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Smartphone use and internet literacy of senior citizens

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Abstract

Purpose – *The purpose of this paper is to analyze the effects of smartphone use on the internet literacy and use by senior citizens.*
Design/methodology/approach – *Empirical study.*
Findings – *The results indicate that the use of smartphones does significantly impact the internet literacy and use of older individuals. Educational background and the duration of smartphone use enhance the ability of seniors to use the internet.*
Research limitations/implications – *A similar study can be conducted in other different countries and see the effect (if any) of national cultures and the type/purpose of usage of the internet; an expansion of this research, with a larger sample size, and more variables would shed greater insight on this important topic.*
Practical implications – *Study provide suggestions to governments, in cooperation with the private sectors, on how to diminish the digital divide for senior citizens not only to improve their well-being, but also because seniors are an important resource that contributes to society financially and intellectually.*
Social implications – *Technology is an important factor that can be used to not only alleviate some of the burden and improve the quality of life of senior citizens, but it can also help increase seniors' contributions to the society.*
Originality/value – *This study contributes in the digital divide research: (digital divide) for senior citizens, contributing factors, and the importance of decreasing it.*

Keywords *Older people, Disability, Accessibility, Online learning, Independence, Smart phone*

Paper type *Research paper*

1. Introduction

Due to the rapid advances in information and communication technologies (ICTs), individuals can now access information from data, collectively create new-shared values through collaboration, participate in policy making and help in enhancing and spreading democracy. Accessibility to various ICT devices, such as computers, smartphones, and tablet PCs, is critical to improve quality of life and well-being, co-create, and participate in social life and causes. However, the so-called digital divide, the accessibility gap in computing devices and internet, across different countries and layers of society and ages, remains a barrier (Greengard, 2009; Min, 2011). Senior citizens are a unique segment of population when it comes to accessibility because of additional accessibility issues that senior citizens have to deal with, and the particular importance accessibility has for this growing segment of population.

Senior citizens, in addition to common accessibility issues (cost and lack of infrastructure) that other segments of population have, face extra accessibility issues because of both their diminishing cognitive and physical capabilities, which may lead to the so-called information divide. For example, according to a survey conducted by the National Information Society

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Agency (NIA) in Korea on the status of the information divide, the information index for older individuals was only 69.2 points (vs 100 points for other citizens). Senior citizens, however, represent a growing and very important segment of population to the economies and societies around the world. Thus, while there are only 600 million people aged 60 or older today, this number will grow to 1.2 billion of them by 2025 and two billion by 2050 (Chang *et al.*, 2009), when they will outnumber children younger than 15 for the first time in history (Gelineau, 2013).

Older citizens are not a burden but a significant resource, financially and knowledge wise, that should be valued. The digital and information divides may impede senior citizens' social well-being (and provide a financial burden to the society) as well as their participation in e-commerce, co-creation, society, and democracy. Technology has the potential to enhance the quality of their life, independence, social well-being, and contribution to society. Therefore, exploring ways to improve the diffusion of ICT to senior citizens has academic and practical implications. Very few studies have dealt with these issues; as John Beard, director of Ageing and Life Course of WHO stated, "unless you measure something, it does not really exist in the minds of decision-makers" (Gelineau, 2013). Governments around the world should be prepared for the ageing population, to improve their well-being and contributions to economy and society.

The recent advances in wireless technology, infrastructure and devices have decreased the accessibility cost and consequently increased their adoption across society layers and countries. The number of people who own smartphones around the world has increased tremendously, particularly in the last two years. In Korea, the smartphone penetration rate in 2012 was 63.7 percent, an increase of 100.3 percent from previous year. For senior citizens, penetration rate was 35.1 percent, an increase of 387.5 percent compared to 2011. Since smartphones allow individuals to access the internet anytime and anywhere, they are emerging as a critical tool to narrow the digital divide. However, if users cannot utilize smartphones easily and freely, they will have difficulties accessing information, to shop, to communicate in the on-line community, and to participate actively in the society. This is especially important for senior citizens as smartphones help enhance not only their quality of life but also the sense of independence and engagement in the society (Kang, 2012). Thus, it would be of interest to study the effect of smartphone in information divide.

This study aims to analyze the effects of smartphone usage on the internet literacy for senior citizens. The paper is organized as follows: Section 2 describes the information divide, co-creation, as well as prior studies on the digital divide and smart devices; Sections 3 explains the research methods used in this study; Section 4 presents the results of the data analysis, including their implications; and the last section concludes the paper by summarizing the contributions of this research, as well as its limitations.

2. Literature review

2.1 Information divide and senior citizens

The term "digital divide" was first used to mean "information divide" by Gary Andrew Pole, a journalist with the *New York Times*, in an article written in 1995 on Schoolnet programs. Korea enacted the Framework Act on National Informatization in 2001, to bridge the information divide among its citizens. This act defined the information divide as the inequality in the opportunities to access and use ICT services through information and communication networks due to differing economic, regional, physical, or social conditions. Today, digital divide and information divide are used interchangeably. The digital divide represents the divergence among groups/countries in ICT technologies access, which depends on the internet/device penetration, cost/affordability, and the broadband quality. The information divide represents the divergence in ICT use (part of which is internet literacy) that depends on the digital divide and other factors, such as economic (affordability), social (education, urbanization, and culture), and demographic factors (Johnson and Ambrose, 2006; Greengard, 2009; Chang *et al.*, 2009).

Another definition of the information divide involves three categories: the access divide, capability divide, and utilization divide (National Information Society Agency (NIA), 2012). The access divide refers to economic inequality between individuals in relationship to their ability to access computers and the internet. The capability divide can be defined as the differences in one's personal ability to use

computers and the internet. The utilization divide is divided into two categories: quantitative utilization that refers to whether the internet is used and the amount of time spent using it; and qualitative utilization relates to how the internet use actually aids in daily life and improves people's well-being.

Because the information divide results in social, economic, and cultural disadvantages, governments around the world endeavored to narrow the gap. Advanced ICT countries have attempted to narrow three types of the information divide throughout the development stages of ICT devices: the introductory stage – decrease the divide in the ownership and performance of ICT devices; the take-off stage and saturation stage – the capability and utilization divides (Hargittai and Hinnant, 2008). When new ICT devices are first introduced in the market, their ownership (e.g. how many people actually have the devices) is important; however, in the take-off and saturation stages, a widespread adoption of the devices and capability of using them become more essential (Hargittai, 2002).

Thus, in South Korea, the most advanced ICT country in the world, the access index (ownership) of its senior citizens is 94.3 points; however, the seniors' capability and utilization indexes are only 42.8 and 51.9 points, respectively. Ordinary citizens in comparison have 100 points for each category: ownership, capability, usability (NIA, 2012). This means that, although there is no significant accessibility divide, there is definitely capability and utilization divides. Narrowing the information divide for senior citizens is not only important from purely the ethical and social perspective but is also critical for pragmatic reasons as the population is ageing fast, more so in developed countries. Ability of senior citizens to connect with other people, access and share information, participate in communities, and co-creating activities (Lee *et al.*, 2012; Hong *et al.*, 2012), shop online, and participate in government decision-making and social movements are important not only to their quality of life and well-being but also for economic, social, and intellectual consequences for the society.

2.2 Information divide and smart devices

As the adoption of smart devices (ownership and usage) has accelerated, so has the research on their usage and consequences. Numerous studies have dealt with the smart devices usage and the information divide (Keum and Cho, 2010; Pimenidis *et al.*, 2009; Brown *et al.*, 2011; Lee *et al.*, 2012; Zhao *et al.*, 2012). Han (2012) and Brown *et al.* (2011) examined the efforts to reduce and eliminate the digital divide through mobile devices, to enhance internet usage. Brown *et al.* (2011) conducted a survey among minority teenagers and low-income persons in the USA and found that the information divide seemed to narrow as people used the internet via smartphones.

Lee (2012), however, empirically proved that even though the increase of smartphone ownership narrowed the access divide, it did not eliminate the utilization divide. In the USA Keum and Cho (2010), who investigated the effect of smartphone use on social media, found that although the use of smartphones prompted some use of social media (such as micro-blogs), there still existed the participation/utilization divide. Thus, there appears to be a new utilization divide dimension, the so-called "smart divide," the differences occurring due to the ability and capability to use smart phones and devices.

In the past, the only way to access internet was through PCs and thus a time gap existed between the access and utilization divide. Nowadays, however, because of the mobile and digital convergence, the access and utilization divides appear almost simultaneously (NIA, 2012). A new information divide has thus emerged due to the convergence of computers and the internet at the individual level. In sum, previous studies, as summarized in Table I, have found the effect of smartphone penetration on the access and information divides (across countries and social layers), and on online shopping, communication, and participation.

3. Research methodology

3.1 Hypotheses development

The objective of this study was to investigate the effects of smartphone use on the internet literacy of senior citizens. In particular, three research questions were specified:

RQ1. Does the use of smartphones affect one's ability to use the internet?

Table I Previous studies on the effect of smart devices on information divide

Author(s)	*Research goal*	*Results*
Keum and Cho	Communication divide related to smartphone use and political influence	Smartphone use triggers a divide in social participation by prompting people to obtain political information through diverse media and communication
Pimenidis *et al.* (2009)	Removing the information divide in agricultural areas through mobile services	The digital divide is largely an access divide in which poverty triggers one's inability to access the internet. The recent widespread of smartphones has decreased the degree of this access divide
Brown *et al.* (2011)	The information divide may be bridged by using the internet via smartphones	The information divide among teenagers from low-income families and minority races has been reduced by their use of the internet via mobile devices
Zhao *et al.*	Analysis of the differences between smartphone users and cellular phone users	There are differences between smartphone users and cellular phone users in usage patterns and purchase desires through mobile shopping
Han (2012)	Analysis of the digital divide and popularization of smartphones in the USA	The capability and utilization divides as well as the divide in internet access among the underprivileged class, whose access to internet was limited, may be reduced with the use of smartphones
Lee (2012)	Analysis of the correlation between the information divide and smartphone ownership	Although the popularization of smartphones increased society's overall access to information, the information divide has become more segmented and complex
NIA (2012)	The 2011 status of the information divide in Korea	A new digital divide is created through the combined effect of mobile and digital convergence

RQ2. Does educational background affect one's ability to use the internet?

RQ3. Does the duration of smartphone use affect one's ability to use the internet?

3.1.1 Smartphone use and the ability to use the internet. Smartphones help decrease the digital and information access divides, as they increase the accessibility to the internet. In a study on the digital divide and smartphone popularization in the USA, Han (2012) observed that smartphones did help decrease the digital divide among socially underprivileged persons. Senior citizens today are more likely to own a smartphone than a PC, or any other wired-internet devices. Smartphones are used for a wide range of tools, from voice phone calls, to sending messages, e-mailing, web surfing, file downloading, accessing and sharing news and other information, calendar and scheduling, playing games, participating in several social media and communities, etc. Smartphones support the following activities: access content – ability to search for information, watch TV and movies, read newspapers, listen to music, use maps, access information about transportation, book tickets, use internet banking, shop, and play games (Kim, 2002); engage in communication – ability to use instant messaging, send e-mails, take photographs and send pictures or videos, and use Facebook or Twitter (Ledbetter, 2009); and participate in communities – ability to conduct meetings, join online clubs or communities, post replies online, use bulletin boards, use internet public services, and participate in public debates (Kozinets, 1999), all parts of what is called internet literacy (Kim, 2002). Therefore, the two unique characteristics of smartphones, compared to wired internet devices and access era are: owned by a single owner (PC could be owned by a group of people – members of a family); and mobile access of the internet (anywhere and anytime), decrease the time gap between access and utilization, especially for senior citizens. Most senior citizens own smartphones rather than PCs; use them often at anywhere and anytime, and therefore are very comfortable in using them (ease of use) but perceive them as more useful (perceived usefulness), compared to what they did with previous wired-internet devices. Then, one can assume that smartphone adoption and use will improve internet literacy for senior citizens. Specifically, we propose the following hypothesis and sub-hypotheses:

H1. The use of a smartphone will positively affect the ability of senior citizens to use the internet.

H1a. The use of a smartphone will positively affect the ability of senior citizens to access content.

H1b. The use of a smartphone will positively affect the ability of senior citizens to participate in communities.

H1c. The use of a smartphone will positively affect the ability of senior citizens to engage in communication.

3.1.2 Internet literacy and educational background. Socio-economic characteristics, such as the educational level, income, profession, and demographic characteristics (age and gender) are factors that trigger the digital and information divide (Kim and Kim, 2009; Keum and Cho, 2010). Not only there is a gap in the divide between younger and senior users, but within the senior segment. One can expect a divide among senior users with different educational background as it influences both how a person perceives the usefulness of a smartphone and the ease of its use. We suggest the following hypotheses:

H2. The educational level positively affects the ability of senior citizens in using the internet.

H2a. The educational level positively affects the ability of senior citizens to access content.

H2b. The educational level positively affects the ability of senior citizens to participate in communities.

H2c. The educational level positively affects the ability of senior citizens to engage in communication.

3.1.3 Internet literacy and the duration of smartphone use. A user's experience with a product or service correlates with the duration of its usage. As the duration of use grows, the user's experiences accumulate and she/he may exhibit different behaviors (ease of use and usefulness) compared to those whose duration of use was short. Senior citizens are more computationally challenged than the other segments of the population, often times they may feel overwhelmed and frustrated, and need more time to get accustomed to the technology. Senior citizens do not have any particular aversion to using the technology, are not enamored with "cool technologies." In fact, many recently retired seniors are quite adept in using smartphones and quite receptive in using it: they see technology as a way to get things done (Greengard, 2009). As more seniors use the technology and more comfortable they feel with it, the higher will be their perceived value of the technology. Therefore, the user's experiences are important and we propose the following hypotheses:

H3. The duration of smartphone use positively affects the ability of senior citizens to use the internet.

H3a. The duration of smartphone use positively affects the ability of senior citizens to access content.

H3b. The duration of smartphone use will affect the ability of seniors to participate in communities.

H3c. The duration of smartphone use positively affects the ability of senior citizens to engage in communication.

3.2 Selection of subjects

To verify how the use of a smartphone affects the internet literacy of senior citizens, the subjects of this study were selected to be 60 years and older, although the NIA's study suggested 50 years of age as seniors (NIA, 2012). The subjects selected were those who had used smartphones in the past, and whose level of internet literacy was below the average (the questionnaires began with the caveat, "Those who feel their ability to use the Internet prior to using a smartphone is already above average should not continue answering the questionnaire"). In total, 225 responses were randomly collected, from October 8, 2012 to January 31, 2013. After excluding those with incomplete answers, the final sample size was 200.

3.3 Data collection

Previous relevant studies were used to develop the questionnaire. The double translation protocol was used to prepare the questionnaire. The original version of the questionnaire was prepared in English by the researchers. This version was translated into Korean by two MIS faculty. The Korean version was translated back into English by two bilingual faculty who specialized in information disability. There was no significant difference between the two English versions. Before the main survey, a pilot test was conducted and its results were used to modify

some of the questionnaire items. A five-point Likert scale (1 = low-5 = high) was employed to measure the respondents' ability to use the internet. The operational definitions and the measurement items of the variables are described in Table II.

4. Data analysis

4.1 Characteristics of the sample

Table III shows the demographic characteristics of the respondents who participated in this study. The respondents have the following general characteristics: over 85 percent of them have used the smartphone for longer than six months; about 65 percent of them use the internet for at least 30 minutes a day; and 86 percent of them have high school or higher level of education.

4.2 Validity and reliability

A factor analysis was conducted to verify the construct validity. An extraction model for a principal component analysis was employed to minimize information loss. In factor analysis, factors with an eigenvalue of more than 1.0 were extracted to determine the number of factors. As shown in Table IV, the results of the analysis demonstrate high factor loading values (0.715 to 0.871).

To measure the reliability of each factor, an internal consistency analysis was performed on individual items using Cronbach's α coefficient. Cronbach's α coefficient provides the most conservative value among various coefficients that evaluate the reliability of measurement items. As shown in Table IV, the reliability of the measured items was high (all above 0.75).

Table II Variable definitions and measurements

Factor		*Operational definition*	*Question items*	*References*
Dependent variables	Ability to access content	The ability to search for data, watch TV and movies, read newspapers, listen to music, use maps, play games, access information about transportation, book tickets, use internet banking, and shop	Searching for information Watching TV and movies, reading newspapers, and listening to music Utilizing maps, traffic information, and play games Booking tickets Internet banking, shopping	Kim (2002) and Kim *et al.* (2011)
	Ability to participate in community	The ability to conduct meetings, join clubs or visit cafés through the internet, post a range of replies, participate in debates, use popular internet complaint services, and use bulletin boards	Having meetings, joining clubs, and visiting cafés Posting replies and participating in debates Using internet public complaint services and bulletin boards	Kozinets (1999), and Kim *et al.* (2011)
	Ability to engage in communication	The ability to use instant messengers, send e-mails, take photographs and send pictures or videos, and use Facebook or Twitter	Using instant messengers (chatting) Using e-mails Taking photographs and sending pictures and videos Using Facebook and Twitter	Ledbetter (2009) and Kim *et al.* (2011)
Independent variable (internet literacy)	Ability to use the internet prior smartphone use	Using the internet via a PC or a notebook prior to using a smartphone		
	Ability to use the internet post smartphone use	After using a smartphone and utilizing the internet using smart devices such as tablet PCs, ordinary PCs, and notebooks as well as smartphones		

Table III Demographic characteristics of the sample

Item		*Frequency*	*%*
Duration of use	Under six months	29	14.5
	Over six months to under two years	134	67.0
	Over two years	37	18.5
	Total	200	100.0
Educational background	Middle school graduate or lower level education	28	14.0
	High school graduate +some college	107	53.5
	College graduate or post graduate school	65	32.5
	Total	200	100.0

Table IV Factor and reliability analysis of dependent variables

Factor		*Measured item*	*Factor loading* *Factor 1*	*Factor 2*	*Factor 3*	*Cronbach's α*
Dependent Variable	Ability to access content	Content 1	0.768			0.787
		Content 2	0.747			
		Content 3	0.742			
		Content 4	0.738			
		Content 5	0.715			
	Ability to participate in community	Community 1		0.871		0.800
		Community 2		0.860		
		Community 3		0.803		
	Ability to engage in communication	Communication 1			0.774	0.750
		Communication 2			0.767	
		Communication 3			0.762	
		Communication 4			0.723	
Eigenvalue			2.754	2.143	2.292	
Kaiser-Meyer-Olkin (KMO)			0.906			
Bartlett test of sphericity			1,012.230			
Significance probability			0.000			

4.3 Results of hypotheses test

To verify the hypotheses, independent *t*-tests were performed to examine the effects of smartphone use on the ability of senior citizens to use the internet. In addition, a one-way ANOVA was performed to analyze the differences in the ability to use the internet by educational background and duration of smartphone use.

4.3.1 Effects of smartphone use on internet literacy. As we can see from the results of the data analysis (Table V), the ability to use the internet prior and post smartphone usage was different for all four hypotheses, at the significance level of $p = 0.01$ which means that senior citizens who were using smartphones showed a higher level of ability to use the internet than those who were not.

4.3.2 Effects of smartphone use on internet literacy by educational level. We analyzed the difference in the effects of smartphone use among three groups of education level middle school graduate or lower-level education; high school graduate; and college graduate or post-graduate school. The ANOVA test (Table VI) showed statistical differences in the average internet literacy performance among the groups, which means that the level of education has a positive effect on the internet literacy of senior citizens.

4.3.3 Effects of duration of smartphone use on internet literacy. As shown in the demographics (Table III), to verify the effects of duration of smartphone use on the ability to use the internet by senior citizens, the duration was divided into three groups: under six months, over six months to under two years, and over two years. Surveys conducted by the Korea Internet Security Agency (2012) and by DMC Media Brand Marketing Team (2012) divided the duration into four groups:

Table V Analysis of differences in the ability to use the internet prior to and after using a smartphone

Variables		*n*	*Average*	*SE*	*t-Value*	*t-Value*
Ability to use the internet	Prior to using a smartphone	200	1.7900	0.69881	13.477	0.000**
	After using a smartphone	200	2.4250	0.85911		
Ability to access content	Prior to using a smartphone	200	1.8750	0.71550	14.892	0.000**
	After using a smartphone	200	2.6100	0.92855		
Ability to participate in community	Prior to using a smartphone	200	1.4550	0.89554	9.089	0.000**
	After using a smartphone	200	1.8950	1.16652		
Ability to engage in communication	Prior to using a smartphone	200	1.9650	0.71155	17.026	0.000**
	After using a smartphone	200	2.8050	0.93882		

Note: $^{**}p < 0.01$

Table VI The effects of education level background on internet literacy of senior citizens

Educational background		*n*	*Average*	*SE*	*F*	*p*
Ability to use the internet	Middle school graduate or lower level education	28	2.1429	0.89087	6.409	0.002**
	High school graduate/some college	107	2.4579	0.74328		
	College graduate or post graduate school	65	2.7692	0.87979		
Ability to access content	Middle school graduate or lower level education	28	2.3929	0.83174	3.865	0.023*
	High school graduate/some college	107	2.5981	0.84518		
	College graduate or post graduate school	65	2.8923	0.93747		
Ability to participate in community	Middle school graduate or lower level education	28	1.7857	1.03126	5.342	0.006**
	High school graduate/some college	107	1.9813	0.87934		
	College graduate or post graduate school	65	2.4000	1.08685		
Ability to engage in communication	Middle school graduate or lower-level education	28	2.4286	0.99735	6.011	0.003**
	High school graduate/some college	107	2.8318	0.79487		
	College graduate or post graduate school	65	3.1077	0.95399		

Notes: $^{*}p < 0.05$; $^{**}p < 0.01$

under six months, over six months to under nine months, over nine months to under one year, over one year to under two years, and over two years. In our study, since most of respondents said that they got accustomed to using the smartphone within six months, we used only three time interval groups.

One-way ANOVA (Table VII) showed statistical differences among the groups, indicating that the longer a person had been using a smartphone, the higher her/his ability level is in using the internet.

4.4 Summary of test results and implications

Table VIII summarizes the results of the hypotheses test. All of the hypotheses were supported.

Several implications can be drawn from the results. First, senior citizens' use of smartphone improves their ability to use the internet. The results showed that the respondents' level of ability to use the internet was an average of 1.79 (five-point scale) before using a smartphone, but it was an average of 2.42 after using a smartphone, an improvement of 0.63 points. Smartphones' singularity in ownership and mobility (any-time/any-where), increases the desire to "play" (explore in usage) and time spent, and therefore, the usage skills by senior citizens.

Senior citizens, by using the smartphones more, find them easier to use. However, the time spent using a device, is not the only factor in improving the perceived ease of use. There are other factors, technology (small devices) and age (older) related, that affect the ease of use. Thus, even though mobile devices have a better ability to zoom and magnify text, the size of the screen makes it harder for senior citizen to navigate and read information. The touch screen feature,

Table VII The effects of duration of smartphone use on internet literacy

Duration of smartphone use		*n*	*Average*	*SE*	*F*	*P*
Ability to use the internet	Under six months	29	2.1724	0.84806	10.869	0.000**
	Over six months to under two years	134	2.4478	0.75161		
	Over two years	37	3.0270	0.89711		
Ability to access content	Under six months	29	2.3103	0.84951	6.899	0.001**
	Over six months to under two years	134	2.6269	0.85551		
	Over two years	37	3.0811	0.89376		
Ability to participate in community	Under six months	29	1.6897	0.80638	7.191	0.000**
	Over six months to under two years	134	2.0448	0.91656		
	Over two years	37	2.5676	1.21428		
Ability to engage in communication	Under six months	29	2.4828	0.91107	14.772	0.000**
	Over six months to under two years	134	2.7687	0.81263		
	Over two years	37	3.5135	0.90128		

Note: $^{**}p < 0.01$

Table VIII Summary of hypotheses test

Area	*Hypothesis*	*p*	*Results*
The use of smartphone	*H1*: the use of a smartphone will positively affect the ability of senior citizens to use the internet	0.000**	Supported
	H1a: the use of a smartphone will positively affect the ability of senior citizens to access content	0.000**	Supported
	H1b: the use of a smartphone will positively affect the ability of senior citizens to participate in community	0.000**	Supported
	H1c: the use of a smartphone will positively affect the ability of senior citizens to engage in communication	0.000**	Supported
Educational level	*H2*: educational level positively affects the ability of senior citizens to use the internet	0.002**	Supported
	H2a: educational level positively affects the ability of seniors to access content	0.023*	Supported
	H2b: educational background level positively affects the ability of seniors to participate in community	0.006**	Supported
	H2c: educational background level positively affects the ability of seniors to engage in communication	0.003**	Supported
Duration of smartphone use	*H3*: the duration of smartphone use positively affects the ability of seniors to use the internet	0.000**	Supported
	H3a: the duration of smartphone use positively affects the ability of seniors to access content	0.001**	Supported
	H3b: the duration of smartphone use positively affects the ability of seniors to participate in community	0.001**	Supported
	H3c: the duration of smartphone use positively affects the ability of seniors to engage in communication	0.000**	Supported

Notes: $^{*}p < 0.05$; $^{**}p < 0.01$

while a technical improvement, it could be harder for senior citizens' shaky fingers (motor skills). The amount of vast applications, while have increased the speed and functional usage of mobile devices, can be a challenge for fading memory of senior citizens and degrading cognitive skills. Therefore, the development of simple user interfaces, with simplified layout and design, and easy applications are important, since they allow senior citizens to approach and use the internet naturally. Mobile phone manufacturers are introducing devices with bigger and more prominent keys, word predictors and larger text, with "yes" and "no" buttons/menus, with text-to-speech tools, sound and light signaler alerts, etc. (Greengard, 2009). IBM, for instance, have introduced Easy Web Browsing, which is a set of features to make it easier for senior citizens to browse the internet. Microsoft and Apple have built magnifying tools, text-to-speech conversion, alternative keys, specialized display, etc.

The use of smartphones by senior citizens should definitely be encouraged as the ageing population is increasing globally, and technology should be used to enhance their quality of life,

independence, and well-being. Advanced technologies, such as eCare, help seniors maintain an independent lifestyle. They help seniors to participate in e-business activities and also community involvement (Chang *et al.*, 2009). Participation in communities is particularly important in today's postmodern society characterized by social dissolution and extreme individualism. Online networks and communities can overcome the lack of traditional community, of fragmented family units, of isolationist society (Johnson and Ambrose, 2006). Humans have a need for relationships and interactions, communications and communal links, all contributors to human well-being that are all helped to achieve by ICTs.

Senior citizens should not be seen as a burden but as an important resource that contributes to society financially and intellectually. Governments must undertake initiatives to decrease the senior citizens' gap in digital and information access. Thus, governments, in cooperation with the private sectors, can provide citizens with devices, if they are not financially able. They should have programs to train older citizens on how to use smartphones as they can provide access to diverse information, and have seniors actively participate in social and political life.

Second, the study's results indicate that educational background affects one's ability to use the internet. Even though its coefficient value is not as high as the others are (which can be interpreted with the fact that improvement in the ability to access content – read newspaper and such – is easier to learn and therefore does not require high level of education compared to the ability to participate in communities), education level is important. However, its effect can be overcome by using highly educated seniors, which are more proficient in using smartphones, and therefore are more internet literate, to train their peers, as they understand the needs of this age group better, are more sympathetic to their challenges, may have more time at hand, and are more motivated and want to contribute. Digital and information access will not only improve the well-being of senior citizens, but also open up work and personal opportunities for staying socially more connected. This way, seniors can contribute to the well-being of society by contributing with their knowledge, experience, and wisdom.

Third, the duration of smartphone's use also affects one's ability to use the internet. As older individuals use the smartphone for their needs or on the recommendation of others, fear and negative feelings regarding smartphones and internet use would gradually disappear. This, complemented with technological (devices and applications) improvements, will increase the ability of senior citizens to use the internet and become natural at it just like the young generation is today.

5. Conclusions

Today two phenomena are emerging at almost the same speed: the world population is ageing very fast (number of older people will more than triple by 2050), and ICT are advancing at the speed of light. Governments around the world are not well prepared and they have resisted tackling the issue of ageing population. Even prosperity in wealthy nations does not guarantee protection for the old. Technology is an important factor that can be used to not only alleviate some of the burden and improve the quality of life of senior citizens, but it can also help increase seniors' contributions to the society.

The main goal of this study was to examine the effects of smartphone use on the internet literacy of senior citizens. The results demonstrated that the use of smartphones significantly influences the ability of senior citizens to use the internet. The level of internet literacy is also influenced by seniors' educational background and their duration of smartphone use. Internet literacy improves the senior citizens' level of participation in economy and society, and overall their quality of life and well-being.

The findings of this study contribute to literature, as it is the first empirical study on the issues related to smartphone and the internet use by senior citizens in the Asia/Pacific region, and it may lead to relevant follow-up studies. It also has significant practical implications, as it provides suggestions for government policy makers in taking steps toward minimization of the information divide for senior citizens.

As with any empirical study, this study has some limitations. Since it was conducted in Korea, the generalizability of the study is limited. Second, potential confounding variables, including the type of smartphones and training opportunities might also have contributed to the impact of internet

use. These limitations can be suggestions for future studies: it could be interesting to conduct a similar study in different countries and see the effect (if any) of national cultures and the type/purpose of usage of the internet; an expansion of this research, with a larger sample size, and more variables would shed greater insight on this important topic.

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