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How to overcome the digital divide? An empirical study of Taiwan's DOCs

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Abstract

Purpose – The digital divide is a concern, as the inequality of information access might have significant influences on social development and quality of life. The purpose of this paper is to examine the perceived benefit of Digital Opportunity Centers (DOCs) programs on remote area participants from the perspective of computer anxiety and personal information ability.

Design/methodology/approach – The Taiwanese Government has built DOCs in remote areas to provide information technology (IT) training and learning programs to citizens residing in these areas. DOC program participants in Taiwan voluntarily completed a self-report questionnaire; the authors received 2,105 completed questionnaires, with a response rate of 84.2 percent. This research used partial least-squares (PLS) to empirical the research model.

Findings – Using PLS, the results show that information and communication technology ability influences the perceived benefit of DOC programs; computer anxiety has significantly negative effects on package software use, internet use, and IT usefulness; and internet use and IT usefulness have positive effects on perceived benefits.

Originality/value – IT is continuously advancing, but digital resources are still lacking within remote areas. DOCs provide citizens different types of learning experiences related to economic, social, and educational development. DOC programs provide participants with opportunities to obtain and improve basic IT knowledge and abilities and decreasing the digital divide.

Keywords Information and communication technology, Computer anxiety, Digital opportunity centers (DOCs), Information technology ability, Information technology usefulness, Internet usage

Paper type Research paper

Introduction

Over the past several years, information and communication technology (ICT), internet technology, and computers have fostered economic growth and social progress, as they have become an inseparable part of our daily and educational lives. ICTs are considered by many development agencies to be critical to achieve socio-economic progress for developing countries and aiding disadvantaged groups (Lin *et al.*, 2015). In recent years, more and better ICTs have been adopted in international, social and economic fields and have become a strong force of social development. Therefore, information and communication technologies for development (ICT4D) issues have received considerable attention. ICT4D refers to the use of ICTs in the fields of socio-economic development, international development, and human rights (Lin *et al.*, 2015; Heeks, 2010; Prakash and De', 2007). ICT4D requires an understanding of community development, poverty, agriculture, healthcare, and basic education (Chib and Harris, 2012). The main point of ICT4D is to help disadvantaged populations

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around the world, but it is usually associated with applications in developing countries (Dias, 2014). Studies about ICT4D mostly examine the use of ICTs for different development objectives, such as: health, education, electronic commerce, government service delivery, etc. in several countries, mainly the ones with low average income.

Especially on the internet, new types of social interactions, or advanced electronic commerce and services, are becoming more and more common worldwide. Interactional tools and services in areas such as e-learning, e-health, e-banking, e-government, and e-commerce, among others, are widely used by many people (Cruz-Jesus *et al.*, 2012; Vicente and Gil-de-Bernabe, 2010; Vicente and Lopez, 2010a, b). Further, internet surfing, Youtube, Skype, social networking sites (e.g. Facebook, Twitter, Instagram), TED talks, e-mail, wiki-sites, and different types of online libraries have enhanced our ability to interact with each other, and increased our knowledge. However, the distribution of information resources has yet to reach everyone around the world, despite the fact that half of the world's population has access to ICT. Since ICT plays a crucial part in economic growth, this gap has created many socio-economic imbalance issues worldwide. In fact, ICT access levels can differ across various regions within one country.

The International Telecommunications Union has indicated that the penetration rates of internet and computer usage in developing countries only reaches half of those associated with the western world (Yu and Chao, 2014). Inequality pertaining to digital rights can have significant impacts on societal development and education. In the literature, this phenomenon is commonly referred to as the "digital divide" (Cruz-Jesus *et al.*, 2012; Gyabak and Godina, 2011). The digital divide has caused many problems in various social, economic, cultural, and education fields. These problems are far more critical than the gap between the rich and poor, and therefore should be taken more seriously (Crenshaw and Robison, 2006; Cruz-Jesus *et al.*, 2012; Epstein *et al.*, 2011; Gunkel, 2003; Gyabak and Godina, 2011).

Customarily, the global digital divide describes inequalities in computer and internet use across different countries (Wijers, 2010). Many national leaders have been promoting the idea of an information society, but are concerned about the significant possibility of this digital divide (Cruz-Jesus *et al.*, 2012). Several researchers have shown that the domestic digital divide usually affects populations that experience digital exclusion, such as the elderly, women, low-income households, remote area citizens, and those with mental or physical disabilities (Cruz-Jesus *et al.*, 2012; Vicente and Lopez, 2010a, b; Crenshaw and Robison, 2006).

Many countries have created policies in order to handle digital divide issues – for example: the European Commission has spent one billion Euros to provide internet access and job opportunities, and thereby help businesses grow (European Commission, 2009). From 2006 to 2015, ICT is expected to create one million jobs in Europe, and broadband-related economic growth activity worth 850 billion Euros (European Commission, 2009). Geographic area is one important factor when assessing the level of digital divide. Ethnic minorities or those with lower incomes are also considered to be less involved in digital technologies (Epstein *et al.*, 2011; Gunkel, 2003).

In addition, ICT4D can be the bridge to improve the digital divide by directly applying information technology (IT) approaches for poverty reduction. Direct use of ICTs can benefit the disadvantaged population and by using it indirectly ICTs can help organizations, non-governmental organizations, governments, and/or businesses, to improve socio-economic conditions. ICTs can be applied directly, benefiting the disadvantaged population, or indirectly, by assisting aid organizations, non-governmental

organizations, governments, and/or businesses, to improve socio-economic conditions. Therefore, ICT4D is one of the important and powerful tools to create policies for handling digital divide issues and to develop the economy and the society.

According to the Taiwan Network Information Center, as of 2013, the number of internet users above 12 years old reached 16.45 million, which is equal to 78.82 percent of the total population of 23.4 million. The broadband population is 16.09 million, which equates to 77.10 percent of the total population. As such, it appears that a digital divide is not an issue in Taiwan. However, one does exist. In remote areas, about 58.7 percent of students do not have computers. In response, the government has promoted an expansion of digital opportunities in remote areas by building Digital Opportunity Centers (DOCs) with information volunteers and information equipment. By providing digital equipment, digital education programs, IT courses, ICT4D courses, and cultural archives to social care, DOCs aim to help remote area populations develop basic information abilities so that they can use digital resources to boost their learning, and further help the growth of their communities. Most DOC participants are the elderly and teenagers. Generally, these participants have low information literacy, and inadequate information access and information application; however, both groups are determined to make use of IT. Also, DOCs encourage life-long learning in the elderly.

ICT has long been considered a way to gain competitive advantage for people – it is viable for both daily use and educational purposes. The National Research Council highlighted the importance of ICT literacy, and that the ability to use technologies for problem solving, critical thinking, communication, collaboration, and decision making is a critical skill in the twenty-first century (Huggins *et al.*, 2014; National Research Council, 2011). Further, educational institutions have paid greater attention to ICT literacy lately (US Department of Education, 2010). Regarding the field of education, the ability to use ICT is considered an important working skill for many students (Bembridge *et al.*, 2011). In addition, ICT ability is essential for citizens, students, and workers in remote areas. However, information education is lacking in rural areas, and citizens' ICT literacy is therefore weaker, leading to a lower proficiency in working and learning. The ICT programs conducted by the DOCs in remote areas not only help to improve the aforementioned problems, but also help the locals to learn in a better way.

Computer and ICT usage are considered essential for a digital learning curriculum, because these technologies allow people to access information and enhance their learning (Hassanzadeh *et al.*, 2012; Kiliç-Çakmak, 2010). The use of technology often has unpleasant side effects, which may include strong, negative emotional states, that arise during interaction with computers. Moreover, for remote area citizens, computer usage may cause tension, anxiety, and stress because of cognitive and psychological factors: this problem is recognized as "computer anxiety." According to previous studies (Gibson *et al.*, 2014; Conti-Ramsden *et al.*, 2010; Tekinarslan, 2008), computer anxiety is a common problem, because many people have negative perceptions about computers and avoid using them despite the fact that computers can improve their quality of life. In fact, computer anxiety is one of the important factors that drive the continuous development of computer supported education.

The primary focus of this study is to explore whether participants' psychological factors influence their interaction with and ability to learn after using DOC programs. In addition, in order to understand whether DOC centers have diminished the digital divide in Taiwan, an additional purpose of this study is to examine the perceived benefit of DOC programs on remote area participants with respect to both computer anxiety and personal information ability. According to Yu and Chao (2014), the

personal information ability was to understand how older adults use the internet and computers, and to identify the contextual factors that enhance or inhibit the use of these tools in their daily lives. The research focusses on the following variables: ICT ability (personal innovativeness, software usage, and internet usage), computer anxiety, and IT usefulness. The results of this study are expected to provide a reference for other remote areas that are being considered for a DOC.

The remainder of this paper is organized as follows: Section 2 reviews the theoretical foundations of ICT ability, computer anxiety, IT usefulness, and perceived benefit; based on this review, the theoretical framework and a set of hypotheses are proposed. Section 3 specifies the research design, including the sample participants, measurement instruments, data collection procedures, and data processing procedures. Section 4 outlines the data analysis and results of the structural equation model (SEM). Finally, Section 5 discusses the theoretical and managerial contributions of the results, draws conclusions, and notes limitations and future research opportunities associated with this study.

Literature review and research hypotheses

In the sections that follow, we provide a detailed theoretical background on the particular constructs of our model. We are interested in the relationships between ICT abilities, computer anxiety, and perceived benefit.

ICT ability

An information system (IS) is an integration of people, data, and IT. People can perform many common daily tasks more effectively after receiving computer training that includes information on how to access the internet. The ability to use ICT is essential in the twenty-first century. Generally, ICT constructs include technological literacy, technological readiness, digital literacy, media literacy, – among others. Several agree on the key facets that make up the construct, including: internet use and packaged software use. Internet usage and computer technology can improve people's daily life and home environment. As computers gradually become a part of people's lives, researchers have increasingly paid attention to both internet and packaged software usage in an integrated IS created by special features of a certain functioning mode (Segev and Ahituv, 2010). Such software can be utilized in both one's personal and family life. For instance, Skype can be a convenient tool for people to contact their family, friends, or healthcare providers. Previous studies have revealed important information about how and why the internet, packaged software, and ICT are used, such as: e-mail, folder and file management, healthcare system access, medical alert systems, Skype, web searching, and application software (Huggins *et al.*, 2014; Yu and Chao, 2014; Heart and Kalderon, 2013; Petter and Fruhling, 2011; Simsim, 2011). Such information skills are indispensable for individuals in student and workplace environments.

Personal innovativeness in ICT refers to one's intention to achieve a mission using new technology. People with high personal innovativeness tend to adopt new techniques from other systems, and propose new ideas (Flynn and Goldsmith, 1993). Everyone has different degree of innovativeness, and the reactions also vary. Personal innovativeness is mainly applied in the field of IT and has also been dubbed as personal innovativeness in IT (PIIT). PIIT is widely used in assessing the acceptance of IS settings (Wu *et al.*, 2011; Thatcher *et al.*, 2007). Conceptually, PIIT is a personal trait that completely describes one's attitude

toward using a new technology in different situations. Webster and Martochhio (1992) indicated that, generally, personal traits are not impacted by environments or internal variables. When a person is deciding whether to adopt a new innovation, PIIT can be used to analyze their mentation, and further understand their behavioral intentions.

Further, Huggins *et al.* (2014) believe that measurements of ICT literacy and ability are vital for the twenty-first century. With ICT becoming a part of people's daily lives, usage of the internet and packaged software has also been increasing. The level of personal information innovativeness influences one's internet and packaged software usage. Yu and Chao (2014) measured older adults' IT abilities by looking into their personal innovativeness, internet use, and packaged software use. Hence, this study is based on these three variables. This study investigates whether the remote area citizens' ICT abilities are impacted by DOC program attendance. Thus, the following hypotheses are proposed:

H1. Personal innovativeness is positively associated with internet use.

H2. Personal innovativeness is positively associated with perceived benefit.

H3. Personal innovativeness is positively associated with IT usefulness.

H4. Personal innovativeness is positively associated with packaged software use.

H5. Packaged software use is positively associated with internet use.

H6. Packaged software use is positively associated with IT usefulness.

H7. Internet use is positively associated with perceived benefit.

H8. IT usefulness is positively associated with perceived benefit.

Computer anxiety

Over the past two decades, ICT, internet technology, and computers have rapidly and dramatically changed the way people live and learn. New ICT and internet technologies have a variety of advantages compared to standalone computers. Technology use can often lead to unpleasant side effects, which may include strong, negative emotional states during interaction with computers. Also, ICT may cause tension, anxiety, and stress for learners. Such cognitive and psychological factors are usually identified as "computer anxiety" (Parayitam *et al.*, 2010). Parasuraman and Igbaria (1990) defined computer anxiety as "the tendency of individuals to be uneasy, apprehensive, or fearful about current or future use of computers." In studies of ISs, anxiety has been viewed as a personality variable that influences ICT adoption behavior.

Nowadays, in technology-based learning environments, research on computer anxiety and its outcomes is very important. Numerous studies have utilized a wide range of samples to prove the interrelationships between internet use, IT usefulness, and technology acceptance (Gibson *et al.*, 2014; Parayitam *et al.*, 2010; Durndell and Haag, 2002; Agarwal, 2000). Researchers have found that computer anxiety is negatively related to the use of the internet, IT usefulness, and packaged software. Azarfam and Jabbari (2012) argued that computer anxiety is one factor hindering the integration of informational technologies into the classroom setting and, as such, an advisable target for intervention. Since remote area citizens have a weaker understanding of new computer technologies and the internet, DOC programs aimed

at teaching ICT also want to help participants eliminate their anxieties as they learn. Based on the above, the following hypotheses are proposed:

H9. Computer anxiety is negatively associated with packaged software use.

H10. Computer anxiety is negatively associated with internet use.

H11. Computer anxiety is negatively associated with IT usefulness.

Perceived benefit

Information literacy is a necessary skill for individuals to effectively recognize, locate, evaluate, and use required information (Kiliç-Çakmak, 2010) from different sources. Pinto (2010) points out that information literacy is vital in the intensive, information-based modern world; it also forms the basis of life-long learning. As new knowledge emerges, people need information literacy skills in order to comprehend and make use of the knowledge in their disciplines of study. Therefore, improving information literacy, especially digital information literacy, is necessary for the effective use of information and the encouragement of life-long learning skills (Kiliç-Çakmak, 2010). DOCs provide space for life-long learning of information skills. In the past, many studies have examined the effects of information skill training. The perceived benefits can be categorized as follows: educational (Balaban *et al.*, 2013; Hassanzadeh *et al.*, 2012), social (Dong *et al.*, 2014; Garcia-Smith and Effken, 2013), cultural (Kivinen and Lammintakanen, 2013), and economic (Dinter, 2013).

The current study also considers these four categories. However, previous research has not examined these four categories of perceived benefit as formative first-order indicators of perceived benefit, or examined their summative effect on DOC perceived benefit. As such, this study considers perceived benefit as a formative construct, since the four categories represent significantly different dimensions. Further, the perceived benefit latent construct is a linear combination of its indicators; when consequences of the latent construct are included, the formative model can be estimated. In light of the above discussion on perceived benefit, the following is hypothesized:

H12a. Education is positively associated with perceived benefit.

H12b. Culture is positively associated with perceived benefit.

H12c. Society is positively associated with perceived benefit.

H12d. Economic is positively associated with perceived benefit.

Figure 1 provides an overview of the hypotheses put forward in this study.

Research design

Instrumentation

Data were collected by conducting a survey. The instrument consisted of a two-part questionnaire. The first part was designed to collect respondents' demographic information pertaining to gender, age, and level of education using a nominal scale. The second part was designed to examine respondents' perceptions of personal innovativeness, packaged software use, computer anxiety, internet use, IT usefulness, and perceived benefit.

The instrument was developed after a thorough review of previous relevant studies. Measurement items were modified to conform to the adoption context of DOC perceived benefit. Our scale development followed the recommendations of MacKenzie *et al.* (2011) and the standard psychometric scale development procedures suggested by Devellis (2003).

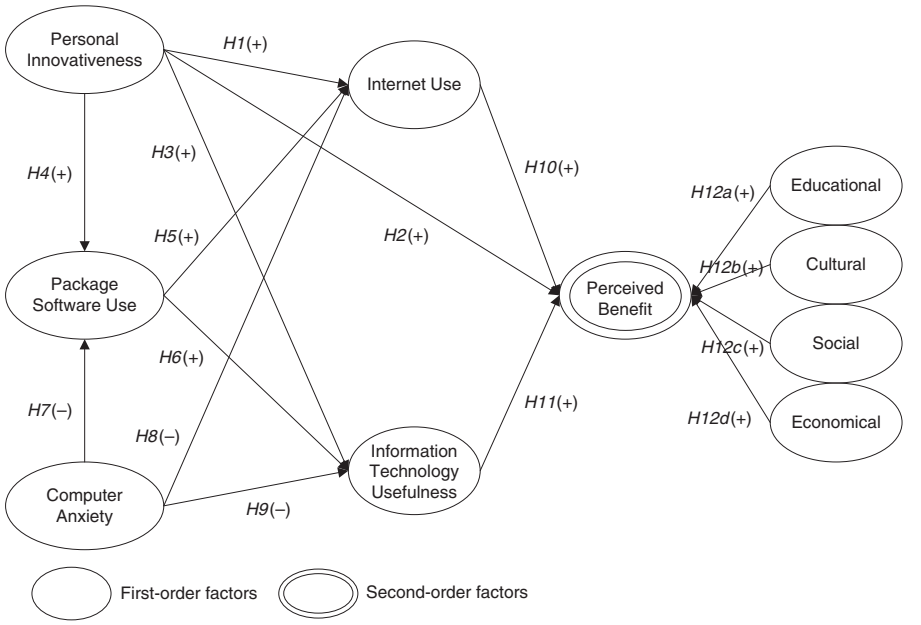


Figure 1.
Research model and hypotheses

Notes: PI, personal innovativeness; PSU, packaged software use; CA, computer anxiety; IU, internet use; ITU, information technology usefulness; PB, perceived benefit; Edu, education; Cul, culture; Soc, society; Eco, economic

ICT ability constructs (personal innovativeness, package software use, and internet use) were adapted from several previous researchers (Yu and Chao, 2014; Heart and Kalderon, 2013; Petter and Fruhling, 2011; Simsim, 2011; Wagner *et al.*, 2010; Flynn and Goldsmith, 1993), and consist of four, four, and five items, respectively. The three items for computer anxiety were based on prior research (Gibson *et al.*, 2014; Azarfam and Jabbari, 2012; Parayitam *et al.*, 2010; Parasuraman and Igbaria, 1990). The IT usefulness scales were adapted from previous researchers (Bouwens and Abernethy, 2000; Chia, 1995) and include four items. Finally, the perceived benefit constructs (education, culture, society, and economic) were adapted from the measurements developed by Dong *et al.* (2014), Balaban *et al.* (2013), Dinter (2013), Garcia-Smith and Effken (2013), Kivinen and Lammintakanen (2013), and Pinto (2010). They contain five, five, six, and seven items, respectively. In total, this research measurement instrument consisted of 44 items to measure the ten constructs in the structural model. Items were measured using five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). To reduce any potential ceiling (or floor) effects, we induced monotonous responses to the items designed to measure the same construct.

Sample and descriptive statistics

Data were collected from 160 DOCs in Taiwan. As a preliminary step, we contacted a manager at each DOC to ensure his/her cooperation. We used a census sample in this study and utilized mail surveys for DOCs that were willing to distribute the survey. Participation in the study was voluntarily. A total of 2,500 respondents participated in the study. In total, 2,105 usable responses were obtained (919 male, 1,186 female), for a

response rate of 84.2 percent. Within the sample population, 22.9 percent were in the 26-35 or 46-55 year-old brackets. Further, 41.1 percent had obtained a high school/technical school certificate (see Table I).

Data analysis

SEM was used in a comprehensive, combined analysis of both the measurement and structural models. The most common SEM techniques include: linear structural relations (LISREL) and partial least-squares (PLS) (Jöreskog and Sörbom, 2005; Chin, 1998). PLS is component-based and uses a least-squares estimation procedure. It can be used to determine both construct validity and structural validity, and can also be adopted to analyze measurements and structural models. Additionally, this research used PLS to analyze the research model.

Measurement validity

The convergent validity and discriminant validity of each first-order construct in the measurement model was assessed. Each first-order construct was modeled as a reflective latent construct accounting for its indicators. Three criteria were considered when assessing convergent validity (Bagozzi and Yi, 2012; Hair *et al.*, 2010; Jöreskog and Sörbom, 2005; Chin, 1998; Fornell and Larcker, 1981): all item loading (λ); investigation of reliability coefficients (Cronbach's α); and composite reliability (CR) coefficients and average variance extracted (AVE).

Table II shows the indices of reliability and convergent validities for the scale. The standardized item loadings ranged from 0.829 to 0.946: all items exceeded 0.70, as

Factor/level	*n*	%	Factor/level	*n*	%
Gender			*Age*		
Male	919	43.7	Under 26	267	12.7
Female	1,186	56.3	26-35	482	22.9
Education			36-45	435	20.7
Grade 11 or less	432	20.5	46-55	483	22.9
High school/technical school certificate	865	41.1	56-65	313	14.9
Faculty degree	349	16.6	Over 65	125	5.9
Bachelor degree	394	18.7			
Master degree or above	65	3.1			

Note: $n = 2{,}105$

Table I.
Respondent Profiles

Construct	Cronbach's α	Composite reliability	Average variance extracted
Personal innovativeness (PI)	0.906	0.934	0.781
Package software use (PSU)	0.889	0.923	0.751
Computer anxiety (CA)	0.771	0.892	0.805
Internet use (IU)	0.940	0.954	0.807
Information technology usefulness (ITU)	0.942	0.956	0.812
Perceived benefit (PB)	0.923	0.946	0.813

Table II.
Construct reliability results

were significant at the 0.01 level (Hair *et al.*, 2010). Internal consistency was assessed using the Cronbach's α coefficient for each of the multi-item factors included in the model. The Cronbach's α coefficients ranged from 0.771 to 0.942, which suggests a high level of reliability. In addition, all construct Cronbach's α coefficients exceeded the 0.70 benchmark suggested by Hair *et al.* (2010). CR is a set of latent construct indicators that are consistent in terms of their measurement. These CR coefficients ranged from 0.892 to 0.956, which exceeded the 0.6 benchmark advised by Fornell and Larcker (1981). Convergent validity was examined using AVE. In this study, all constructs demonstrated AVE values of between 0.751 and 0.813, exceeding the 0.5 limit recommended by Fornell and Larcker (1981). Overall, the AVE from the constructs demonstrated satisfactory reliability and validity. In sum, the internal reliability and validity results were acceptable, which enabled us to proceed to an estimation of the structural model.

Discriminant validity refers to the degree of distinctive concept measurements, and implies that within the same scale, correlations among constructs should be higher than those across different constructs. Discriminant validity is evident when the AVE for each construct is greater than the squared correlation between that construct and any other construct in the model (Fornell and Larcker, 1981). As shown in Table III, the overall discriminant validity coefficient of the constructs demonstrated satisfactory discriminant validity. The constructs demonstrated overall satisfactory convergent validity and discriminant validity.

Hypotheses testing

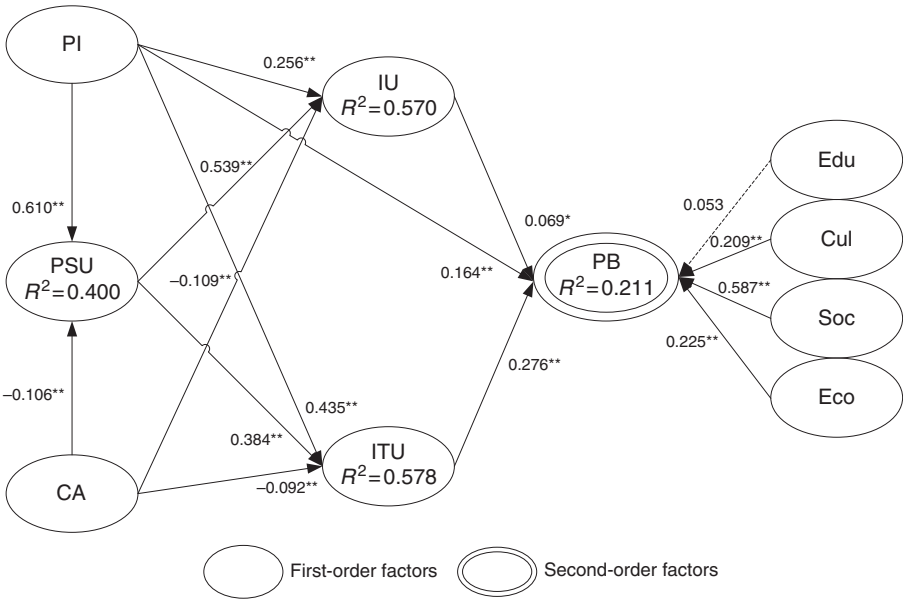
To test the research hypotheses, we specified paths between constructs in order to build a structural model that matches the proposed relationships. Figure 2 shows the results of the SEM estimation, including standardized path coefficients for each hypothesized path in the model, significance based on one-tailed *t*-tests, and the amount of variance explained (R^2). In the PLS analysis, the R^2 values are used as a goodness-of-fit measure (Hulland, 1999). Standardized β coefficients from the estimated structural model are reported in Table IV along with the associated *t*-values for each construct.

As shown in Figure 2, the construct of personal innovativeness, packaged software use, and computer anxiety were significant determinants of both internet use ($\beta = 0.256$, 0.539, and −0.109) and IT usefulness ($\beta = 0.435$, 0.384, and −0.092). As such, *H1*, *H3*, *H5*,

	Mean	SD	PI	PSU	CA	IUA	IU	PB
PI	3.622	0.866	*0.781*[a]					
PSU	3.532	0.948	0.621*	*0.751**				
CA	2.924	1.055	−0.125*	−0.184*	*0.805*[a]			
IU	4.019	0.924	0.602*	0.717*	−0.235*	*0.807*[a]		
ITU	3.806	0.888	0.684*	0.671*	−0.210*	0.709*	*0.812*[a]	
PB	3.890	0.646	0.392*	0.314*	−0.028	0.356*	0.428*	*0.813*[a]
(Correlation)^2			0.468	0.514	0.055	0.514	0.503	0.183
Discriminant validity coefficient			1.669	1.461	14.636	1.570	1.614	4.443

Table III.
Discriminant validity using average variance extracted

Notes: [a]Average variance extracted (AVE); convergent validity = AVE⩾0.5. Discriminant validity coefficient = AVE/ square of correlation coefficient, where the square of the correlation coefficient = the highest square of the correlation coefficient between the factor of interest and remaining factors. *$p < 0.05$



Notes: Value on path: standardized coefficients (β); R^2, coefficient of determination; and *$p<0.05$, **$p<0.01$

Figure 2. Results of the structural model testing

Hypotheses	Path from/to	Standardized coefficient	*t*-value	Test result
H1	PI→IU	0.256**	10.603	Supported
H2	PI→PB	0.164**	5.710	Supported
H3	PI→ITU	0.435**	17.128	Supported
H4	PI→PSU	0.610**	35.913	Supported
H5	PSU→IU	0.539**	24.286	Supported
H6	PSU→ITU	0.384**	15.906	Supported
H7	CA→PSU	−0.106**	−5.926	Supported
H8	CA→IU	−0.109**	−7.678	Supported
H9	CA→ITU	−0.092**	−6.075	Supported
H10	IU→PB	0.069*	2.134	Supported
H11	ITU→PB	0.276**	8.107	Supported
H12a	Edu→PB	0.053	0.706	Rejected
H12b	Cul→PB	0.209**	2.536	Supported
H12c	Soc→PB	0.587**	7.597	Supported
H12d	Eco→PB	0.225**	3.014	Supported

Notes: Edu, Education; Cul, Culture; Soc, Society; Eco, Economic. *$p < 0.05$, **$p < 0.01$

Table IV. Estimation results for *H1-H12*

H6, *H10*, and *H11* were supported. These constructs explained 57.0 and 57.8 percent of the variance in internet use ($R^2 = 0.570$) and IT usefulness ($R^2 = 0.578$), respectively. The construct of personal innovativeness and computer anxiety were significant determinants of packaged software use ($\beta = 0.610$ and -0.106). *H4* and *H9* were therefore supported. Further, personal innovativeness explained 40.0 percent of the variance associated with packaged software use ($R^2 = 0.400$). In addition, personal

innovativeness, internet use, and IT usefulness were all reported to be important antecedents of perceived benefit ($\beta = 0.164$, 0.069, and 0.276). Therefore, *H2, H7*, and *H8* were all supported. The components of perceived benefit, education, culture, society, and economic were all reported to be factors associated with perceived benefit ($\beta = 0.053$, 0.209, 0.587, and 0.225, respectively). However, the effect of education was non-significant. Therefore, *H12b-H12d* were supported. Finally, personal innovativeness, internet use and IT usefulness, culture, society, and economic together explained 21.1 percent of variance associated with perceived benefit ($R^2 = 0.211$).

Discussion and conclusion

In the past several years, ICT, ICT4D, internet technology and computers have fostered economic growth and social progress and have become an inseparable part of our daily and educational lives. However, computer and internet accessibility varies dramatically across different countries and/or individuals. ICT access inequality has significant impacts on social development and education, which has been referred to as the "digital divide." Governments all over the world have started paying increased attention to the digital divide issue, and introduced policies aimed at reducing or eliminating it. The Taiwan Government has promoted the expansion of digital opportunities in remote areas by constructing DOCs with e-service volunteers and management systems. DOC volunteers are tasked with helping remote area populations develop basic information abilities with digital equipment through digital education programs and IT courses. DOCs mainly provide two types of services: they train rural learners to gain essential skills required in the information age, and they apply new technologies and tools within the rural and remote districts. In short, DOCs provide citizens different types of learning experiences related to economic, social, and educational development. This study explored whether DOC program participants' personal mental factors and ICT abilities impacted their DOC learning. This study examined the perceived benefit (educational, social, cultural, and economical) of DOC programs on remote area participants from the perspectives of computer anxiety and personal information ability. ICT ability was measured by combining variables including personal innovativeness, packaged software usage, and internet usage. The results show that personal innovativeness and internet use both influence remote area citizens' learning within DOC programs; moreover, personal innovativeness has a larger impact than internet use, because it is a personal trait. When a citizen has higher personal innovativeness, he or she is more willing to accept new ICT, and to rate DOC programs as helpful.

In addition, as the internet becomes an increasingly integral part of people's lives, studies on the internet and IT use, especially with respect to older adults, have become increasingly relevant. The internet has become a major tool for many people to stay in contact with friends, relatives, colleagues, and partners (Segev and Ahituv, 2010; Yu and Chao, 2014; Wagner *et al.*, 2010). Such a convenient feature may intrinsically motivate people to start or keep using it. For example, Michael is a 60-year old diabetic. He often accessed the internet to search for information about diabetes and how to control the disease, but he could not find any useful information. By participating in a DOC informational education program, he learned more about searching for educational information about diabetes. This is but one example of the positive impact DOC programs have regarding teaching citizens about basic internet use.

With computer, internet, and ICT usage gradually becoming ubiquitous, a thorough study of the measures used for computer anxiety was needed. Due to the fast

development of new ICTs, the tendency for remote area citizens to develop computer anxiety was often higher than for urban citizens. In turn, this study investigated whether compute anxiety is negatively related to the use of the internet, IT usefulness, and packaged software use. The results show a negative relationship between computer anxiety and the above variables. These findings are consistent with those obtained in previous research (Gibson *et al.*, 2014; Parayitam *et al.*, 2010; Durndell and Haag, 2002). When the level of computer anxiety is higher, the levels of internet use, IT usefulness, and packaged software use are lower. Further, the results show that a lack of knowledge pertaining to computer use, the internet or IT leads to higher computer anxiety in DOC program learners. However, DOC programs provide participants with opportunities to obtain and improve basic IT knowledge and abilities and decreasing the digital divide.

To understand the learning that takes place within DOC programs, this study was conducted with four perceived benefits as the formative constructs: educational, cultural, social, and educational. The results show that the perceived benefits have a significant impact on all dimensions other than educational. In contrast to traditional information education programs, DOC programs focus on social and economic aspects, with the course content focussing on basic informational knowledge, computer use, and internet skills. However, participants may still have difficulties applying what they have learned from DOC programs when they encounter new technologies in their daily lives. Therefore, the perceived benefits of DOC programs have no significant impact on the educational construct, as compared to the other three constructs.

To conclude, IT is continuously advancing, but digital resources are still lacking within remote areas. Therefore, some governments and private institutions have tried to solve this digital divide by providing information education to residents in these areas. This study aimed to identify the factors that influence the effectiveness of the information training programs. It is hoped that research in this area will continue, as this will contribute to the development of theory regarding the implications and gratifications of the digital divide policy.

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