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# BUILDING THE DIGITAL BRIDGE: A LONGITUDINAL STUDY OF COMMUNITY LEARNING CENTERS

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## Abstract

*This paper formulates a definition of digital divide in the context of developing countries such as India and develops theoretical models that relate potential antecedents to adoption and use of rural information centers by direct users, mediated users, and nonusers. It develops a survey instrument for the direct-user model and tests it with 60, 11- and 12-year-old students in rural and semirural schools, who have been using the centers for computer-based learning alongside traditional learning for more than a year. Results show that perceived usefulness of the computer-based system, prior information technology experience, and empathy of the human assistant are positively associated with the students' preference of computer-based learning. The follow-up stages of this research consist of a longitudinal study of the three models with larger samples of students and other members of the rural populace. This is planned as a cohort study which will investigate the change in antecedents of intention to use the centers as individuals progress from nonuser to mediated user and then to direct user and the resultant implications.*

**Keywords:** Digital divide, rural information center, technology adoption

## Introduction

The digital divide has become a major concern of policy makers, industry leaders, and academics all over the world. The digital divide can have serious implications for developing countries like India, where nearly 79 percent of the population live and work in rural areas and have little access to personal computers (PCs) and the Internet. The realization that equitable access to information can accelerate the economic, social, and cultural development of the rural populace has created a sense of urgency in developing countries to improve information technology (IT) infrastructure and bridge the digital divide (Persaud 2000). Community Learning Center (CLC) is an example of a digital divide bridging initiative in India's Karnataka state that is jointly funded by the state government and Azim Premji Foundation, the non-profit social wing of software giant Wipro Information Technologies ([www.azimpremjifoundation.org/html/CLC.htm](http://www.azimpremjifoundation.org/html/CLC.htm)). The initiative aims to set up information centers in rural and semi-urban primary schools across the entire state within the next five years (more details on CLCs are provided in the research methodology section).

This paper presents the results of a preliminary study evaluating the CLC bridging initiative. The feasibility and scope of the study were ascertained in June and July, 2002, in a series of meetings with senior officials of the state government and executives of the Foundation in Bangalore, India. Theoretical foundations of the research, research models, and survey instruments were developed from August to November, 2002. Survey data was collected from 60 students in 30 schools, where CLCs have been in operation for more than a year, in December 2002 and January 2003.

## Digital Divide in India

### *Definition of Digital Divide*

Definitions of the digital divide vary across the literature depending on the particular context of interest. However, most definitions are based on the perception that a gap exists between beneficiaries and non-beneficiaries of the Internet and the Information Age. In the global context, the extent of the divide between developed and developing countries in terms of number of PCs and users of the Internet is shown in Table 1.

**Table 1. Global Digital Divide (Source: [http://millenniumindicators.un.org/unsd/mi/mi\\_goals.asp](http://millenniumindicators.un.org/unsd/mi/mi_goals.asp), 2001)**

	Internet Users/100 People	PCs/100 People
Developing countries	5.53	5.71
Transition countries	6.80	8.59
Developed countries	38.04	36.73

From this data, it is clear that PC ownership and access to the Internet are at such low levels in many developing countries that a first step in bridging the digital divide may be providing access to useful information through a PC rather than owning a PC. Therefore, rather than PC ownership, a more appropriate criterion to define the divide within such countries could be based on the equity of information access (Kim and Kim 2001). For instance, in India, a city such as Bangalore may have a home PC penetration of 22 per 100 households (source: [www.idcindia.com](http://www.idcindia.com)) and an Internet café for every 500 households, whereas villages within a 50 km radius of the city may not have any PCs or Internet access. Thus in such contexts, with a large discrepancy between rural and urban populations, we define the digital divide as the lack of access to information that is relevant and useful to the rural populace (Mansell 2002) and can be made available through PCs and the Internet.

### *Bridging the Digital Divide in India*

Bridging the digital divide consists of two aspects that have attracted research and development attention: (1) technology that is affordable and usable by rural people and (2) information content that is relevant and useful to rural people. In India, one effort addressing the technology aspect is the development of the Simputer, a low-cost hand-held computer that aims to bring the Internet to the masses (<http://www.simputer.org>). Priced at below US \$200, Simputer has been designed with text-to-speech capability that will allow Web content to be delivered in local languages. The second aspect is being addressed by initiatives that use existing technologies to provide relevant and useful information to the rural population (Best and Maclay 2002). Some notable examples are the village information centers in Pondicherry in the Tamil language set up by the M. S. Swaminathan Research Foundation (<http://www.mssrf.org>) and the Gyandoot (messenger) e-government project in Dhar District of Madhya Pradesh (<http://www.gyandoot.nic.in>). The focus of our study is to evaluate the CLC initiative, which belongs to this second category of efforts.

### *Research Question*

The success of these initiatives will depend on their adoption and use by the rural population. Past studies evaluating success of rural information centers are mostly qualitative in nature (e.g., Best and Maclay 2002; Kanungo 2001) and investigate the wider contextual factors impacting success (e.g., Roman and Colle 2002). Further, the theoretical and empirical research on individual adoption of information technologies (Agarwal 2000) has been mostly in the organizational context in developed countries, the findings of which may not be applicable to rural people in developing countries. This study aims to evaluate the adoption of rural information centers using the lens of information technology adoption theory. Therefore, the research question for this study is:

What are the attitudinal factors, subjective influence factors, situational factors, and individual factors that affect the adoption and use of rural information centers by individuals in developing countries?

## Theory, Research Model and Hypotheses

### Theory

Conceptualizations of IT acceptance have been based on the theory of planned behavior (TPB) (Ajzen 1991), which is an extension of the theory of reasoned action (TRA) (Fishbein and Ajzen 1975). TRA is based on the proposition that an individual's overt behavior is determined by an individual's *intention* to perform that behavior. This in turn is a function of two factors, one's *attitude* toward performing the behavior and one's *subjective norm*, which reflects perceptions that significant referents desire the individual to perform or not perform the behavior (Moore and Benbasat 1991). TPB extends TRA by adding *perceived behavioral control* (PBC), which reflects perceptions of internal and external constraints on behavior (Ajzen 1991). Taylor and Todd (1995) propose an alternative version of the TPB model with decomposed belief structures. In this model, attitudinal, normative, and control beliefs are decomposed into multidimensional belief structures.

### Research Model

The research model to explain an individual's adoption of rural information centers is shown in Figure 1. The elements of decomposed TPB (Taylor and Todd 1995) that are relevant to adoption of rural information centers by individuals in developing countries were identified based on our literature review and interviews during the feasibility study. The independent variables are grouped into attitudinal influences, subjective (normative) influences, individual influences (internal controls), and situational influences (external controls). The dependent variable is an individual's intention to use the information center.

### Hypotheses

We formulate seven hypotheses as a part of this research model.

The technology acceptance literature (Davis 1989) highlights perceived usefulness and perceived ease of use as important determinants of attitude toward a technology and intention to use it. In the context of our study, we hypothesize

*H1: Perceived usefulness is positively related to an individual's intention to use the information center.*

*H2: Perceived ease of use is positively related to an individual's intention to use the information center.*

Subjective norms have been found to influence intention to use a technology in addition to individual's attitude (Moore and Benbasat 1991). In the context of rural information centers, the significant referents that are likely to influence individual users are family members and authorities. Hence, we hypothesize

*H3: Family influence is positively related to an individual's intention to use the information center.*

*H4: Superiors' (Authorities') influence is positively related to an individual's intention to use the information center.*

Perceived behavioral controls can constrain or facilitate intention to use a technology (Ajzen 1991). In the context of our study, important internal behavioral controls could be users' self-efficacy (Taylor and Todd 1995) and experience with using the technology (Legris et al. 2003). Therefore, we hypothesize

*H5: Experience is positively related to an individual's intention to use the information center.*

*H6: Self-efficacy is positively related to an individual's intention to use the information center.*

External controls in rural information centers are typically in the form of a human mediator to facilitate the use of the technology. We hypothesize

*H7: Human assistance is positively related to the individual's intention to use the information center.*

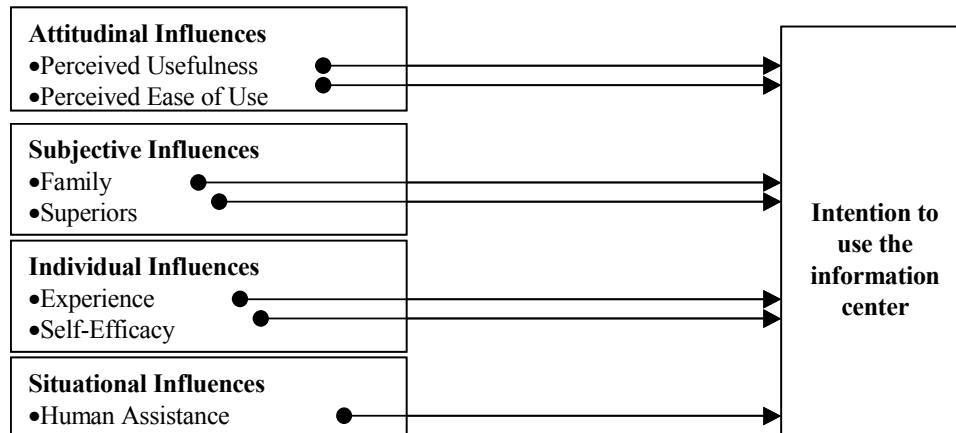


Figure 1. Research Model

## Research Methodology

### *Survey Instrument*

Several constructs in the survey instrument were adopted and operationalized from the literature on technology adoption. In the context of rural information centers, the new scales for human assistance and the dependent variable were self-developed in this study. All constructs' questions were initially anchored on a seven-point scale from strongly disagree (1) to strongly agree (7), but the rural students found it difficult to interpret their answers on this scale. The scale was therefore changed to three-points: disagree (1), neutral (2), and agree (3). The dependent variable "Intention to Use" was measured in terms of a proxy variable "Preferred Method of Learning" as it was felt that students might not be able to express their intention to use directly. A copy of the survey instrument will be provided upon request.

### *Administering the Survey*

The survey was administered to students in 30 schools where CLCs have been in operation for more than one year. Each CLC is equipped with four to eight multimedia PCs, based on the number of students in the school. The PCs are loaded with Windows 98 and Microsoft Office 98, games, and educational software in the local language, Kannada, and English developed by the Foundation. Each CLC is staffed with a Young India Fellow (YIF), who supervises the computer sessions for the students and acts as human assistant for community use after school hours. Students take three to five computer-based classes of 45 minutes each per week. We administered the survey to two students randomly selected from each of the 30 schools to obtain a sample size of 60. All students selected had been using the CLC for at least one year. The students were assured of confidentiality and were informed that the data was being collected as part of a research study to assess the services provided by the CLC.

## Data Analysis and Results

### *Demography*

The sample consists of 28 males and 32 females. A total of 95 percent of students surveyed are from grades six and seven, which places them in the age group of 11 to 12 years. Father's occupation for 43 percent of the students is farmer; for 23 percent, it is skilled labor or factory worker; for the remainder, it is shop owner, unskilled labor, or government worker. Mother's occupation was listed as housewife for 85 percent of the students.

**Table 2. Reliability and Factor Analysis Results**

	<b>Factor 1</b>	<b>Factor 2</b>	<b>Factor 3</b>	<b>Factor 4</b>
<b>PEUS1</b>		0.718		
<b>PEUS2</b>		0.631		
<b>PEUS3</b>		0.758		
<b>PEUS5</b>		0.770		
<b>PEOU1</b>	0.624			
<b>PEOU3</b>	0.708			
<b>PEOU4</b>	0.778			
<b>PEOU5</b>	0.884			
<b>EXPE1</b>				0.929
<b>EXPE2</b>				0.915
<b>SEFF1</b>			0.919	
<b>SEFF2</b>			0.819	
<b>Eigen Value</b>	3.125	2.460	1.571	1.206
<b>Variance</b>	26.043	20.497	13.089	10.053
<b>Cumulative Variance</b>	26.043	46.540	59.629	69.681
<b>Cronbach Alpha</b>	0.787	0.667	0.786	0.878

**Instrument Validation**

Reliability and convergent validity of the multi-item constructs in the survey instrument were tested using the Cronbach’s alpha reliability coefficient (Cronbach 1951). Table 2 indicates that all constructs had acceptable reliability close to or above 0.707 (Nunally 1978). Post reliability testing, all of the items belonging to the four multi-item constructs were subjected to factor analysis using principal component analysis with varimax rotation (see Table 2). All rotated factors have eigen values above 1, passing the factor adequacy test (Johnson and Wichern 1998). Also, all items load higher on their intended constructs than on other constructs with a minimum loading of 0.624 (greater than the acceptable threshold of 0.5 [Hair et al. 1998]). Thus all constructs passed the discriminant validity test.

**Results of Hypotheses Testing**

Regression analysis was performed for the dependent variable on the seven independent variables using stepwise regression. For our model R<sup>2</sup> was 35.8 percent, which is considerably higher than the acceptable value of 10 percent for explanatory power (Falk and Miller 1992). The results of the hypotheses testing are shown in Table 3.

**Table 3. Hypotheses Resting Results**

<b>Hypotheses</b>		<b>Coefficient</b>	<b>T-value</b>	<b>P-value</b>	<b>Result</b>
<b>H1</b>	<b>Perceived Usefulness</b>	<b>0.309</b>	<b>2.741</b>	<b>0.008</b>	<b>Supported</b>
H2	Perceived Ease of Use	-0.074	-0.675	0.502	Not supported
H3	Family Influences	-0.073	-0.656	0.515	Not supported
H4	Superiors Influences	0.029	0.256	0.799	Not supported
<b>H5</b>	<b>Experience</b>	<b>0.323</b>	<b>2.868</b>	<b>0.006</b>	<b>Supported</b>
H6	Self-Efficacy	0.020	0.179	0.859	Not supported
<b>H7</b>	<b>Human Assistance</b>	<b>0.286</b>	<b>2.632</b>	<b>0.011</b>	<b>Supported</b>

Overall, three hypotheses regarding the relationships between perceived usefulness, experience, and human assistance and the dependent preferred method of learning are supported. The hypotheses related to perceived ease of use, family and superiors' influence, and self-efficacy are not supported.

## Discussion and Implications

The findings of the study are summarized in Figure 2.

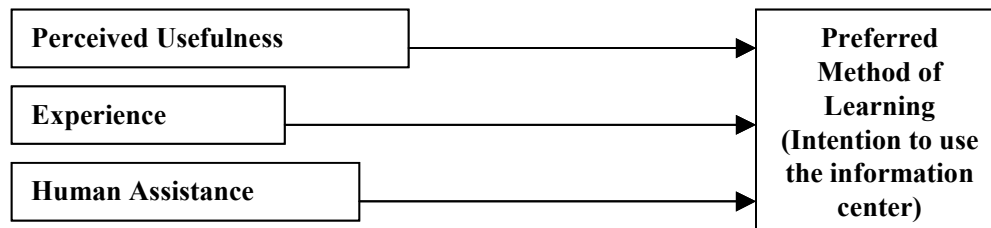


Figure 2. Summary of Research Findings

### *Perceived Usefulness*

Perceived usefulness has been recognized as an important predictor of an individual's adoption of information technologies (Davis 1989). Specifically, students who find computer-based learning relatively more useful than the traditional method of learning are more likely to prefer only this form of learning. Hence, to encourage usage, the Foundation should provide services that are perceived as being useful and must market the center's usefulness to the community. The educational software and games at the CLCs must be made as useful and as close to the existing educational curriculum as possible.

### *Experience*

The results of this study support previous studies (Legris et al. 2003), showing a positive influence of an individual's prior experience with IT on the individual's intention to use the IT. Specifically, this study has concluded that if a student has used computers before elsewhere (not at the CLC), then he or she is more likely to prefer only computer-based learning. Based on this finding, the Foundation should encourage general use of PCs among its users. The school authorities should encourage more use after school hours by students who have little experience with computers.

### *Human Assistance*

As we hypothesized, the empathy shown by the human assistant toward the individual student shapes their intention to use the IT. In our study, if the student is comfortable with the human assistant and receives positive encouragement from him/her, then the student is likely to prefer only computer-based learning. Thus, the Foundation should employ active individuals who can strongly encourage and help the users of the center. The YIF is viewed by the students as their "computer teacher." Therefore, the YIFs can be very influential in guiding the use of the information centers by students.

### *Rival Hypotheses*

The hypotheses regarding the effect of perceived ease of use and self-efficacy on intention to use the information center may not have been supported because the students appear to be fairly comfortable with the applications they use which have been taught to them. The hypothesis regarding the impact of family influences on intention to use CLCs may not have been supported due to the backgrounds of parents, who are mainly farmers and housewives, with little awareness about computer applications being used by the students. The hypothesis regarding the impact of superiors' (school authorities') influence on intention to use the

information centers may not have been supported because the students are more likely to find the encouragement of the human assistant, who is computer literate, more important.

### Future Research

This study has defined the digital divide in the context of rural population in developing countries. By extending technology adoption theory it has formulated three models and tested the direct user model with reference to adoption of rural information centers. The direct-user model tested in this study has identified factors influencing adoption of CLCs by existing users who use the system directly. The other two models we developed (Figures 3 and 4) attempt to explain nonusers’ intention to adopt CLCs and mediated-users’ (who use the CLCs through human mediators) intention to use the information centers. The subsequent stages of this research will consist of a longitudinal study of the three models with larger samples of students and extending to other members of the rural populace. This is planned as a cohort study that will investigate the change in antecedents of intention to use the centers as individuals progress from nonuser to mediated user and then to direct user and the resultant implications.

### Acknowledgements

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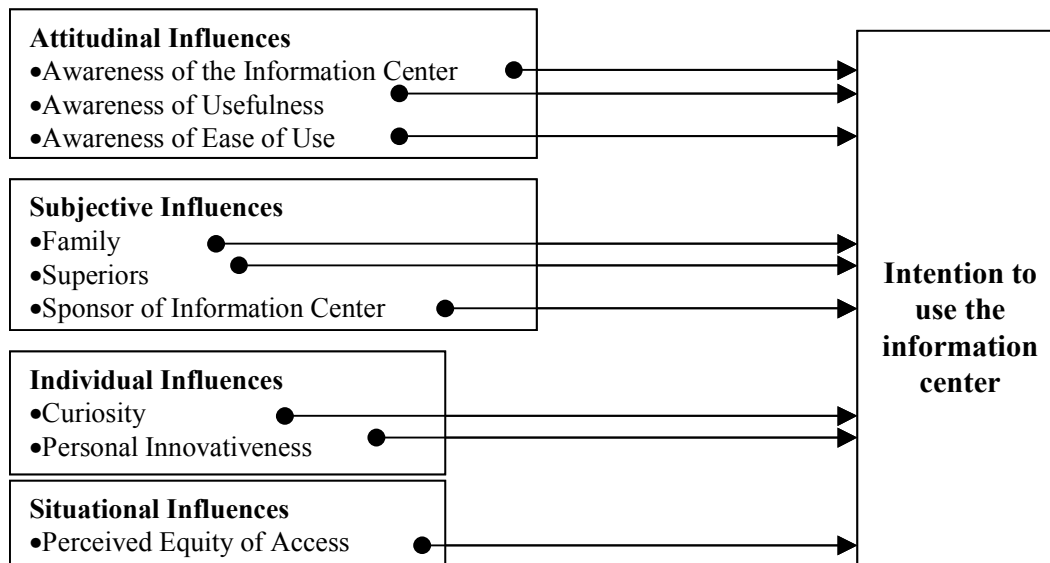


Figure 3. Nonuser Model



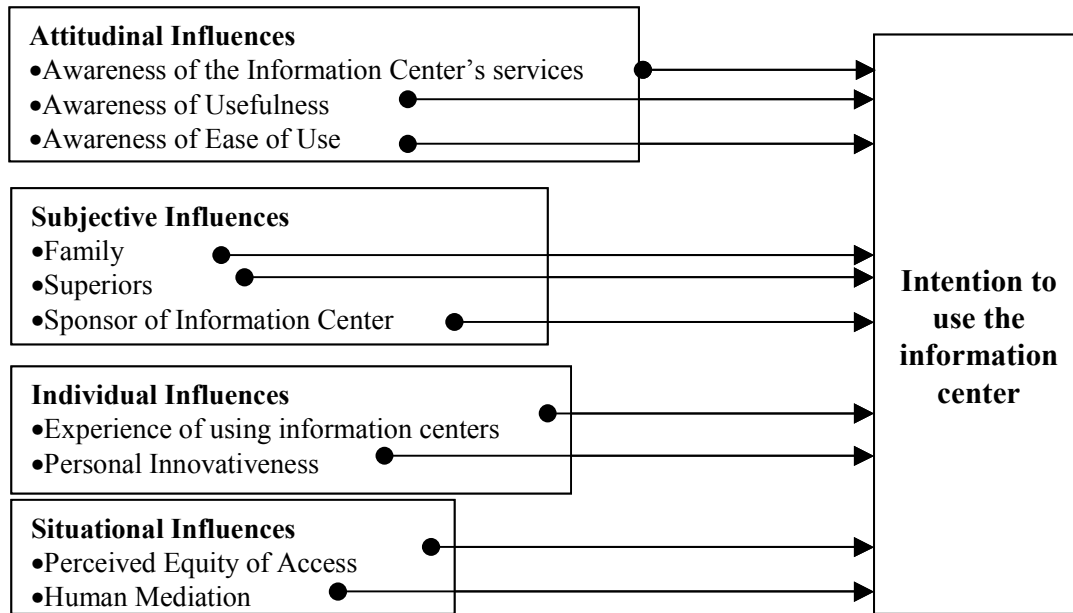


Figure 4. Mediated-User Model

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