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Gender Differences in Teacher Computer Acceptance

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Teachers' computer acceptance is an important factor to the successful use of computers in education. This article explores the gender differences in teacher computer acceptance. The Technology Acceptance Model (TAM) was used as the framework to determine if such differences are present. Survey questionnaires were administered to 186 preservice teachers, the questionnaire consists of two independent variables (perceived usefulness and perceived ease of use), together with the dependent variable (intention to use). The results of model testing using LISREL indicated that the two independent variables, perceived usefulness and perceived ease of use, directly affect the intention to computer use as stated in the TAM. Furthermore, significant gender differences in computer acceptance were also found: (a) perceived usefulness will influence intention to use computers more strongly for females than males, (b) perceived ease of use will influence intention to use computers more strongly for females than males, and (c) perceived ease of use will influence perceived usefulness more strongly for males than females. Impacts and implications to teacher professional development are also discussed.

There is a need to know the factors affecting teachers' computer use and its implications to teachers' professional development strategies. There have been a number of studies on the relationship between user attributes and computer use. Woodrow (1992) showed that a positive computer attitude is a necessary prerequisite and an integral part of computer literacy. Moreover, teachers' positive attitudes towards computers are recognized as a necessary condition for effective use of computers in the classroom. Other studies have tried to determine the factors that contribute to a positive or negative attitude towards computer use. Gressard and Loyd (1985) found that the perceived usefulness of computers can influence attitudes towards computers and the amount of confidence a teacher possesses in using computers may influence his or her implementation in the classroom. However, Russell and Bradley (1997) found that male teachers reported significantly greater confidence with computers than did females and recommended teacher professional development should take into account the particular needs of female teachers.

On the other hand, Summers (1990) found that the lack of knowledge and experience in the computing area is one of the most common reasons for teachers' negative attitudes towards computers. Furthermore, computer anxiety is identified as a major cause of resistance to using computers (Russell & Bradley, 1997). It was found that increased computer experience reduces computer anxiety in many student teachers (Gardner, Discenza, & Dukes, 1993). Nevertheless, it may depend on the type and duration of computer experience (McInerney, McInerney, & Sinclair, 1994; Beasley & Sutton, 1993). In investigating the changes in preservice and inservice teachers' attitudes towards computers, Yildirim (2000) found that teachers' attitudes (anxiety, confidence, and liking) significantly improved after the computer literacy course.

Zhang and Espinoza (1997) found that attitudes towards the computer—in particular measures of comfort/anxiety and perceived usefulness—were significant predictors of the need for learning computing skills, which will in turn greatly affect the computer literacy level. Such findings suggest that in computer training courses, it is important to assess and change the trainee's computer attitudes to enhance the effectiveness of the training. The successful use of computers in the classroom depends on the teachers' attitudes towards computers (Lawton & Gerschner, 1982). Some teachers are often resistant to using computers in the classroom, so the development of teachers' positive attitudes towards computers is considered to be a key factor in fostering computer integration and the enhancement of quality learning and teaching using computers (Yuen, Law, & Chan, 1999). In a review

of the literature on factors affecting teachers' use of information and communications technology (ICT), Mumtaz (2000) highlighted the role of pedagogy and suggested that "teachers' beliefs about teaching and learning with ICT are central to integration" (p. 319).

Teachers' attitudes have not been emphasized in the implementation of ICT into the classroom, though studies stated that teachers' attitudes as well as knowledge and skills in using computers are major factors affecting their initial acceptance of computer technology and their future behavior regarding computer usage (Violato, Mariniz, & Hunter, 1989; Koohang, 1989). Computer knowledge and skills are not sufficient to ensure that teachers will use them in their teaching (Thomas, Tyrrell, & Bullock, 1996), as "teachers' attitudes towards computers affect their instructional use of computers and likelihood of profiting from training" (Kluever, Lam, & Hoffman, 1994, p. 251).

In examining computer attitudes of teachers or students, many studies adopt some, but not all, constructs from the different models, while at the same time, derive their own constructs, combined together to form many different computer attitude scales or computer attitude measures (Kay, 1993). Nevertheless, the application of the constructs of the TAM is common in developing various computer attitude scales. One of the foci in these studies is on exploring and validating computer attitude scales. However, the need for a well-defined framework is essential to predict and explain teacher's computer use, and to provide necessary inputs to planning and implementing successful professional development. Also, rarely could studies be found on issues of gender differences in teacher computer acceptance though they are noted in some studies (Russell & Bradley, 1997). Thus, the purpose of the present article is to review and assess the compatibility of the TAM and its application in understanding preservice teachers' computer acceptance; and to apply the framework to identify the gender differences in teacher computer acceptance. Implications to teacher professional development will also be discussed.

TECHNOLOGY ACCEPTANCE MODEL

Fishbein and Ajzen (1975) developed the Theory of Reasoned Action (TRA) to predict and understand human social behavior. As an adaptation of the TRA, Davis (1989) first advocated his TAM. While TRA is composed of individual perception of attitude towards behavior and the social factor subjective norm, the TAM argued that behavioral intention was determined solely by attitude attribute (Davis, Bagozzi, & Warshaw, 1989). Davis and

his colleagues further refined the attitude scale towards computer use, which was solely determined by two fundamental determinants, perceived usefulness and perceived ease of use. In his longitudinal study comparing the two models with empirical data for assessing how well the models predict and explain the determinants of user acceptance, it was found that TAM was a simple but powerful model. Results showed that attitude only partially mediated the effects of the beliefs on intention while subjective norms had no effect on intention (Davis, et al., 1989).

While social psychology maintained the view that social attitudes are key concepts designed to capture consistency and to help predict and explain human behavior in the last several decades, today there are numerous studies in social psychology and education aimed at finding a measurement in attitude scale. Davis (1989), based on his findings of the longitudinal research that attitude only partially mediated the effect of behavioral intention, proposed to disregard the attitude component in his TAM model. Nevertheless, he claimed that his research develops and validates the two specific variables, perceived usefulness and perceived ease of use are fundamental determinants of user acceptance.

Following the TRA, Ajzen (1988) proposed the Theory of Planned Behavior (TPB). He clearly explained that many factors can disrupt the intention-behavior relation and the TRA alone has a deficiency considering the external obstacles that interfere with the performance of any behavior. Therefore, TPB includes a conceptual framework including the original constructs as in TRA, the attitude towards behavior, subjective norm, and the new construct, perceived behavioral control. By definition, perceived behavioral control refers to "the perceived ease or difficulty of performing the behavior" and it is assumed to "reflect the past experience as well as anticipated impediments and obstacles" (Ajzen, 1988, p. 132). Mathieson (1991) applied the TPB to examine computer acceptance. He proposed that the three factors, (a) attitudes towards use, (b) subjective norms, and (c) perceived behavioral control, affect the behavior. The research found that "intention was predicted by attitude towards use and perceived behavioral control, but not by subjective norms" (p. 185). This suggested that social pressure does not influence individual's decision to computer use, and Mathieson (1991) also suggested that "attitude has a slightly stronger effect on intention than perceived behavioral control" (p. 185).

Taylor and Todd (1995) compared the TAM to various models based on TPB in terms of their contribution to the understanding of information technology (IT) usage. They concluded that, in terms of the ability to explain IT usage behavior, the results show that the TAM and the other models

are comparable. Other empirical tests of the TAM (Adams, Nelson, & Todd, 1992; Davis, 1993; Chin & Todd, 1995; Hu, Chau, Liu Sheng, & Tam, 1999) have for the most part, been supportive of the model. In the results of their meta-analysis of the empirical literature on factors affecting IT usage, Mahmood and Swanberg (2001) concluded that "there exists a strong and significant positive relation between the perception of ease of use and the perceived usefulness of an IT system to actual amount of usage" (p. 107) as advocated by the TAM.

There are findings that show gender differences exist in computer acceptance. Young (2000) found significant gender differences in computer attitudes of 462 middle and high school students. The male domain scale showed that boys were more likely to have claimed computers as a male area. Moreover, the perceived usefulness of computers indicated that females reported finding the computers more useful for school and careers. Thus, higher levels of confidence and for males the absence of negative teacher attitudes, are associated with greater computer skills. In spite of encouragement of females by teachers, the manner in which males felt discouraged, and the girls' rejection of statements indicating that computers and technology were largely a male domain, boys were still more confident than the girls. Using TAM as theoretical framework, Venkatesh and Morris (2000) studied gender's role in technology acceptance of 342 workers over a five-month period. Compared to women, men placed a greater emphasis on perceived usefulness in determining behavioral intention. On the other hand, women weighted perceived ease of use more strongly in determining behavioral intention than men did at an earlier time frame. It was found that perceived ease of use was not a significant determinant of behavioral intention for men. There were no gender differences in the role of perceived ease of use in determining usefulness. Over the long term, men were more strongly influenced by perceived usefulness in determining behavioral intention, compared to women. Similarly, women continued to weight perceived ease of use as a direct determinant of behavioral intention more strongly than men. Consistent with the results in the short term, there were no differences in the perceived ease of use to the perceived usefulness relationship between men and women. However, whether this applies to teachers is still in doubt and further empirical investigation is needed. Thus, the aim of this article is to explore gender differences in teacher computer acceptance in contrast to the studies in other workplaces.

METHOD

Subjects

The study targeted preservice teachers who are mostly new degree holders, joining the one-year full-time teacher education program (Postgraduate Certificate in Education) at the University of Hong Kong in the academic year 2001-2002. According to past experience, the majority of these graduates will become teachers and work locally. It is believed that a study of these subjects would provide a good understanding of the preservice teachers, but also shed light to understand the future computer use of inservice teachers.

Among the 186 respondents, 24.9% were male respondents and 75.1% were female respondents. About two thirds of the respondents are new graduates 22 to 24 years of age. The age range of the respondents was less than 22 (9.8%), 22-24 (68.5%), 25-27 (12.5%), 28-30 (2.7%), and over 30 (6.5%). The majority of the respondents (87.5%) had no teaching experience. Nevertheless, a small number of respondents had some years of teaching experience in primary or secondary schools: less than 1 year (7.6%), 1-2 year (3.8%), and 3-5yr (1.1%). Major teaching areas of the respondents was Chinese language (21.5%); English language (13.4%); mathematics (11.8%); biology (10.8%); chemistry (12.9%); business and accounts (7.0%); economics (6.5%); geography (8.6%), and history (7.5%). Nearly all respondents (98.4%) had access to computers at home. About one third of the respondents did not have formal computer training at all, though about another one fifth had extensive formal computer training: 1-8 hours (17.9%); 9-16 hours (13.6%); 17-24 hours (6.0%); 25-32 hours (6.5%), and 33 or above (21.7%).

Measurement Items

The use of TAM to investigate student-teachers' computer acceptance is advantageous because of its well-researched and validated measurement instrument. Specifically, the questionnaire was designed to include five items of perceived usefulness (PU1 to PU5), five items of perceived ease of use (PEOU1 to PEOU5), two items of intention to use (ITU1 to ITU2). All items are measured on a 7-point Likert scale, with 1 as strongly disagree and 7 as strongly agree. The major measurement items are listed in the appendix. Subjects were also asked to report their self-reported usage. Duration of usage was measured in hours per week and was coded into seven categories,

namely, Less than or equal to 4 hours; 4 to 6 hours; more than 6 to 9 hours; more than 9 to 12.5 hours; more than 12.5 to 16 hours; more than 16 to 20 hours; and over 20 hours. The degree of current usage of computer was measured in a 7-point Likert scale. At the same time, subjects were asked to state demographic data in the first part of the questionnaire, including sex, age range, major teaching areas, access to computer at home, and if there is any previous formal computer training experience.

Procedure

Data were collected using a user-reported self-assessment approach. It deemed to be appropriate because of considerable literature support for its use in intention-based studies and being the common method used in TAM research (Davis, 1989; Collopy, 1996; Hu et al., 1999). At the beginning of the semester in October, a total of 282 questionnaires were distributed through the various group representatives. Subjects were asked to return the completed questionnaires to their group representatives within a week's time, just before they left for their school experience. Group representatives collected the questionnaires in a sealed envelope and returned them to the researcher for collection; 186 questionnaires were collected with a return rate of 66%.

FINDINGS

Summary of the Observed Variables

The descriptive statistics of the measurement items are shown in Table 1. It shows that all the items were generally positive perceptions towards computer use, all mean scores were over four. The mean scores range from 4.60 to 5.79, while the standard deviations range from 1.15 to 1.51. All constructs satisfied the criteria of reliability (alpha > 0.80).

Table 1
Descriptive Statistics and Cronbach's Alpha

	N	Mean	Std. Deviation	Alpha values
Perceived Usefulness (PU)				
PU1	185	5.19	1.23	0.8759
PU2	185	4.92	1.33	
PU3	186	5.21	1.25	
PU4	185	5.19	1.30	
PU5	186	5.37	1.25	
Perceived Ease of Use (PEOU)				
PEOU1	186	4.72	1.33	0.8629
PEOU2	184	4.60	1.29	
PEOU3	186	4.99	1.15	
PEOU4	186	4.75	1.22	
PEOU5	185	5.04	1.51	
Intention of Use (ITU)				
ITU1	185	5.79	1.17	0.8510
ITU2	186	5.68	1.19	

Discriminant validity is demonstrated if an item correlates more highly with items within the same factor than with items in a different factor (Campbell & Fiske, 1959). The inter-item Pearson correlation coefficients shown in Table 2 depict the discriminant validity where the coefficients of inter-item within each measurement construct are much higher than correlations across constructs.

The factor components were then analyzed by a principal component factor analysis, with a varimax rotation method. The components generated confirm the corresponding constructs as predicted by the TAM model. The percentages of variance explained by the components ranged from 11.245 to 45.302.

A one-way analysis of variance (ANOVA) was employed to determine the mean differences between the different gender groups on the major variables (teaching experience, computer training, PU, PEOU, ITU, and Usage). No significant differences were found between gender groups for each variable (Table 4).

Table 2
Inter-item Correlations Coefficients

	PU1	PU2	PU3	PU4	PU6	PEOU1	PEOU2	PEOU3	PEOU5	PEOU6	ITU1	ITU2
PU1	1.00											
PU2	0.65	1.00										
PU3	0.68	0.58	1.00									
PU4	0.69	0.50	0.78	1.00								
PU6	0.45	0.45	0.59	0.52	1.00							
PEOU1	0.39	0.35	0.31	0.31	0.41	1.00						
PEOU2	0.30	0.24	0.26	0.30	0.34	0.71	1.00					
PEOU3	0.26	0.34	0.35	0.32	0.43	0.71	0.69	1.00				
PEOU5	0.39	0.41	0.33	0.33	0.40	0.65	0.60	0.64	1.00			
PEOU6	0.25	0.18	0.17	0.22	0.24	0.58	0.39	0.37	0.39	1.00		
ITU1	0.38	0.38	0.29	0.37	0.28	0.27	0.22	0.25	0.30	0.36	1.00	
ITU2	0.32	0.26	0.30	0.35	0.28	0.20	0.22	0.20	0.28	0.34	0.74	1.00

Table 3
Rotated Component Matrix of Factor Analysis Results

	Component		
	1	2	3
PU1	0.805		
PU2	0.727		
PU3	0.888		
PU4	0.831		
PU6	0.662	0.330	
PEOU1		0.875	
PEOU2		0.845	
PEOU3		0.830	
PEOU5	0.309	0.779	
PEOU6		0.566	0.461
ITU1			0.871
ITU2			0.880
Eigen values	5.436	1.879	1.349
Percentage of variance	45.302	15.662	11.245

(Values of less than 0.3 were not shown)

Table 4
Summary of One-Way ANOVA

	Group Mean (S.D.)		
Variables	**Male**	**Female**	**F**
Teaching Experience	1.24 (0.565) *n*=45	1.17 (0.536) *n*=138	1.688
Computer Training	3.18 (2.124) *n*=45	2.90 (1.908) *n*=138	3.605
PU (total score)	25.27 (6.132) *n*=44	26.04 (4.894) *n*=138	2.194
PEOU (total score)	25.20 (5.980) *n*=45	23.70 (4.973) *n*=137	2.939
ITU (total score)	11.36 (2.533) *n*=45	11.50 (2.097) *n*=139	3.509
Usage (total score)	9.41 (2.644) *n*=44	8.84 (2.553) *n*=132	0.167

LISREL Models

LISREL is a software product designed to estimate and test statistical models of linear relationships among latent and manifest variables. It is an extremely powerful structural equation modeling technique that has been used extensively in research (Adams et. al., 1992; Taylor & Todd, 1995; Hu et al., 1999). *LISREL* was then used to analyze the survey data and to perform the analysis towards model testing.

Figure 1 shows the resulting path coefficients of the overall (male and female) model. For the overall model, the data supported most of the individual causal paths postulated by TAM. Perceived usefulness had a significant direct positive effect on preservice teacher's intention to computer use, with standard path coefficient 0.43 ($p<0.001$). Literally, this coefficient suggested that every unit increment in perceived usefulness would strengthen an individual's (positive) intention to computer use by 0.43 units. Perceived usefulness also had a direct and significant effect on usage, with standard path coefficient 0.38 ($p<0.001$). Effect of intention to computer use towards self-reported usage was significant and shown a 0.33 path coefficient. Thus, perceived usefulness had a direct effect, as well as an indirect effect, through the mediating intention to computer use, on usage. Perceived ease of use had positive effects on both perceived usefulness (path coefficient = 0.58) and

intention to computer use (path coefficient = 0.15). Although it is a significant direct effect on perceived usefulness (t = 7.41, p<0.000), its effect on intention to computer use is statistically non-significant.

From the R square values, it shows that perceived ease of use explain 33% of the variance in perceived usefulness, while perceived ease of use and perceived usefulness together explain 29% of the variance in intention to computer use. Intention to computer use and perceived usefulness account for 38% of the variance in usage.

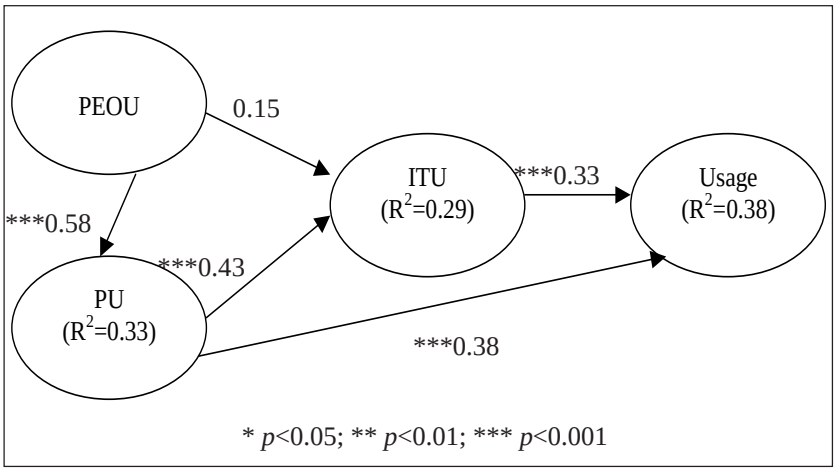

Figure 1. Overall model testing results

This finding is consistent with prior research (Venkatesh & Davis, 2000; Hu et al., 1999; Davis, 1989) that while "the effect of usefulness on usage was significant," "the effect of ease of use on usage, controlling for usefulness, was non-significant" with the reason that "ease of use operates through usefulness" (Davis, 1989, p. 331-332).

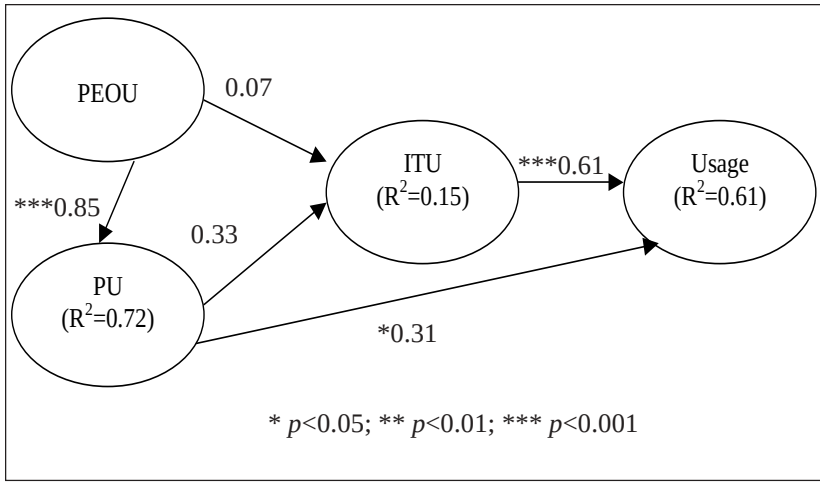

Figure 2. Model testing results for male respondents

The *LISREL* model was then analyzed on male (Figure 2) as well as female data (Figure 3) to examine the gender differences of the effect of each construct to the model.

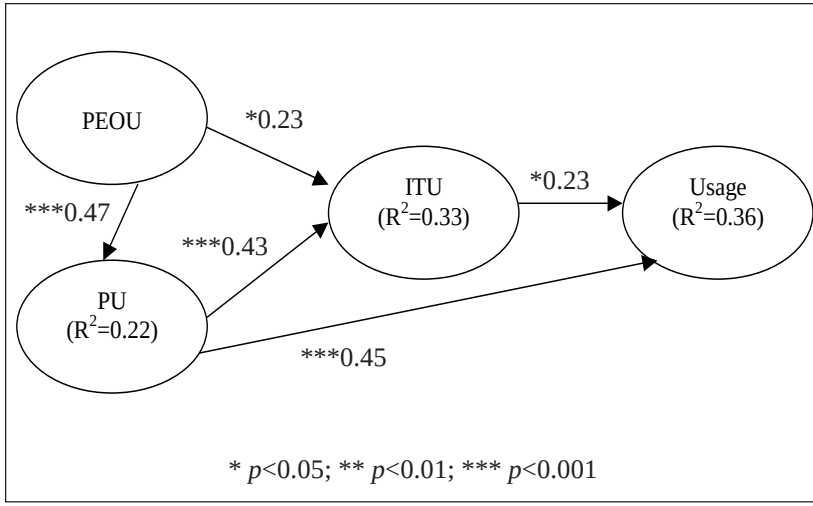

Figure 3. Model testing results for female respondent

Table 5 summarizes the path coefficients for each causal path in the models described in Figures 1, 2, and 3. All data segments provide an overall fit of the model postulated by TAM. However, compared to women, men placed a greater emphasis on perceived ease of use in determining perceived usefulness (0.85 for male; 0.47 for female). On the other hand, women weighted perceived ease of use more strongly in determining intention to computer use than men did (0.07 for male; 0.23 for female). The causal path from perceived usefulness to intention to computer use is nonsignificant for men. For women, the strong direct significant effect of perceived usefulness in determining intention to computer use shows that it was hindered by the overall model, which is not consistent to prior research findings of Venkatesh and Morris (2000).

Table 5
Summary of Causal Path Analysis

Causal Path	Path coefficients Overall	Male	Female
PEOU→PU	***0.58	***0.85	***0.47
PEOU→ITU	0.15	0.07	*0.23
PU→ITU	***0.43	0.33	***0.43
PU→USAGE	***0.38	*0.31	***0.45
ITU→USAGE	***0.33	***0.61	*0.23

* $p<0.05$; ** $p<0.01$; *** $p<0.001$

In agreement with what most literature postulates, the two independent variables, perceived usefulness and perceived ease of use, contribute significantly to the behavioral intention to computer acceptance and actual self-reported usage, accounted for 38%, 61% and 36% of the overall (Figure 1), male (Figure 2) and female (Figure 3) model respectively.

DISCUSSION

To improve computer acceptance in the past, attention has been given to developing better user interface. However, the importance of a computer is its flexibility and various functionalities. A computer system could never be designed as a "simple" system, comparable to any other electrical appliances, such as a television set or a refrigerator. On the contrary, there is a lot of room to improve acceptance through a better understanding of user perceptions, such as "user perceptions were instrumental in explaining a substantial

proportion of the variance in both current use and future use intentions" (Agarwal & Prasad, 1997, p. 572). Several general observations can be drawn from the findings.

The findings of this study suggest that perceived ease of use is a unique and important contribution to the development of acceptance of computer use. In other words, teachers first of all would probably accept and adapt to using the computer if they perceive the computer as easy to use. From a practical perspective, this finding suggests that to assist individuals in accepting the computer, it may be necessary to help them develop a positive perception of the ease of the use of computers. As Lankshear, Snyder, and Green (2000) recommended the understanding of "both literacies and technologies as embedded in a larger social practices and as related to each other in ways that are tied to the purposes, values, beliefs, and identity-making aspects of these practices" (p. 153) is a crucial part of professional development. The possible strategies may include increasing self-confidence of the user (Russell & Bradley, 1997), providing successful experience during use, and a continual support for experiential learning. It is especially important to note that much of the traditional training has focused on the transfer of technical knowledge and skills in using particular software applications (McDougall & Squires, 1997). The role of self-perception has been largely ignored. Without attention to developing a positive perception of the ease of use, many teachers will simply not develop the computer skills they require, even after prolong training; they will not develop a positive intention to computer use.

Perceived usefulness indeed influences computer acceptance to a much greater extent. A computer system is useful only if it is applied to a context. Without an overview of how computers can integrate with teaching and learning perspectives, computers may not be perceived as useful at all. Training should not be decontextualized from practices (Lankshear, Snyder, & Green, 2000). The possible strategies may include providing best practice modeling, opportunity for further applications, and a continuous development plan.

Another key area of the findings is the gender differences. These are seldom discussed elsewhere. Firs, perceived ease of use is not significant at all towards intention to computer use, for the male subjects. Although perceived ease of use is one of the two important independent determinants in the TAM, the effect of perceived ease of use mainly influences intention to computer use through perceived usefulness (path coefficient=0.85). The characteristics that most men are more independent and task oriented (Minton & Schneider, 1980) can be a plausible explanation. Men also appear

highly motivated by productivity-related factors such as usefulness (Venkatesh & Morris, 2000). Thus, the finding of this research recommends a different focus in designing training programs, that is, to allocate more time to developing a positive perception of usefulness, especially how computers can be integrated with pedagogical use, instead of know-how in using a computer system. On the contrary, perceived ease of use (path coefficient=0.23) contributes significantly higher to the intention to computer use in females, though it is still to a lesser extent compared with perceived usefulness (path coefficient=0.43). This finding suggests that there should be a more balanced time allocation to developing a more positive perception on both factors.

This study attempts to explore the teachers' computer acceptance and found that perceived ease of use and perceived usefulness are the two independent variables towards computer use. It also reveals the gender differences in the application of the TAM. These findings are definitely important to the design of teachers' professional development. Viewing teacher training as a kind of remedy for teachers' inadequacy (Neil, 1986), teachers' computer training is, still in many cases, unified and one-off. Without a continuous development plan for teachers (Bradley, 1991), the problem of acceptance would still be an important barrier to the successful use of computers in education. The study has collected the views of preservice teachers at a given point of time, however, studies find that the factors to preadoption and postadoption may be different (Karahanna, Straub, & Chervany, 1999; Bhattacherjee, 2001), that is, a factor that contributes positively to acceptance may not necessarily contribute to the same extent and degree after adoption. Sometimes, on the contrary, a factor may hinder further computer use. It is believed that the study on a longitudinal perspective should be conducted to gain better understanding of the users' acceptance behavior. Moreover, this study collected preservice teachers' views on "computer" acceptance in a general term. This may also limit knowing the differences between other technologies or software applications. Therefore, further studies on the area of the acceptance towards different technologies and the acceptance differences on a continuous basis would also be recommended.

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APPENDIX
MEASUREMENT ITEMS (ADOPTED FROM DAVIS, 1989; P.331)

Perceived Usefulness	
PU1	Using computer improves my job performance.
PU2	Computer enables me to accomplish tasks more quickly.
PU3	Using computer enhances my effectiveness on the job.
PU4	Using computer increases my productivity.
PU5	Overall, I find computer useful in my job.
Perceived Ease of Use	
PEOU1	Learning to operate computer is easy for me.
PEOU2	It is easy for me to become skillful in using computer.
PEOU3	Computer is flexible to interact with.
PEOU4	My interaction with computer is clear and understandable.
PEOU5	Overall, I find computer easy to use.
Intention to Use	
ITU1	I intend to use computer when it becomes available in my work place and at home.
ITU2	I intend to use computer in my job as often as possible.