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Moderators in the Adoption of E-Learning: An Investigation of the Role of Gender

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Abstract

Past research has hypothesized and empirically supported a model for learners' acceptance of e-learning. To further investigate the influence of gender on e-learning acceptance, data were collected from a sample of 259 Taiwanese undergraduates that were relatively balanced between genders. Comparisons of means and multiple-group Structural Equation Modeling (SEM) with LISREL were used to analyze the data.

Examining *t*-test results indicated that differences in construct means between males and females occurred only for some of the model predictors. Specifically, men have more confidence in using the technology, more Internet experience, a higher perception of system interactivity, and higher beliefs of usefulness and ease of use than women. However there is no significant difference in their intentions to use the e-learning system. In addition, multiple-group SEMs revealed that gender moderated some of the relationships between the hypothesized determinants and intentions to use the e-learning system. In particular, women's adoption intention for distance education purposes is more strongly influenced by system interactivity. Women's perception of e-learning usefulness is negatively influenced by self-efficacy. Some implications for practical purposes are addressed.

1. Introduction

E-learning has become an information system market full of growth potential with the computer and Internet steadily gaining popularity [1] [32]. The phenomenon seems to have gone in the direction as Peter Drucker, a noted management professor, has pointed out that the biggest impact of Information Technology (IT) would be on knowledge industries such as education and medicine that were in great need of increased productivity [6]. Corporate training, universities, government, and K-12 education have become four important market segments for e-learning.

An e-learning system is an integrated system as opposed to stand-alone, single-function systems. Recently, more advanced e-learning systems, such as WebCT (http://www.webct.com) and Cyber University of NSYSU (http://cu.nsysu.edu.tw) have been developed. These systems are specifically designed for teaching and learning purposes and can be used to integrate course development tools, course material (audio, video, and text), e-mail, live chat sessions, online discussions, and the World Wide Web. With this kind of system, instructional delivery and communication between instructors and students can be conducted either synchronously or asynchronously.

According to the Digest of Education Statistics 2000 [25], between 1988 and 1998, the enrollment growth of key demographic groups has been changing. During that ten-year period, the enrollment in degree-granting institutions for females (16%) was higher than for males (6%). This difference was especially noticeable at the graduate level, as the number of female full-time graduate students increased 60% as opposed to a 17% increase for males. A similar increase of female students has taken place in Taiwan between 1986 and 1999, according to the Ministry of Education [23]. In the adoption of innovation (in this case, e-learning), the factors predicting e-learning adoption may vary across demographic groups. The purpose of this study then is to investigate how gender will influence the acceptance of an e-learning system. In particular, the following research questions guided the study:

1. Do male and female learners have similar perceptions and use intentions regarding e-learning acceptance?
2. Do the relationships between learners' behavioral intentions to use an e-learning system and determinant factors differ for male and female learners?

2. Literature Review

2.1 Research Model

Lee and Pituch [21] proposed and empirically supported an e-learning acceptance model as shown in Figure 1. The model is derived from the Technology Acceptance Model [10] and Diffusion of Innovation (DOI) perspective [27]. This model uses behavioral intention as a surrogate for IT acceptance of novice learners. The acceptance criteria were categorized into behavioral intentions to use the e-learning system as a supplementary learning tool (IU1) and as a distance education method (IU2). Lee and Pituch found that factors related to IT acceptance included perceived usefulness (PU), perceived ease of use (PEOU), system characteristics (functionality, interactivity, and response), and learner characteristics (self-efficacy and Internet experience). In this study, as well as that of Lee and Pituch, behavioral intention is

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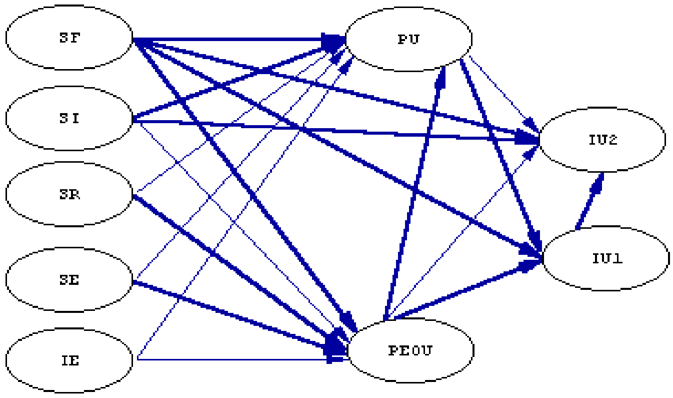

Bold line – Significant at .05

Figure 1. E-learning acceptance model (Lee & Pituch [21])

interpreted as the strength of one's intention to use an e-learning system either as a supplementary tool for a face-to-face class or as an entire on-line distance education method. Based upon Davis et al. [10], perceived usefulness is interpreted as the prospective learner's subjective probability that using an e-learning system will increase his or her learning performance. Perceived ease of use is interpreted as the degree to which the prospective learner expects the e-learning system to be free of effort.

In addition, Lee and Pituch [21] hypothesized that e-learning acceptance was related to three system factors and two learner characteristics. The system characteristics are defined as follows. System functionality (SF) is a learner's opinion or perception of system functions related to learning and relative advantage as to time and place in learning. Relative advantage, according to Rogers [27, p.212], is "the degree to which an innovation is perceived as being better than the idea it supersedes." System interactivity (SI) is a learner's opinion or perception of the e-learning system's ability in enabling interactions between teacher and students, and among students themselves. System response (SR) is the degree to which a learner perceives whether the system response is fast/slow, consistent, and reasonable in requesting a system service [2]. For the learner characteristics, self-efficacy (SE), based on [7], is defined as one's self-confidence in his or her ability to perform certain learning tasks using an e-learning system. Internet experience (IE) is the extent to which a prospective learner uses the Internet [28].

2.2 The Role of Gender

Associations between gender and technology have been reported. An early example of gender differences in technology adoption was telephone use, where women's use of the telephone for socialization purposes helped expand this usage in both residential and business areas [22]. Hopkins [18, p.3] encouraged others to study gender differences, stating, "A significant part of the study of technology and gender is the study of how new technologies are evaluated through the lens of an existing gender system."

Gender differences have also been found with other technology adoption. For example, "computational reticence" [33, p.365] is the resistance to become emotionally and socially involved with computers. It explained women's initially less frequent use of computers. In addition, men and women tend to view the world differently. Men tend to see the real world as a hierarchical structure whereas women tend to view it as an interconnected web of people [16]. From this perspective, computer and communication technology might affect men and women differently because of the different communication patterns adopted. Also, gender is one of the physiological factors influencing knowledge acquisition. For example, men are inclined to be competitive and aggressive and may respond better to competitive games [17]. In addition, a study of knowledge workers in the airline industry found that women and men differed in their beliefs of usefulness and ease of use but not actual use of e-mail [13]. That study also suggested that researchers should include gender in IT adoption models. Another study investigating gender differences in adopting new software systems found that men's technology acceptance was more strongly affected by their perception of usefulness, while women were more strongly influenced by perceptions of ease of use and subjective norms [34].

The e-learning acceptance model (as shown in Figure 1) has been validated in prior research. It provides a sound framework for further exploration of gender differences in technology adoption. In addition, reviewing the literature suggests that construct means and some of the relationships in the model may vary for males and females. Therefore, the focus of the research is on exploring how these groups may differ regarding e-learning acceptance and its determinants.

3. Methodology

For this study, data collected from previous research [21] were examined for gender differences. In brief, participants in the study consisted of postsecondary students enrolled in computer classes at a college in

Taiwan. Students were given a 40-minute live demonstration of an e-learning system and 30 minutes to individually practice with it. The e-learning system used is the Cyber University at National Sun Yat-Sen University, Taiwan. It provides Internet users with a guest account. A total of 259 surveys were collected from participants in the demonstration and practice phases. Respondents were relatively balanced between sexes (male 41.7%, female 58.3%) and educational divisions (traditional students 55.2%, non-traditional students 44.8%). The survey instrument that was used in [21] is shown in Appendix 1. Seven-point Likert-type scales were used to measure learners' agreement/ disagreement level for usefulness, ease of use, behavioral intentions, system functionality, system interactivity, and system response. The same scales were used to measure learners' confidence in using the technology as well as the extent to which learners had previously used the Internet. Learners' demographic data were also collected. To address research question 1, separate *t*-tests were used to examine gender differences in the composite means of all nine factors. For research question 2, multi-group Structural Equation Modeling (SEM) [4] [20] [31] with LISREL 8.50 was used to identify the moderating effects of gender on the research model (as shown in Figure 1).

A multi-group SEM is "an SEM extension that permits the comparison of models over multiple populations or groups" [31, p.219]. The main focus of a multi-group analysis is to identify differences in path coefficients between groups [20]. Prior to testing a multi-group path model, researchers typically test the equality of factor structures of the measurement model across groups [19]. In this study, such a factor-loading invariance model was tested by examining the difference in model fit as reflected by chi-square statistics for two opposing confirmatory factor analysis (CFA) models: one with the factor loadings constrained to be the same across groups and the other without such constraints. Second, a test of invariance of the model paths was conducted by constraining the paths to be the same across both groups [4] [20]. Model fit indices were examined. In addition, modification indices were also examined to determine which path, if estimated separately for each group, would result in a significant chi-square decrease reflecting an improvement in model fit. Models were re-specified accordingly and tested. The procedure continued until there were no more modification indices indicating possible improvement in model fit. Covariance matrices for both male and female groups were used as input data for the multi-group SEM. For sample size considerations, researchers using the SEM approach have recommended various minimum sample sizes. A minimum of 100 has been suggested [3]. In addition, the average sample size for MIS studies using LISREL was 249 (minimum 41, maximum 451) [15]. Therefore, the sample size of 108 men and 151 women in this study was considered adequate.

4. Research Findings

As shown in Table 1, male learners had higher mean scores than female learners for each of the nine constructs associated with learners' behavioral intentions to use e-learning. Using an alpha level of .05, significant differences favoring males were found for the constructs perceived usefulness, perceived ease of use, system interactivity, self-efficacy, and Internet experience. With the Bonferroni approach, where .05 was divided by the number of tests (9) or .006, to adjust the significance level to minimize the chances of making a Type I error, male learners had significantly higher means in perceived usefulness, perceived ease of use, self-efficacy, and Internet experience than female learners.

Table 1. Differences in factor means based on gender

	Male		Female			
Factors	*M*	*SD*	*M*	*SD*	*t* value	Prob.
PU	5.14	1.03	4.78	0.91	2.996	.003**
PEOU	5.31	1.11	4.86	1.00	3.399	.001**
IU1	5.27	1.24	5.00	1.04	1.874	.062
IU2	5.30	1.22	5.13	1.20	1.095	.275
SF	5.72	1.07	5.69	0.95	0.239	.812
SI	5.06	1.17	4.73	1.06	2.362	.019*
SR	4.89	1.09	4.73	0.92	1.303	.194
SE	5.01	1.21	4.49	1.07	3.666	.000**
IE	5.39	1.32	4.90	1.21	3.087	.002**

Note. N = 108 for male, 151 for female, df = 257 for each factor. $^{*}p < .05$. $^{**}p < .006$ using Bonferroni approach.

A multi-group SEM was conducted to compare the structural equation model over male and female learners. The purpose of this analysis was to identify if gender moderated any of the relationships in the model used to predict learners' behavioral intentions to use e-learning. Prior to testing the differences in path estimates between males and females, measurement models were tested for each group separately. Table 2 shows that the measurement models (single group CFA) for both females and males had adequate model fit. In addition, examining the difference in fit between a baseline model that allowed all factor loadings to vary across the two groups and a factor loading invariance model that constrained the factor loadings to be the same for males and females provides support for the more restrictive model. As presented in Table 2, the difference in the fit of these models is not statistically significant, $\chi^2_{\text{difference}}$ (41, N = 259) = 54.29, p > .05. In addition, since the overall fit indicators provide support for the invariant factor loading model, this measurement model was used to test the difference in the relationships among constructs for males and females.

Following the establishment of a common measurement model, a series of multi-group SEMs were performed. As suggested by [4] [20], the first model specified that the structural paths, reflecting the relationships among the constructs, were the same for males and females. The analysis of this model indicated an acceptable model fit, χ^2/df = 1.43, CFI = .957, NNFI = .951. However, the modification indices indicated that the chi-square would decrease 3.88 if the path from SE to

Table 2. Test results of multi-group SEMs based on gender

Model	N	χ^2	df	χ^2/df < 3.0[a]	χ^2_{diff}	df_{diff}	CFI > .90[a]	NNFI > .90[a]
Single Group CFA								
Female	151	311.13*	216	1.44			0.962	0.952
Male	108	316.76*	216	1.47			0.956	0.944
Multiple Group CFA								
Baseline (no constraints)	259	627.89*	432	1.45			0.959	0.948
Factor Loading Invariance	259	652.58*	473	1.44	54.29	41	0.957	0.949
Multiple Group SEM Models								
1. Paths Invariance	259	687.67*	480	1.43			0.957	0.951
2. Free SE->PU	259	683.72*	479	1.43	3.95*	1	0.958	0.951
3. Free SI->IU2	259	679.74*	478	1.42	3.98*	1	0.958	0.952

[a] Recommended values. * p <.05.

PU were estimated separately for each group. A model allowing for this relationship to differ across groups was then specified accordingly and tested. The fit of this model was acceptable, χ^2/df = 1.43, CFI = .958, NNFI = .951, and had better fit than the initial model, $\chi^2_{difference}$ (1, N = 259) = 3.95, p < .05. The modification indices for this second model also suggested that the chi-square would decrease 3.90 if the path from SI to IU2 were estimated separately for each group. This third model was specified accordingly and tested. The fit of this model was also acceptable, χ^2/df = 1.42, CFI = .958, NNFI = .952, and had better fit than the second model,$\chi^2_{difference}$ (1, N = 259) = 3.98, p < .05. For this third model, a modification index of 4.94 was obtained for freeing the estimation of the path from IU2 to IU1. Since the link was not in the hypothesized model, it was not considered. No other modification indices (the largest was 3.246) indicated that any further improvement in model fit could be achieved by freeing estimation of other paths.

The moderating effects of gender on the relationships in the path model are presented in Table 3. The standardized direct effects found to be the same across gender groups are shown in the common metric column. The values shown in the female and male columns are the standardized path coefficients estimated separately for each group. In particular, system interactivity influenced behavioral intention to use the IT as a distance education method for females (0.213, significant) but not for males (0.042, insignificant). Self-efficacy negatively influenced the perception of usefulness for females (-0.199, significant) but not for males (0.013, insignificant). The results of multi-group SEMs for gender are illustrated in Figure 2.

5. Discussion

The results of this study indicated that, with regard to e-learning, male learners had more confidence in using the technology, more Internet experience, a higher perception of system interactivity, and higher beliefs of technology usefulness and ease of use. These results are consistent with prior studies [8] [24] [26] [35]. For example, males were found to have significantly higher computer self-efficacy [24]. Females, on the other hand, were found to have significantly less positive attitudes/opinions towards computing than males [8] [26] [35]. In a recent study investigating gender differences in individual adoption of technology, the respective composite means of perceived usefulness, perceived ease of use, and behavioral intention for men were all higher than women's at three different stages (post training, after one month, and after three months), although the difference of perceived usefulness in the post training stage was insignificant [34]. The results of this study as presented in Figure 3 are in accord with those prior studies. Yet one prior research investigating gender differences in e-mail use presented mixed results: men had a significantly higher perception of ease of use than women, but had an opposite results for perceived usefulness [13].

Examining the differences in construct means through

Table 3. The moderating effects of gender on the research model

Outcome	Determinant	Standardized Direct Effects: Common Metric	Female	Male
Perceived Ease of Use	System Functionality	0.187*		
	System Interactivity	0.125		
	System Response	0.276*		
	Self-efficacy	0.277*		
	Internet Experience	0.110		
Perceived Usefulness	Perceived Ease of Use	0.215*		
	System Functionality	0.114*		
	System Interactivity	0.334*		
	System Response	0.171		
	Self-efficacy		-0.199*	0.013
	Internet Experience	0.086		
Intention to Use 1 (Supplementary tool)	Perceived Usefulness	0.379*		
	Perceived Ease of Use	0.276*		
	System Functionality	0.304*		
Intention to Use 2 (Distance Education)	Intention to Use 1	0.405*		
	Perceived Usefulness	0.110		
	Perceived Ease of Use	0.090		
	System Functionality	0.234*		
	System Interactivity		0.213*	0.042

Note. $N = 259$. * $p < .05$.

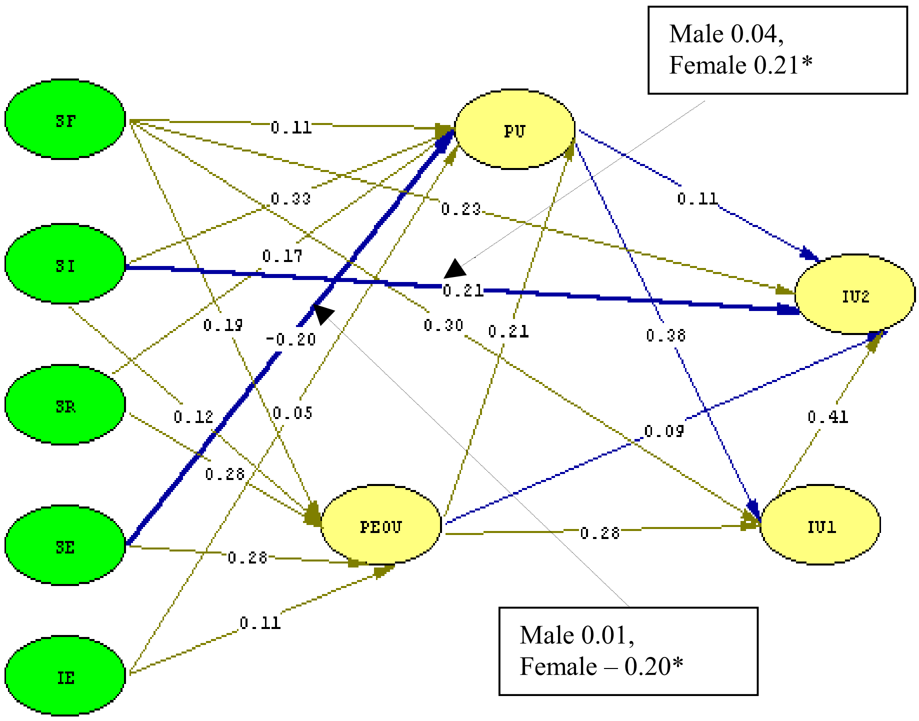

Figure 2. Multi-group SEM results for male and female learners

the path model of this study (SE -> PEOU -> PU -> IU1 -> IU2) indicated that gender differences were large for self-efficacy but decreased on the path to IU2 as shown in Figure 3. The p-value for the *t*-test of these mean differences increased from less than .001 (significant) to a .275 (insignificant). These results are consistent with the finding that gender differences occur in the “the initial expectations for performance” [12, p.106] [13].

In addition, gender showed a moderating effect on some of the relationships in the path model. The relationships in the path model were the same for both female and male learners except for two paths. First, the direct effect of system interactivity on intention to use IT for distance education was present for females but not for males. In other words, system interactivity was more important to female than male learners in determining intention to use the IT for distance education. Considering the many-to-many communications provided by the Web-based learning technology, it enables the networking approach of communication pattern apparently preferred by female learners and, therefore, seems to be more important for females than males. This finding is consistent with the notion as stated by [13] that women tend to adopt a networking approach, using discourse to achieve intimacy, support, consensus, and rapport [30], whereas men tend to adopt a communication pattern based on social hierarchy [29]. These two communication patterns appear to have different implications to learners’ intentions to use the e-learning system.

Second, self-efficacy significantly impacted perceived usefulness for females in a negative direction. This suggests that females with more confidence in using the technology have weaker beliefs in the technology’s usefulness. One possible explanation for this counterintuitive finding is that female learners who have relatively lower initial confidence in using a new technology may be overwhelmed after a brief exposure to the technology and, as a result, may have overly high expectations of its usefulness. On the other hand, females having a higher confidence level may perceive that the system is not that useful. This phenomenon needs to be further investigated.

In addition, study results indicated that the relationship between perceived usefulness and behavioral intentions were the same for men and women, and the relationship between perceived ease of use and behavioral intentions also did not differ for men and women. Therefore, the findings [34] that men’s adoption decisions were more strongly influenced by their perceptions of usefulness, and women’s were more strongly influenced by perceptions of ease of use, were not supported.

6. Conclusions

Theoretically, this study further identifies some of the differences in the perceptions of technology acceptance and differences in the relationships between predictors of this acceptance for males and females. Although male learners have significantly more confidence in using the technology, more Internet experience, a higher perception of system interactivity, and higher beliefs of usefulness and ease of use than female learners, there is no significant difference in their intentions to use the e-learning system. In addition, gender has moderating effects on the relationships between the hypothesized determinants and intentions to use the e-learning system. In particular, women’s adoption intention for distance education purposes is more strongly influenced by system interactivity. Women’ perception of e-learning usefulness is negatively influenced by self-efficacy.

For practical purposes, the results of this study may be beneficial to educators and corporate trainers. The findings in this study suggest that specific factors may be targeted to enhance IT use among the groups. For example, special emphasis can be placed on improving system interactivity in order to elevate female learners’ intention to use the e-learning system for distance education.

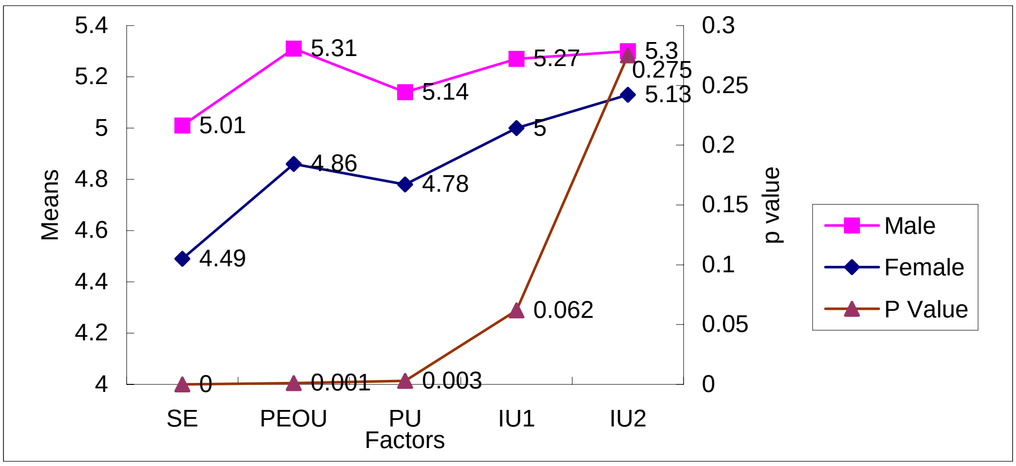

Figure 3. Gender differences on factor means

7. Appendices

Appendix 1: Operationalization of Constructs

Constructs	Questions	References
Perceived Usefulness (PU)	Using the Web-based learning system will allow me to accomplish learning tasks more quickly. Using the Web-based learning system will improve my learning performance. Using the Web-based learning system will make it easier to learn course contents. Using the Web-based learning system will increase my learning productivity. Using the Web-based learning system will enhance my effectiveness in learning.	[9][14]
Perceived Ease of Use (PEOU)	Learning to operate the Web-based learning system is easy for me. It is easy for me to become skillful at using the Web-based learning system. I find the Web-based learning system easy to use.	[9][14]
Intention to Use (IU1) (IU2)	**The Web-based learning system as a supplementary course tool:** I will always try to use the Web-based learning system to do a learning task whenever it has a feature to help me perform it. I will always try to use the Web-based learning system in as many cases/occasions as possible. **The Web-based learning system as an entire distance education method:** I intend to take this course and always try to use the Web-based learning system to do a learning task whenever it has a feature to help me perform it. I plan to take this course and always try to use the Web-based learning system in as many cases/occasions as possible.	[5][11]
System Functionality (SF)	The Web-based learning system offers flexibility in learning as to time and place. The Web-based learning system offers multimedia (audio, video, and text) types of course contents.	
System Interactivity (SI)	The Web-based learning system enables interactive communications between instructor and students. The Web-based learning system enables interactive communications among students.	
System Response (SR)	When you are using the Web-based learning system, system response is fast. In general, the response time of the Web-based learning system is consistent. In general, the response time of the Web-based learning system is reasonable.	[2]
Self Efficacy (SE)	**I am confident of using the Web-based learning system …** Even if there is no one around to show me how to do it. Even if I have only the online instructions for reference.	[7][28]
Internet Experience (IE)	**Please indicate the extent to which you use the Internet to perform the following tasks:** Gathering information Communication (e.g. email, chat) Downloading free software	[28]

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