000*	-.001	0.028*	-.001	0.012*
Ln(Monthly individual income)	.023	0.007*	.036	0.000*	.025	0.000*	.019	0.000*
Primary education	.025	.236	.079	0.000*	.055	0.002*	.028	.083
Secondary education	.048	.052	.129	0.000*	.118	0.000*	.070	0.000*
Tertiary education	.100	0.001*	.232	0.000*	.203	0.000*	.157	0.000*
Number of top five contacts having a mobile phone	-.005	.432	-.012	0.002*	.013	0.008*	-.003	.374
Number of top five contacts having an email account	.010	.214	.005	.181	.021	0.04*	.006	.246
Number of top five contacts have used social media	.052	0.000*	.035	0*	.026	0.003*	.046	0.000*
Impact on economy (1) (Somewhat improved)	.023	.252	-.035	0.031*	-.038	.056	-.016	.347
Impact on economy (2) (Improved greatly)	.016	.561	-.033	.124	-.010	.677	-.001	.931
Impact on knowledge (1) (Somewhat improved)	.017	.421	.044	0.005	-.052	0.009	.037	0.023*

				*		*		
Impact on knowledge (2) (Improved greatly)	.052	0.04*	.043	0.025 *	-.007	.755	.038	0.029*
Impact on ability to contact in emergency (1) (Somewhat improved)	-.006	.789	-.013	.446	-.015	.497	-.002	.919
Impact on ability to contact in emergency (2) (Improved greatly)	.021	.423	-.027	.121	-.008	.744	-.009	.639
Impact on social interaction (1) (Somewhat improved)	-.020	.428	-.024	.165	.006	.799	-.013	.501
Impact on social interaction (2) (Improved greatly)	-.016	.534	.007	.702	-.010	.671	.008	.676
They cause people to become divided, socially politically, etc. (1) (Neutral)	.006	.810	.011	.620	-.002	.934	-.024	.143
They cause people to become divided, socially politically, etc. (2) (Disagree)	.015	.542	.021	.128	-.079	0.000 *	.026	.110
People get addicted to using them (1) (Neutral)	.012	.593	.012	.610	-.004	.843	-.013	.427
People get addicted to using them (2) (Disagree)	.008	.745	.013	.361	.004	.877	.005	.776
Children are exposed to inappropriate content (1) (Neutral)	-.032	.159	-.017	.490	-.018	.304	-.007	.657
Children are exposed to inappropriate content (2) (Disagree)	.000	.988	-.020	.120	.011	.665	-.021	.263
Private information can be seen by others through the mobile and Internet (1) (Neutral)	-.004	.869	.012	.548	.031	.106	.017	.282
Private information can be seen by others through the mobile and Internet (2) (Disagree)	-.007	.758	.004	.792	.027	.287	.022	.230
Availability of a fixed line telephone at home	-.165	0.006 *	.031	.644	.124	0.000 *	.011	.641
Availability of electricity	.037	.333	-.100	.215	-.016	.622	.009	.728
Availability of electricity	.028	.134	.036	0.006 *	.022	.240	.020	.155
Availability of a radio	.047	.104	.035	0.009 *	.018	.256	.063	0.002*

Note: \* significant at 95%

The model behaves differently to each country. The coefficients will be explained by variable.

- Gender: Being a female decreases the ICT usage index by 5% in India and Cambodia while for other countries gender variable is not significant index by less than 1% Cambodia, Pakistan and India. Age is not a significant variable in Bangladesh.
- Income: Income is significant in all four countries and it has a positive influence on the ICT usage variable
- Education: Education has the highest coefficient in the model. Only tertiary education is significant in Bangladesh. For India primary education is not a significant variable as per the model. For Cambodia and Pakistan, all 3 levels of education are significant.
- Number of top 5 contacts have used social media: This is a significant variable for all 4 countries which has a positive influence on the ICT usage variable.
- Number of top 5 contacts having a mobile phone and email: In Pakistan these two variables are significant with positive influence on the dependent variable
- Perceived impact of knowledge: This is positively influenced the ICT usage variable in Bangladesh, Cambodia and India

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