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Revista de cercetare și intervenție socială

ISSN: 1583-3410 (print), ISSN: 1584-5397 (electronic)
Selected by coverage in Social Sciences Citation Index, ISI databases

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Revista de cercetare și intervenție socială, 2015, vol. 50, pp. 156-171

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Holt Romania Foundation
REVISTA DE CERCETARE SI INTERVENTIE SOCIALA
is indexed by ISI Thomson Reuters - Social Sciences Citation Index
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An Assessment of Individual and Technological Factors for Computing Validation: Motivation and Social Processes

Tzong-Song WANG[1], Sheng-Wen HSIEH[2]

Abstract

This study identified the attitudes toward using computers and Web-based technology as measured by the Computer attitude scale (CAS) and the Web-based attitude scale (WAS). Also this study examined individual and technological factors which determine learner levels of anticipation to adopt Web-based learning technology in postsecondary education. A conceptual and modified model that was an extension of the Technology Acceptance Model (TAM), TAM2, and Web-based Instruction (WBI) provided the theory and design for the study. Data were analyzed through two-way MANOVA to decipher learner behaviors related to adopting Web-based learning technology in postsecondary education. A combination of behavioral and psychometric questionnaires consisting of TAM perceptions, computer attitude scales, Web-based attitude scales, and demographic information was created. Results in this research noted that prior computing experiences had significant correlations between the CAS and the WAS. Perceptions of usefulness and ease of use, intentions to use for supplementary learning and distance education had significant relationships based on CAS and WAS. The study suggested that the TAM assessment process may be potentially valuable in teacher candidate assessment and recruitment, with an eye to increasing the pace of online resource diffusion. The aim is to model and predict the learner behavior and to assess the motivation of computing identification for some technological factors. Knowledge of social change process, as it synthesizes motivations and beliefs with technological innovations, is necessary for leaders who seek to build a better world through using technology in education.

Keywords*: virtual learning, technology acceptance model, web-based learning, education, computing, motivation.*

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Introduction

Recently, serious concerns about the proper role, effectiveness, and future of educational technology in the classroom have been raised (Mann & Robinson, 2009). The typical college student of today is a frequent user of information technology. The vast majority (i.e., slightly more than 85%) of Fall 2009 college freshmen report proficiency in basic computer use (Heimler *et al.*, 2009). Information technology (IT) has begun gradually to play an indispensable role in industrialized society. For many people, computers have become valuable tools to access information and communicate with others (Wang, 2012). Course Management Systems (CMS) or Learning Management Systems (LMS), such as WebCT, Blackboard, and Moodle, have been widely adopted by many educational institutions for online course-building (Vrasidas, 2004). Hammoud *et al.* (2008) reported that students often have a positive attitude toward WebCT, and the use of WebCT has a positive influence on students' achievements and their outcomes.

Wei, Hung, Lee & Chen (2011) and Wang (2013) pointed out technology can help learners to have better learning experiences in terms of experiential learning, constructivist learning and joyful learning. Learners responded that interactive learning could increase their learning motivations and help them concentrate on the instruction and learning activity. Also, results showed learners were well-perceived the usefulness and ease of use of the technological education.

Individual acceptance and usage of new technology has been studied extensively over the past two decades, especially the Technology Acceptance Model (TAM), by (Davis, Bagozzi & Warshaw, 1989), and its successor, TAM2 (Venkatesh & Davis, 2000), which has aroused particular interest. Above models provide a stable and adequate way for predicting user acceptance of a wide range of new technologies. The TAM posits that the impact of other external variables on behavioral intention is fully mediated by perceived usefulness (PU) and perceived ease of use (PEOU) (Davis, 1989) (Davis, 1993). Davis theorized in the TAM that an individual's actual system usage is determined by behavioral intention, which is in turning determined by perceived usefulness and perceived ease of use. TAM has been widely discussed by many scholars. Lee (2001) developed a modification of the Technology Acceptance Model and used structural equation modeling to decipher learner behaviors related to adopting Web-based learning technology in postsecondary learning.

Gender as one of the individual factors affects the acceptance of virtual learning is still in dispute. Tsai and Lin (2004) revealed gender differences on perceptions of Internet. Gender differences affect mobile learning use intention (Wang, Wu & Wang, 2009). Gender stereotypes exist in information and communication technologies (Selwyn, *2007).* Most importantly, Shashaani (1993) believed that gender differences in computing receptivity are strongly affected by cultural context. In contrast, Christensen, Anakwe and Kessler (2001) found that there were no gender differences in distance learning receptivity. Zhang (2005) has reached a similar conclusion. In Hargittai and Shafer's study (2006), the differences in online abilities between men and women are limited.

Nanayakkara (2007) has found that release time, the ease of use, perceived usefulness, training and support, and reliability are the five most essential factors for e-learning systems. The author would like to assess different external factors in Taiwan with different elements and compare the results of different studies. This study drafts a conceptual mode based on TAM extension with the aim of researching following questions: (1) What were the relationships between post-secondary learner attitudes toward using computers and Web-based learning? (2) What were the relationships between prior computing experiences and post-secondary learner attitudes toward using computers and Web-based learning? (3) What differences existed in the postsecondary learner attitudes toward using computers and Web-based learning related to computing skills? (4) What differences existed in the postsecondary learner attitudes toward using computers and Web-based learning related to gender and learners' major fields of study?

Based on the research questions as above, the following null hypotheses have been established.

H1: There were no statistically significant relationships between the post-secondary learner attitudes toward using computers and attitudes toward using Web-based learning.

H2: There were no statistically significant relationships among PCE, CSs, the postsecondary learner attitudes toward using computers and attitudes toward using Web-based learning.

H3: There were no statistically significant relationships between computing skills and the postsecondary learner attitudes using computers and attitudes toward using Web-based learning.

H4: There were no significant relationships in the postsecondary learner attitudes toward using computers and Web-based learning related to gender and learners' major fields of study.

Methodology

TAM constructs and adaptations

The study followed the work of Lee (2001) who developed a modification of the Technology Acceptance Model, and used the Structural Equation Modeling to decipher learner behaviors related to adopting Web-based learning technology in adult and higher education. A combination of individual and technological questionnaires consisting of TAM perceptions, computer attitude scales, Web-based learning attitude scales, and demographic information was constructed.

The TAM perceptions separated behavioral intentions into two dimensions: intention to use for supplementary learning (IU1) and intention to use for virtual education methods (IU2). In addition to the TAM's constructs of perceived ease of use (PEOU), perceived usefulness (PU), individual factors such as personal and experiential characteristics are included in these concepts.

The personal characteristics consisted of two dimensions: Attitude toward Computers (CAS), Attitude toward Web-based learning (WAS). The experiential characteristics were comprised of four dimensions. The first dimension was Prior Experiences with Computers (PEC) - including experience in using word processing packages (PEC1), experience in using database programs (PEC2), and experience in using computer programming languages (PEC3).

The second dimension was Prior Experiences with Networks (PEN) - including experience in using the Internet/World Wide Web (PEN1), experience in using Internet programming languages (PEN2), and experience in using multimedia (PEN3). The last two of the four dimensions about computing skills (CSs) were Computer Skills (CS), and Network Skills (NS). The CAS and WAS were used to investigate different components of attitudes, including liking to work with a computer (comlike), confidence to use a computer (comcofd), comfort in using a computer (comcomf), perception of computer usefulness (comusfl), and liking to work with Web-based resources (weblike), confidence in using Web-based resources (webcofd), comfort in using Web-based resources (webcomf), perception of Web-based resources usefulness (webusfl).

The relationships among different factors related to the CAS and WAS were presented in (*fig. 1*).

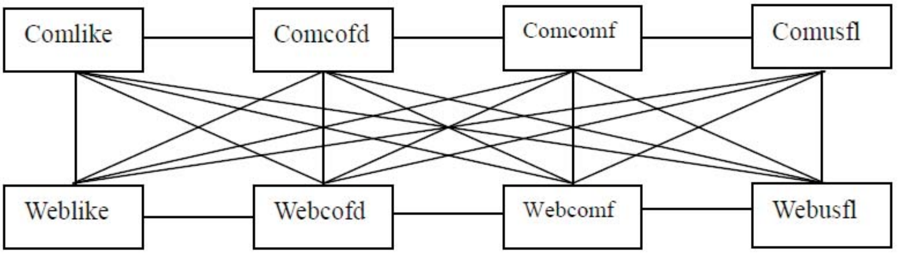

Figure 1. Relationships among different factors related to the CAS and WAS

Davis (1989) identified user attitudes as directly affecting behavioral intentions to use information technologies. Behavioral intentions, in turn, directly influence actual usage. In this study, the core constructs of the TAM concept included prior computing experience (PCE), computing skills (CSs), perceived usefulness (PU), perceived ease of use (PEOU), and behavior intention to use Web-based as a supplementary learning tool for IU1 and as a major learning medium for IU2.

The original TAM constructs were grounded on suggestions from Davis (1989) that external factors have full causal relationships with behavior intentions IU1, IU2. The importance of attitudes and beliefs for learning to use computers has been widely acknowledged. Due to the fact that the TAM computer attitude scale could not survey the perception of computer and Web-based environments simultaneously, it was necessary to include both the CAS and WAS in the model to recognize the perceptions of computer and Web-based environments.

Fig. 2 presents the research model, which was inferred, from TAM. This conceptual model which includes the direct effects of PEC, PEN on the CAS and the WAS based on the prior computing experience is positively linked to a positive attitude (Thompson, Higgins & Howell, 1994). Additionally, there is a causal relationship between computing skills like CS, NS and CAS, WAS based on the study of Smith and Necessary (1992) that reveals statistically significant differences between perceived knowledge of computers and an attitude towards computers. Also a pretest/posttest study by Woodrow (1992) supported the positive relationship between computing skills and positive attitude towards computers by measuring the change in knowledge of computers and attitude towards computers. This inferred model also demonstrates that IU1 is hypothesized to influence IU2. A study report from Chau (1996) hypothesized and empirically validated the link.

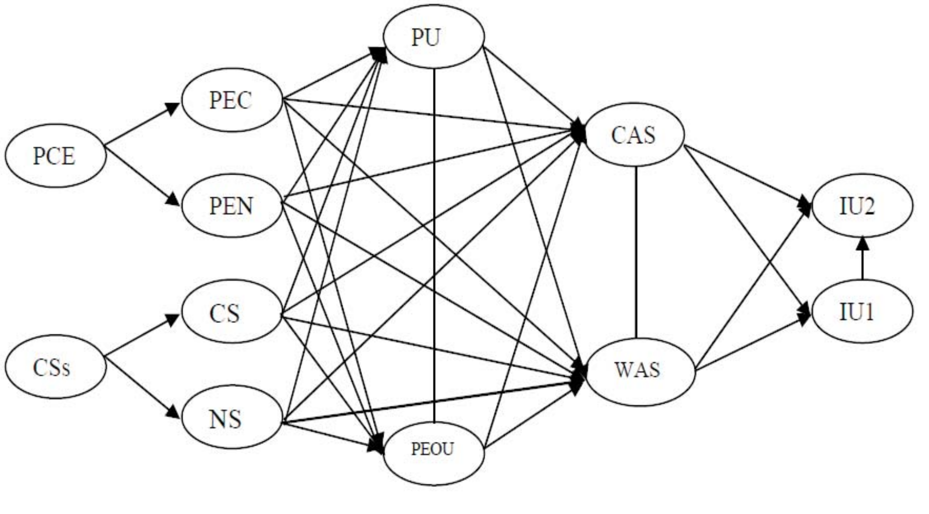

Figure 2. *Inferred TAM Constructs Relationships*

The inferred TAM model focuses on the extent that determinant factors contain PU, PEOU, IU1, IU2, PCE and CSs, and how these factors might serve to predict postsecondary learner attitudes toward using computers and toward using Web-based learning. A series of multiple stepwise regression analyses can be performed on data related to the correlations of external factors such as gender and different majors of study field.

A conceptual model investigates individual and technological factors of external variables for computing resources serve as potential predictors of postsecondary learner attitudes toward computer and Web-based learning. The research questions of this study associated with these factors, such as PU, PEOU, IU1, IU2, PCE (including: PEN1, PEN2, PEN3, PEC1, PEC2, PEC3), CSs (including: CS, NS), and the correlations of external factors to future participation of using Web-based learning technology are related as (*fig. 3*).

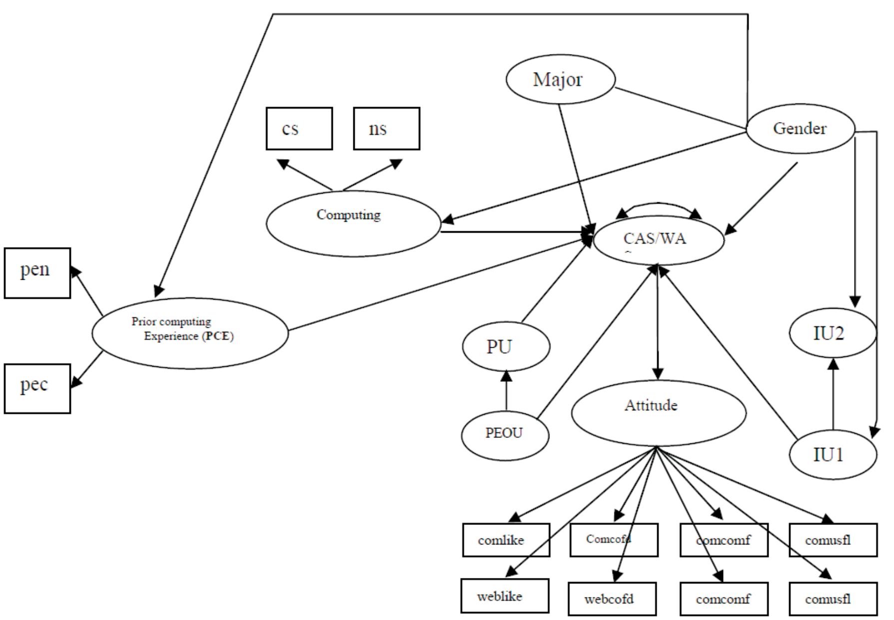

Figure. 3. *A conceptual model of external factors for computing resources*

Sample and survey instrument

Intact groups were adopted in this study to complete a short training session for Web-based learning such as computer class cohort clusters. Cluster sampling here was used to select computer classes. Cluster samples of classes were given about 60 minutes of demonstration on how to use the Internet. The instructor spent about 40 minutes to conduct a demonstration related to the whole process of Web-based learning methods for the students and was followed by 20 minutes of practice by students themselves. Samples were collected from 4 technical universities located in northern, middle, and southern Taiwan so that they were not confined to only one district. Two classes were drawn from each university. In total, there were 265 respondents out of a total of 312 participants majoring in Management Information Systems, Healthcare Administration, and Pharmacy, participated in this study.

A survey instrument with 67 items was developed by referencing prior studies (Davis, Bagozzi & Warshaw, 1989) (Compeau & Higgins, 1995). Seven-point Likert-type scales were used to measure learner agreement/disagreement levels. The survey instrument is composed of five sections. The perceived usefulness (PU) and the perceived ease of use (PEOU) related to use of Web-based learning technology were placed into a multiple-choice format in section A. Section B asked questions about the intentions of using Web-based learning either as a supplementary learning tool or as an entire online distance education method.

Sections C and D asked about attitudes toward computing and attitudes toward Web-based learning with the combined scales of CAS and WAS. Finally, the basic demographic information for individual respondents including age, gender, academic divisions, and degree sought, and major of studies is grouped in Section E.

Instrument reliability and validity

Two classes of students have participated in a pilot study to assure the reliability and validity of the instrument. An initial reliability analysis of the hypothesized constructs was conducted with the 72 responses from the pilot study. The statistical results of instrument reliability analysis for the pilot study as a whole, based on Cronbach (1951), was .945. The reliability was defined as the consistency of the instrument in measuring whatever it intends to measure (Wiersma, 1995).

In addition, Wiersma also defined validity of measurement as the extent to which the instrument measures what it is designed to measure. Content validity concerns whether an indicator's items are representative of the domain it is supposed to measure (Kline, 1998). Instrument content validity was established by including response items that have previously been reported in the literature and by developing response items that related directly to the research questions being investigated. The operationalization of constructs guided by these principles assured the instrument's content validity. External validity was strong as judged by the researcher in that students for the sample included higher education and continuing education students, and they were part of the populations of the Web-based learning technology users.

Results and discussion

Potential relationships between CAS and WAS were investigated through the application of the Pearson *r* technique to show any relationships related to research question 1 and null hypothesis 1. The correlation coefficient, $r = .80$, $p = .000$, presented a positive significant relationship at the .01 level ($p < .01$, 2-tailed) between the CAS ($M = 5.61$, $SD = 1.27$) and the WAS ($M = 5.46$, $SD = 1.34$). This result indicated there was a high correlation between the perception of computer attitudes and Web-based attitudes.

The experiential factors examined included the following: years of computer use, frequency of computer use, and Internet use. Some individual variables related to experience in using computers and the Internet in this study referred to prior computing experiences (PCE)—including prior experience in using any word processing packages (PEC1), prior experience in using any database programs (PEC2), prior experience in using computer-programming languages (PEC3), prior experience in using the Internet (PEN1), prior experience in using any Internet programming languages (PEN2), prior experience in using multimedia (PEN3), and computing skills (CSs)—including computer skill (CS) and network skill (NS). Significant correlations among PEC1, PEC2, PEC3, PEN1, PEN2, PEN3 with the CAS and the WAS related to research question 2 and null hypothesis 2 are shown in (*Table 1*).

Table 1. *Correlations among PEC1, PEC2, PEC3, PEN1, PEN2, PEN3 with CAS and WAS*

	PEC1	PEC2	PEC3	PEN1	PEN2	PEN3	CAS	WAS
PEC1	1.00	.31**	.23**	.51**	.28**	.28**	.26**	.17**
PEC2		1.00	.38**	.23**	.43**	.25**	.20**	.14*
PEC3			1.00	.15*	.53**	.25**	.20**	.25**
PEN1				1.00	.18**	.45**	.30**	.25**
PEN2					1.00	.35**	.23**	.12*
PEN3						1.00	.30**	.26**
CAS							1.00	.80**
WAS								1.00

Note. N = 265.
* *Correlations were significant at the .05 level (p < .05, 2-tailed).*
** *Correlations were significant at the .01 level (p < .01, 2-tailed).*

Analysis of computing skills

The independent-samples *t* test was conducted to find any statistically significant differences regarding CAS and WAS, based on different computing skills, namely, CS and NS. The results indicated there was a significant difference on both the CAS, t (263) = 3.79, p = .000 and the WAS, t (263) = 2.77, p = .006, regarding learner ability or inability to use computer skills, such as a mouse, keyboard, system interfaces, and application software skills. Also, a significant difference was found on both the CAS, t (263) = 4.74, p = .000 and the WAS, t (263) = 4.39, p = .000, regarding learner ability or inability to use network procedures skills such as electronic mail software and Internet browsers. There were positive statistical results regarding respondent ability or inability to use computer skills and network skills related to research question 3 as well as null hypothesis 3.

Differences in factor based upon gender

A series of t tests were performed to determine any differences between male and female learners regarding the following factors such as Perceived usefulness (PU); Perceived ease of use (PEOU); Intention to use for supplementary learning (IU1); Intention to use for distance education (IU2); Prior computing experiences (PCE); Computing skills (CSs).

As shown in *Table 2*, participants in this study were selected randomly from different academic majors of study who were taking computer courses. Male learners had a higher mean score than female learners in specific parts of above constructs such as PU, PEOU, IU1, and IU2 associated with learners' future participation in cyber learning. Significant differences were found between male and female learners regarding PU, PEOU. Male learners (M = 5.62) perceived significantly higher usefulness of the Web-based learning technology than did female learners (M = 5.26), t (263) = 2.84, $p = .005$. Male learners (M = 5.71) perceived use of Web-based learning technology to be significantly easier than did female learners (M = 5.33), t (263) = 3.17, $p = .002$. In addition, using a significance level of .10, male learners (M = 5.81) had significantly higher intention to use the technology for supplementary learning than did female learners (M = 5.59), t (263) = 1.71, $p = .09$.

Table 2. *Differences in Factor Means Based Upon Gender*

	Male		Female			
Factors	*M*	*SD*	*M*	*SD*	*t value*	Prob. (*p*)
PU	5.62	1.02	5.26	.91	2.84	$.005^{**}$
PEOU	5.71	.87	5.33	.91	3.17	$.002^{**}$
IU1	5.81	1.02	5.59	.94	1.71	.09
IU2	5.96	1.03	5.78	1.11	1.22	.22
PCE	4.04	1.28	4.22	1.31	.60	.32
CSs	1.10	.23	1.12	.26	.23	.55

Note. *N = 76 for male, 189 for female. df = 263 per factor.* $^{*}p < .05$. $^{**}p < .01$.

The *figure 4* shows that among the TAM variables, gender had the most significance in predicting positive perceptions toward usefulness of computing and its ease of use, as well as the intention to use the Web for virtual education courses. The probability levels of .002, .005, and .022 were statistically significant at the .05 level.

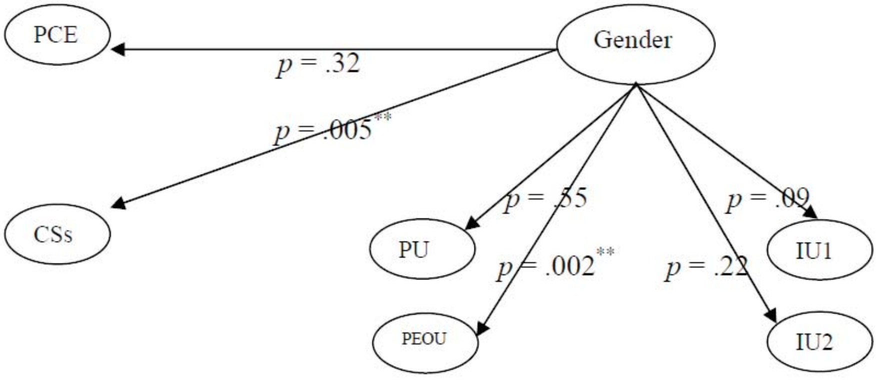

Figure 4. *Gender as the Significant Factor related to the CAS and WAS*

Based on the above data analysis, a composite and conceptualized model for this study in the investigation of factors of technological receptivity, individual characteristics, and future participation related to virtual learning for learners in postsecondary education is shown in *Fig. 5*.

There were several individual and technological factors such as PU, PEOU, IU1, IU2, PCE, CSs, gender, and majors deserve probing. Multiple stepwise regression analysis was performed on data related to the research question. These factors were investigated and were found to have a directional influence on the dependent variables, the CAS and the WAS. Findings of this study were exhibited as the overall conceptual model for future participation of using Web-based learning technology among external factors. This regression is expressed by the following equation with standardized regression coefficients:

$$CAS = 73.89 + .204 * PEN1 + .174 * PEN3 + .131 * PEC3$$

$$WAS = 71.75 + .144 * PEN3 + .154 * PEC3 + .165 * PEN1$$

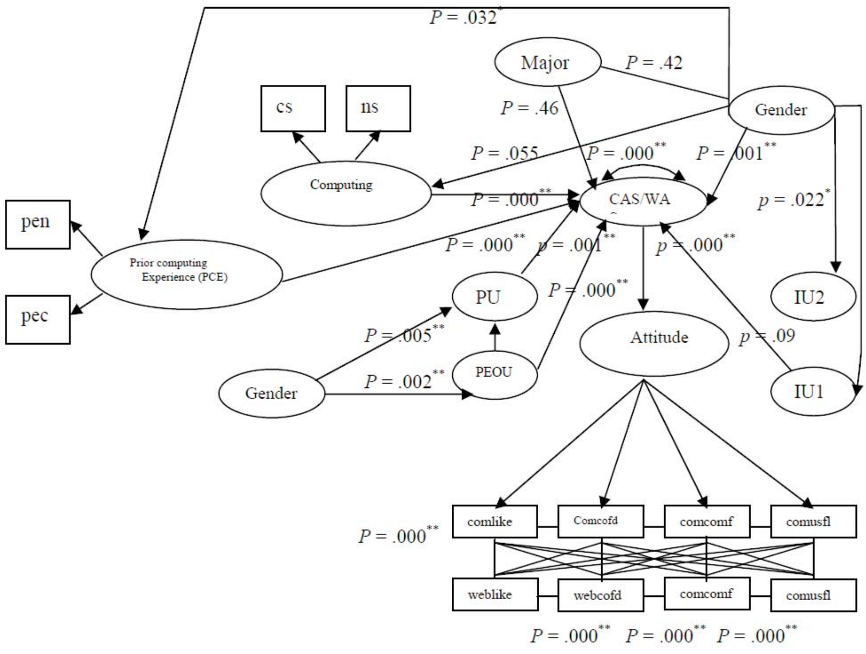

Figure. 5. *Overall Conceptual Model of Individual and Technological Factors for Computing*

Besides, the role of gender plays another significant factor in technology receptivity in the study. While developing computing skills, female needs to be taught in a more concrete way with complex practices (Clegg & Trayhurn, 2000). Virtual learning that lack of interactive teaching style might restrict female students' learning effectiveness and result in lower receptivity (Crews & Butterfield, 2003).

In the original TAM, behavior intention is determined by attitude and perceived usefulness. Many studies regarding gender differences have concluded that male students have more positive attitude toward computers and the Web than females (Pektas & Erkip, 2006; Liaw, 2002; Kay, 2009). In the study, intention to use for virtual learning as a major tool was also a significant factor in identifying student receptivity of online courses. It is similar to Simon and Paper's study (Simon & Paper, 2007) that intention to use is a valid predictor of actual technology use. And perceived usefulness of online learning systems influences positively on online learning acceptance and student satisfaction 9 (Lee, Mendlinger, 2011; Meelissen & Drent, 2008).

This study has investigated the correlations of adult students' computing technology, individual characteristics and future expectations to participate in virtual learning. It had suggested that individuals had more experiences in using the Internet, multimedia, and any computer programming languages, then the learners had more positive attitudes toward using computers and Web-based learning resources. Mendez and Gonzalez (2013) stated that adult students across the world who have become able to embrace information technology can make it a part of their learning culture. Similarly, it is logical to assume that school and university classroom teachers who are receptive to technology applications and who have been comfortable using Web courses or resources will be advocates for increasing the pace of adoption of the innovation.

Computer receptivity by gender often related to cultures differences in different countries. In Turkey, adolescents are strongly affected by their parents' gender roles and view technology, especially in engineering education as the field of males. In Netherlands, female workers account for only 10% of Information and Communication Technology related jobs and males have more positive attitudes toward ICT than females. Chinese female students are confident with programming skills but have less computing experience compared with British female students. Female students have less positive attitudes toward the Internet.

Conclusions

Since the factor of Chinese social culture, it is not surprising that the study discovered that gender and motivation intention to use were both significant identifiers in determining student acceptance of online courses. Even with strong Taiwanese parental advocacy that daughters select a technical career—such as in management information systems, health care management, and pharmacy—the women in this research were two times more reticent about using online resources or taking online courses than their male counterparts.

To advance the pace of appropriate use of virtual education, educational leaders should be encouraged to provide practical and early Web-based learning technology experiences for students. The more experience and skills adult learners acquire, the more receptive they will be to virtual learning. For computing to become pervasive, the climate for adult web use in the twenty-first century is an important area of concern for e-commerce or e-service. It takes time for people to accept an attitudinal position toward web use. Especially in modern engineering education and training, a lot of different strategies have been adopted and used to improve virtual learning outcomes. Acceptance and usage of modern technology and computers in education present an important issue. Learners must have an open attitude towards Web-based technologies. The concept of improvement of technological engineering education could be addressed from a number of different perspectives.

What interventions may be necessary to confront the assessment of different individual and technological factors are important to consider. Whether or not the computing validation in this study is a generational phenomenon such as digital natives or digital immigrants, a part of the zeitgeist of this century, or based in cultural differences remain to be seen, and the topics are worthy of much further study.

Acknowledgements

The authors would like to express sincerest appreciation to a group of volunteers, students of Tajen University, Far East University, who did a great job by answering these questionnaires and making observation in the field of Web-based learning technology.

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