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Research Article

The Roles of Education and Literacy in the Digital Divide Among Middle-Aged Adults: Cross-National Evidence from the United States, Japan, and South Korea

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Abstract

Internationally representative data of middle-aged adults 45 – 65 years old [*n*(United States) = 2,150; *n*(Japan) = 2,318; *n*(South Korea) = 2,800] from the 2012 Program for International Assessment of Adult Competencies were analyzed to examine the roles of education and literacy in relation to the digital divide. Results from survey-weighted binary logistic regressions showed that both educational attainment and literacy were positively associated with all four measures of information and communication technology (use of the computer, email, online information and transaction) use in all three countries. The middle-aged adults in the United States benefited more from the educational attainment than those in Japan, in terms of email and online information use. The middle-aged adults with lower education and basic skills (i.e., literacy) may benefit from the educational intervention and additional information and communication technology training, and in turn, improve the digital divide in later life, regardless of differences in culture and economy.

Keywords: International; education; information technology; East Asian countries

Disproportionate access to information and communication technology (ICT) by sub-populations such as older adults and adults with lower socioeconomic status, referenced as the digital divide, was a significant concern of economically developed nations in the late 20th and early 21st century (Light, 2001). While the overall patterns of the digital divide have been documented, a large amount of heterogeneity in both ICT use and skill levels remains among adult populations (Ono & Zavodny, 2007). Considering the importance of ICT use to help prevent socioeconomic and health disadvantages in later life (Pruchno, 2019), this study focuses on middle-aged adults.

The present study was framed by two theories: resources and appropriation theory (van Dijk, 2013) and diffusion of innovation theory (Rogers, 2003). The first posits that ICT use is largely determined by a collection of personal and positional characteristics, and the latter emphasizes a need to examine these characteristics from a life course perspective. Personal and positional characteristics include sociodemographic factors that reflect one's rank within a hierarchical distribution of resources (e.g., income,

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time, motivation, human capital) over the life course. For example, those with higher income, more available time, and greater motivation (both to learn and use ICT) are likely to use ICT more. In turn, one's rank can be understood to either limit or enhance ICT use (van Dijk, 2017).

ICT use is further determined by one's digital literacy (van Dijk, 2013). ICT disparities reflect a balance between opportunity and risk exposure in earlier life stages, and this balance differs across age groups (Ferraro et al., 2009). In view of the diffusion of innovation theory (Rogers, 2003), middle-aged adults whose formative years occurred prior to the 1990s, when ICT infrastructure was limited, may have lacked opportunity to develop strong digital literacy skills. Moreover, middle-aged adults may also have diverse perceptions and attitudes towards ICT (Backonja et al., 2014). These issues point to a need to develop a greater understanding of the digital divide among middle-age adults (Morris, 2007).

Aside from age, other important personal characteristics include sex and health. Men typically have greater ICT access and usage (Friemel, 2016; Kim et al., 2016), as do individuals who are healthy and/or non-disabled (Fang et al., 2018). Key positional characteristics include educational attainment, employment status, income, and social network. Education (Elena-Bucea et al., 2020; Fang et al., 2018; van Dijk, 2012), employment (Paggi & Jopp, 2015; Tikkanen, 2017), income (Fang et al., 2018; Friemel, 2016), and social support are all positively associated with greater ICT access and usage (Hong & Cho, 2016; Kim et al., 2016; van Dijk, 2012). Among these key indicators, educational attainment is by far the strongest predictor.

Understanding the link between ICT use and education among middle-aged adults is complicated by two issues: First, formal education is typically completed by one's late 20s (National Center for Education Statistics, 2018), so there is often a gap between formal education and current literacy skills that reflect a foundation for digital literacy and ICT use (van Dijk, 2017). Second, education is an important determinant of ICT use regardless of age, but efficacy is particularly important by the time one reaches middle to later life. (van Dijk, 2012). Therefore, middle-aged adults with low literacy may have difficulty using ICT (Yamashita et al., 2019), but whether the digital divide differs by basic literacy skills remains unknown. Relatedly, it should be noted that this study does not address specific pathways between education, literacy, and ICT use. However, the education-ICT use relationship could be explained by multiple pathways, including personal and positional characteristics. For example, education-related outcomes, such as literacy proficiency and income, are the indicators of economic access to digital devices and the Internet across adult life stages.

A Cross-Cultural View: Gaps in the Literature

The digital divide is understood to differ substantially across countries due to cross-national variation in economic conditions, digital infrastructure, and collective attitudes toward ICT (Drori & Jang, 2003). Yet, nationally representative cross-national research in terms of individual-level ICT use is scare (Ono & Zavodny, 2007), and little is known about whether personal and positional determinants of ICT use differ cross-nationally. The present study focuses on the United States, Japan, and South Korea, which includes a Western country with an individualistic-oriented culture and Eastern countries with a group-oriented culture (i.e., Confucianism). All three nations have high technology usage rates (e.g., internet usage rate: Untied States = 85%, Japan = 91%, and South Korea = 96%) (World Bank, 2019). These differences and similarities provide useful contexts from which to exam cross-national differences in the importance of education and literacy for ICT use.

The current study contributes to the existing literature by providing cross-national evidence surrounding the links between both education and literacy with ICT use at the individual level, while taking the demographic and socioeconomic characteristics into account. Several international reports examined the bivariate relationships between literacy and ICT use across nations but detailed examinations with the statistical control have not been conducted to date (Grotlüschen et al., 2016). Moreover, while the links between education and ICT use are well-established (van Dijk, 2012), at least within a single-nation context, the role of adult literacy skills has not been extensively studied. This is important because literacy skills are a possible underlying mechanism that links ICT use with educational attainment (van Dijk, 2013). Additionally, the current study adds much needed refinement to the measurement of both ICT use and literacy by focusing

on specific ICT use types (i.e., general, email, online information, and online transaction) and a detailed measure of literacy (De Haan, 2004). In particular, population-level large scale assessments of adult literacy data have not been fully utilized in the digital divide research. Finally, whether theoretical understandings of the digital divide (van Dijk, 2013) extend to middle-aged adults, in general, and in a specific cross-cultural context, remains an open question.

Research Questions

The present study focuses on establishing associations of both education and literacy skills with ICT use among middle-aged adults in three developed, but culturally distinct, nations, and whether these associations differ by ICT use type (e.g., general, email, information, and transaction).

1. Are education and literacy associated with ICT use among middle-aged adults in the United States, Japan, and South Korea?
2. Are associations of education and literacy with ICT use among middle-aged adults moderated by country?

It is hypothesized that education and literacy are independently and positively associated with ICT use across all three nations. However, it is expected that the impact of education and literacy on ICT use differs by type and by country.

Methods

Data

Data were derived from the 2012 Program for the International Assessment of Adult Competencies (PIAAC) public use file (Organization for Economic Co-operation and Development [OECD], 2016), which includes respondents between 16 and 65 years old in 24 countries. PIAAC used a computer-adaptive assessment of basic skills, which provided 10 sets of plausible values for literacy skills. Skill assessments were conducted in each country's primary language (OECD, 2019). The sample was limited to those between 45 and 65-years old (Total n = 7,268; United States n = 2,150; Japan n = 2,318; South Korea n = 2,800). Appropriate sampling and replicate weights were used to adjust for non-response bias and the complex sampling design, respectively.

Measures

Dependent Variables

ICT use was measured by a set of four dichotomous indicators. *Computer User* indicates whether a respondent uses a desktop, laptop, or hand-held electronic device in everyday life. Those who answered no were excluded by the PIAAC from the following usage questions: *Email User* denotes whether a respondent uses email at least once a month. *Online Information User* indicates whether a respondent uses the internet for information seeking at least once a month. *Online Transaction User* indicates that a respondent uses the internet for purchasing, selling, and/or banking at least once a month.

Independent Variables

Educational Attainment indicates whether a respondent has at least a bachelor's degree. PIAAC provides more detailed educational attainment classifications but for the purpose of this study, cross-national comparability and the interpretability of results, the dichotomous variable (i.e., 0 = less than a bachelor's degree vs. 1 = bachelor's degree or higher) was created. *Literacy Skills* were based on a set of 10 plausible values with scores that range between 1 (low) and 500 (high). On a related note, this study adopted literacy rather than other available PIAAC skill measures such as numeracy and problem-solving skills in technology-rich environment, because literacy is the foundational skills, which are likely comparable across countries. Other available measures may not be cross-nationally comparable, due to, for example, the varying focuses of education systems and cultural differences (e.g., mathematics and computer science education).

Covariates

Models were adjusted for personal, positional, and resource factors. Personal factors: *Age* was recorded in 5-year increments (45-49; 50-54; 55-59; and 60-65 years old) because a continuous age measure was not available in the U.S. public use file. *Sex* included options for female or male. *Self-Rated Health* was measured on a five-point scale from poor to excellent. Positional factors: *Paid Work* indicates whether a respondent had a paid job in the last 12 months. *Parents' Education* was dichotomized to indicate whether at least one parent/guardian had

at least a post-secondary degree. *Living with a Spouse/ Partner* is a dichotomous indicator (0 = no, 1 = yes). *Child* indicates whether a respondent had at least one child in their household. Resource factors: *Income* was measured in terms of monthly earnings and was recorded in deciles. In PIAAC, any respondent who reported no paid work in the past twelve months was assumed to have no income. As such, they were assigned to the lowest decile to be included in this study. *Country* was denoted by three dichotomous indicators (i.e., United States, Japan, or South Korea).

Analytic Approach

A weighted descriptive summary was computed for the overall analytic sample and each respective country, which was accompanied by bivariate tests to assess crude unadjusted differences. First, weighted binary logistic regression models without the covariates were used to establish bivariate relationships between each dependent variable and both independent variables, respectively. Subsequently, moderator functions (Muthén et al., 2016) were included for both independent variables by country to account for the cross-national design. Finally, fully adjusted and weighted models with the covariates were constructed to address both research questions. Statistical significance was evaluated at the 0.05 level. All programs were generated using the IDB analyzer version 4.0 (IEA, 2016) and executed in SAS version 9.4.

Sensitivity Analysis

Alternative models that included different measurement strategies for the independent variables and different combinations of covariates were examined to establish robustness of findings. Multicollinearity was assessed by the variation inflation factor (VIF > 4.0) (Allison, 1999), and model quality was evaluated with the area under the receiver-operating characteristics (ROC) curve (Hosmer & Lemeshow, 2013). Sampling weights (SPFWT0) and replicate weights (SPFWT1-80) with the jackknife2 variance estimation technique were applied in all models (OECD, 2016). Per the PIAAC (2016) technical report, the number of recommended replications for the United States was increased by 35 so that the three countries were comparable in the weighted analysis.

Results

Weighted descriptive summaries are shown in Table 1. South Koreans (83%) were more likely to be computer users compared to American (80%) and Japanese (78%) adults. However, among computer users, Americans were more likely to be email users, and online information users, compared to South Korean or Japanese adults. While there is no significant difference in the online transaction users between Americans and South Koreans, South Koreans were more likely to be online transaction users than Japanese. Americans were more likely to have at least bachelor's degree (29%) compared to Japanese (23%) and South Korean (14%) adults. The average literacy skills score was higher in Japan (284) compared to the United States (264) and South Korea (253).

Regression results are displayed in Tables 2 through 5. Model 1 results show that educational attainment and literacy skills are both associated with ICT use across all three nations, and this is relatively consistent across ICT usage type. Middle-aged adults with at least a bachelor's degree had a greater likelihood of using a computer in everyday life [Odds-ratio (*OR*) = 2.29, $p < 0.05$]. This educational pattern was consistent across all examined ICT types: email (*OR* = 5.69, $p < 0.05$), online information (*OR* = 3.54, $p < 0.05$), and online transaction (*OR* = 1.45, $p < 0.05$), while the differences in the estimated ORs between Japan and the United States were detected for email and online information (see the next section for more details). Similarly, higher literacy skills were consistently associated with greater odds of using computers, email, online information, and online transaction. A one unit increase in literacy skills is associated with a 0.01 increase in the odds of ICT usage. Given that literacy skills were measured on a 500-point scale, seemingly small, estimated odds ratio reflects a substantial effect. For example, we expect the odds ratio to be about 1.5 when the literacy proficiency improved by 50 points. In comparison to the findings about education (e.g., *OR* = 1.45 in the online transaction), potential effects of literacy seem equivalent, if not larger.

In regard to research question 2, the moderator functions in Model 2b and Model 2c show that the association between ICT use and education partially differs cross-nationally only between Japan and the United States, and that the association between ICT and literacy skills is comparable across all three nations. Specifically, higher

education appears to be a weaker determinant of email (*OR* = 0.20, $p < 0.05$) and online information (*OR* = 0.46, $p < 0.05$) in Japan compared to the United States. In other words, the positive effects of education on email and online information use were lower among middle-aged Japanese adults than those in the United States.

Results were robust. There was no sign of multicollinearity (VIF = 1.17 – 2.18 < 4.0), and all fully adjusted models demonstrated acceptable predictive accuracy (i.e., ROC curve scores between 0.70 and 0.78) Additionally, a series of alternative models (e.g., models with/out race/ethnicity and immigrants in the U.S. data) was examined to investigate potential sources of omitted variable bias, but these models produced substantively consistent results. While race/ethnicity and immigrant status are relevant in the U.S. sample, their inclusion makes cross-national comparison less feasible.

Discussion

Education and literacy skills were both associated with all four types of ICT use (i.e., general, email, online information, and online transaction) among middle-aged adults, and in a positive direction. These findings align with the proposed theoretical framework (van Dijk, 2013), and they add to previous research that has typically focused on adult populations (Fang et al., 2018; Hong & Cho, 2016; Morris, 2007). Education likely determines ICT exposure and access in earlier stages of life. The timing of formal education completion may differentiate initial adaptation of ICT innovations (e.g., see the diffusion of innovation theory, Rogers, 2003), which has implications for usage in subsequent life stages. Moreover, educational attainment is closely linked to socioeconomic status (i.e., resource factor), which largely determines access to ICT (Elena-Bucea et al., 2020; van Dijk, 2017). The central role of education for ICT use was further substantiated by the literacy skills findings.

Literacy skills were consistently associated with ICT use. Basic literacy skills are the foundation for more complex skill sets like digital literacy and health literacy (van Dijk, 2017; Yamashita et al., 2019). Present findings add to the education-related literature by showing that ICT use is independently associated with literacy skills net of education among middle-aged adults. Given close links between literacy skills and education, literacy could have explained the association between education and ICT use. Those with greater education and literacy likely have ICT-related advantages (e.g., familiarity, confidence, and interest in ICT) (van Dijk, 2012), whereas those with relatively lower education and literacy likely face barriers to ICT use (e.g., access to, experience with, and necessary skills to use ICT).

In regard to cross-national differences, computer use was more prevalent among middle-aged South Koreans compared to American or Japanese adults. Among middle-aged computer users, Americans were more likely to engage in email, online information, and online transaction than Japanese adults. The differences between Americans and South Koreans in the engagement in email and online information were identified, while no statistical difference was observed in the online transaction. These cross-national differences were not observed in the regression results, which suggests that they are likely due to cross-national differences in the prevalence of education and literacy, as well as socioeconomic and cultural factors (Drori & Jang, 2003; Ono & Zavodny, 2007; Rogers, 2003). In addition, in view of the resources and appropriation theory, and diffusion of innovation theory, the differing ICU use could have been impacted by the sociohistorical context to the cohort of middle-aged adults, and timing of ICT diffusion in each country (Rogers, 2003; van Dijk, 2013).

Associations of education and literacy with ICT use were largely comparable across the United States, Japan, and South Korea, with a couple exceptions. Education was a stronger determinant of both email and online information use among Americans compared to Japanese middle-aged adults. These findings may speak toward cross-national differences in education systems. For example, the primary and secondary Japanese systems focus on traditional education and the U.S. curriculum is relatively more applied (Wieczorek, 2008), which may result in the differences in developing literacy skills and use of ICT (Liu, 2018). Disentangling these education-related findings with respect to the education system, infrastructure and culture warrant future attention.

Significant covariates such as income and self-rated health may help refine the interpretation of the computer use-related findings in future research. By the same token, the statistical significance of sex and paid work

in relation to the email use need further exploration to study gender, types of job (e.g., technology-intensive) and relevant socioeconomic differences in the common communication method (Tikkanen, 2017). Moreover, the roles of parents' education and age in relation to online information use and online transaction use should be investigated more to contextualize the findings from this study when more cross-national data become available. Interestingly, Park and Jun (2003) reported that South Korean adults and U.S. adults showed different online transaction behaviors in terms of risk tolerance and time spent. Presumably, parent's educational attainment and age might have been linked with the cultural differences (i.e., perceived risk and online shopping). Yet, more future research is needed to empirically examine the role of parent's education in relation to the digital divide and cultural differences (e.g., individual vs. group-oriented culture) across East Asian and Western nations.

Limitations

The present study sought to establish associations of both education and literacy with ICT use, and thus provided cross-national evidence to help provide robust findings. Future research that includes higher-level constructs and/or societal-level factors is needed to explore the cross-national differences presented in this study. Also, more in-depth inquiries through qualitative interviews and field observations to refine the interpretations of county-level differences in future research. The PIAAC limited specific ICT use assessments (i.e., email, online information, and online transaction) to self-reported computer users. In addition, specific ICT use measures cannot extend to specific device use (e.g., computer, smartphone, tablet), and as such, the interpretation might have overlooked access to specific digital device. While the application of survey weights was intended to address this issue, some bias due to the over-representation of middle-aged adults who have at least some ICT experience may remain. Finally, omitted variable bias cannot be ruled out.

Strengths and Contributions

Previous research has overwhelmingly focused on general ICT use (De Haan, 2004), and this study examined detailed ICT measures. The present findings are among the first surrounding specific ICT use and literacy skills. Moreover, previous research has largely relied on overly simple measures of literacy, and PIAAC provided refined literacy assessments. This study demonstrated that education and literacy are independent determinants of the digital divide across cultures, which highlights the universal importance of foundational skills. Finally, extant research has almost exclusively focused on older adults (Mitchell et al., 2018), and the current study extends relevant theoretical contexts (Rogers, 2003) to middle-aged adults.

Implications and Conclusion

Investment in malleable and foundational determinants of digital literacy, such as basic literacy skills, may be a fruitful strategy to help close the digital divide. Given that links between technology and aging have become stronger in more recent years (Pruchno, 2019; van Dijk, 2012), it may be advantageous to enhance basic skills in mid-life through adult education (Ferraro et al., 2009). By the same token, such efforts to improve adult literacy may also benefit other life domains, such as health-related issues and social isolation, which are prevalent in later life (Mitchell et al., 2018; Yamashita et al., 2019).

In sum, continuous investment in education, technology, and human capital across the life course is critical for closing the digital divide (Chinn & Fairlie, 2007). It is evident that both basic and digital skills training should be part of such efforts. Private settings and one-on-one sessions for skills training are preferred by adult populations (Friemel, 2016). ICT developers should focus their efforts on designing age-friendly and culturally sensitive hardware and applications (Pruchno, 2019). Finally, the promotion of positive images of ICT use among the aging population is needed to encourage engagement (Fang et al., 2018).

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TABLE 1: Weighted Descriptive Summary by Country

VARIABLES	All (n = 7,268)	USA (n = 2,150)	Japan (n = 2,318)	South Korea (n = 2,800)
	Percentage or mean (S.E.)	Percentage or mean (S.E.)	Percentage or mean (S.E.)	Percentage or mean (S.E.)
ICT use in everyday life				
Computer user	80.03%	80.45%	78.13%	82.55%*†
Email user [a]	82.93%	90.56%	70.08%*	59.77%*†
Online information user [a]	77.45%	84.35%	59.59%*	75.11%*†
Online transaction user [a]	58.47%	68.59%	33.00%*	52.95%†
Personal factors				
Age (5-year age group)			*	†
45-49	25.78%	26.24%	23.48%	28.90%
50-54	25.50%	26.88%	20.73%	29.39%
55-59	22.51%	23.04%	21.41%	22.14%
60-65	26.21%	23.84%	34.38%	19.56%
Sex (female)		47.14%	50.43%	49.77%
Self-rated health (1-5: poor – excellent)	3.13 (0.02)	3.40 (0.03)	2.81 (0.02)*	2.34 (0.02)*†
Positional factors				
Educational attainment (Bachelor's degree or higher)	25.91%	29.16%	22.77%*	14.88%*†
Paid work (yes)	77.57%	77.56%	78.66%	74.87%*†
Parents' education (at least one parent/guardian with a postsecondary education degree)	23.46%	27.41%	23.23%*	8.61%*†
Living with spouse/partner (yes)	84.43%	83.49%	86.28%	84.70%†
Having child/ren in household (yes)	86.07%	85.10%	84.92%*	94.74%†
Resource factors				
Literacy skills (score 0-500)	268.46 (0.85)	264.51 (1.22)	283.82 (1.14)*	252.55 (0.94) †
Income (decile)	4.70 (0.05)	4.87 (0.08)	4.53 (0.08)	4.16 (0.07)* †

* $p < 0.05$ (vs. USA); † $p < 0.05$ (vs. Japan)
Sampling weights and replicate weights were applied. For the bivariate tests, either t-test or chi-square test was used.
a. only computer users were included.
Data source: 2012 PIAAC Public Use File

TABLE 2: Estimated Odds-Ratios for Weighted Binary Logistic Regression of Computer Use on Persona, Positional, and Resource Predictors

EFFECTS	Model 1a Odds ratio (Standard error)	Model 2a Odds ratio (Standard error)
Personal effects		
Age (5-year age group)		0.90 (0.05)*
Sex (female)		0.88 (0.13)
Self-rated health (1-5: poor – excellent)		1.22 (0.07)*
Positional effects		
Educational attainment (Bachelor's degree or higher)	**2.67 (0.34)***	**2.29 (0.32)***
Paid work (yes)		0.88 (0.13)
Parents' education (at least one parent/guardian with a post-secondary education degree)		1.13 (0.18)
Living with spouse/partner (yes)		1.12 (0.19)
Having child/ren in household (yes)		0.85 (0.17)
Resource effects		
Literacy skills (score 0-500)	**1.01 (0.01)***	**1.01 (0.01)***
Income (decile)		1.05 (0.02)*
Japan (vs. USA)	1.71 (0.77)	2.54 (1.28)
South Korea (vs. USA)	2.25 (1.09)	1.84 (1.01)
Moderation effects		
Education *x* Japan (vs. USA)	0.89 (0.13)	1.00 (0.17)
Education *x* South Korea (vs. USA)	0.99 (0.18)	1.00 (0.20)
Literacy *x* Japan (vs. USA)	1.00 (0.01)	0.99 (0.01)
Literacy *x* South Korea (vs. USA	1.00 (0.11)	1.00 (0.01)
Model fit index (Area under the ROC curve)	0.75	0.78

* $p < 0.05$; Educational attainment, literacy skills, country and interaction effects were further evaluated in terms of consistency between models; ROC curve = receiver operating characteristics curve; Sampling weights and replicate weights were applied

Data source: 2012 PIAAC Public Use File

TABLE 3: Estimated Odds-Ratios for Weighted Binary Logistic Regression of Email Use on Persona, Positional, and Resource Predictors

EFFECTS	Model 1b Odds ratio (Standard error)	Model 2b Odds ratio (Standard error)
Personal effects		
Age (5-year age group)		0.89 (0.05)*
Sex (female)		0.59 (0.07)*
Self-rated health (1-5: poor – excellent)		1.09 (0.07)
Positional effects		
Educational attainment (Bachelor's degree or higher)	**5.30 (2.18)***	**5.69 (3.04)***
Paid work (yes)		0.58 (0.11)*
Parents' education (at least one parent/guardian with a post-secondary education degree)		1.84 (0.32)*
Living with spouse/partner (yes)		0.91 (0.14)
Having child/ren in household (yes)		0.81 (0.16)
Resource effects		
Literacy skills (score 0-500)	**1.01 (0.01)***	**1.01 (0.01)***
Income (decile)		1.06 (0.02)*
Japan (vs. USA)	0.94 (0.79)	1.47 (1.71)
South Korea (vs. USA)	0.62 (0.60)	0.43 (0.48)
Moderation effects		
Education *x* Japan (vs. USA)	0.23 (0.10)*	0.20 (0.10)*
Education *x* South Korea (vs. USA)	0.80 (0.33)	0.66 (0.32)
Literacy *x* Japan (vs. USA)	1.00 (0.01)	1.00 (0.01)
Literacy *x* South Korea (vs. USA	1.00 (0.01)	1.00 (0.01)
Model fit index (Area under the ROC curve)	0.73	0.73

* $p < 0.05$; Educational attainment, literacy skills, country and interaction effects were further evaluated in terms of consistency between models; ROC curve = receiver operating characteristics curve; Sampling weights and replicate weights were applied

Data source: 2012 PIAAC Public Use File

TABLE 4: Estimated Odds-Ratios for Weighted Binary Logistic Regression of Online Information Use on Persona, Positional, and Resource Predictors

EFFECTS	Model 1c Odds ratio (Standard error)	Model 2c Odds ratio (Standard error)
Personal effects		
Age (5-year age group)		0.96 (0.06)
Sex (female)		0.82 (0.11)
Self-rated health (1-5: poor – excellent)		1.02 (0.06)
Positional effects		
Educational attainment (Bachelor's degree or higher)	**3.38 (0.73)***	**3.54 (0.92)***
Paid work (yes)		0.93 (0.15)
Parents' education (at least one parent/guardian with a post-secondary education degree)		1.33 (0.18)*
Living with spouse/partner (yes)		1.17 (0.19)
Having child/ren in household (yes)		0.89 (0.16)
Resource effects		
Literacy skills (score 0-500)	**1.01 (0.01)***	**1.01 (0.01)***
Income (decile)		1.01 (0.02)
Japan (vs. USA)	0.27 (0.20)	0.37 (0.32)
South Korea (vs. USA)	1.10 (0.99)	0.81 (0.80)
Moderation effects		
Education *x* Japan (vs. USA)	0.44 (0.11)*	0.46 (0.12)*
Education *x* South Korea (vs. USA)	0.57 (0.17)	0.51 (0.17)
Literacy *x* Japan (vs. USA)	1.00 (0.01)	1.00 (0.01)
Literacy *x* South Korea (vs. USA	1.00 (0.01)	1.00 (0.01)
Model fit index (Area under the ROC curve)	0.70	0.70

* $p < 0.05$; Educational attainment, literacy skills, country and interaction effects were further evaluated in terms of consistency between models; ROC curve = receiver operating characteristics curve; Sampling weights and replicate weights were applied

Data source: 2012 PIAAC Public Use File

TABLE 5: Estimated Odds-Ratios for Weighted Binary Logistic Regression of Online Transaction Use on Persona, Positional, and Resource Predictors

EFFECTS	Model 1d Odds ratio (Standard error)	Model 2d Odds ratio (Standard error)
Personal effects		
Age (5-year age group)		0.81 (0.04)*
Sex (female)		0.86 (0.11)
Self-rated health (1-5: poor – excellent)		1.06 (0.05)
Positional effects		
Educational attainment (Bachelor's degree or higher)	1.77 (0.28)*	1.45 (0.24)*
Paid work (yes)		1.01 (0.17)
Parents' education (at least one parent/guardian with a post-secondary education degree)		1.57 (0.20)*
Living with spouse/partner (yes)		0.81 (0.14)
Having child/ren in household (yes)		0.97 (0.18)
Resource effects		
Literacy skills (score 0-500)	1.01 (0.01)*	1.01 (0.01)*
Income (decile)		1.01 (0.02)
Japan (vs. USA)	0.65 (0.48)	1.34 (1.16)
South Korea (vs. USA)	1.34 (1.00)	1.45 (0.36)
Moderation effects		
Education *x* Japan (vs. USA)	0.83 (0.17)	1.05 (0.23)
Education *x* South Korea (vs. USA)	1.18 (0.25)	1.29 (0.32)
Literacy *x* Japan (vs. USA)	1.00 (0.01)	0.99 (0.01)
Literacy *x* South Korea (vs. USA	1.00 (0.01)	1.00 (0.01)
Model fit index (Area under the ROC curve)	0.75	0.76

* $p < 0.05$; Educational attainment, literacy skills, country and interaction effects were further evaluated in terms of consistency between models; ROC curve = receiver operating characteristics curve; Sampling weights and replicate weights were applied

Data source: 2012 PIAAC Public Use File