Implementation Strategies and the Technology Acceptance Model: Is "Ease of Use" Really Useful or Easy to Use in Implementation?

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ABSTRACT

The large investment in information technology in the education sector has made the investigation of technology acceptance important for this sector. In this paper, a questionnaire was given to 282 one-year full-time postgraduate students in education to assess their computer acceptance and intended professional usage in the future. The Technology Acceptance Model (TAM) was used as the framework for analysis. Results of the study suggest an overall consistency of TAM factors examined for explaining usage; however, several areas were identified where individual teacher acceptance differed in their computer acceptance decision-making when compared with previous studies. Specifically, the pre-service teachers in this study made computer acceptance decisions largely based on the usefulness of the computer while ease of use was limited to being only a secondary consideration. However, significant gender differences exist in our findings as well, with male respondents most likely to indicate an insignificant effect on the ease of use factors in influencing usage intention, and with female prospective teachers indicating a influence of ease of use similar to what has been found in prior TAM studies. Implications of gender and context on the significant differences in the determinant, ease of use, are discussed.

INTRODUCTION

The Hong Kong Special Administrative Region (HKSAR) has a total public expenditure of HK$287.18 billion (US$36.82 billion) in the 2002-2003 year. Education accounts for over one-fifth of this total public expenditure and is the largest single item of government expenditure. Moreover, additional funding is provided through a formal establishment of the Quality Education Fund (QEF) in 1998 with an allocation of HK$5 billion (US$641 million). Information technology, being one of the five major categories sought funding from the QEF, was approved with an amount of HK$5234 million (US$671 million). To promote the use of information technology (IT) for enhancing the effectiveness in teaching and learning, the Chief Executive announced in his 1997 Policy Address to equip all teachers with necessary IT skills. This mission to improve IT usage in education was financially supported by the recurrent government expenditures on information technology education, training, and equipment, and is an area of tremendous concern in an era of tight government budgets and deficits generally. Therefore, teacher's acceptance and use becomes an area of critical concern to the government as a measure of the successful of these efforts in encouraging the use of IT in education.

At the same time, computer acceptance has been an important research issue in information systems. Among the various models appeared to evaluate and to predict acceptance, Technology Acceptance

Model (TAM) is the most widely referred. Davis (1989) firstly introduced TAM, and proposed that perceived usefulness and perceived ease of use are the fundamental determinants of user acceptance. Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance; perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort. The two determinants were found highly correlated to self-reported usage. This is consistent with logical relationships that when a person finds a system easy to use and useful, he or she would have a higher motivation to use it.

There are many later studies using TAM as core framework (Davis et al., 1989; Adams et al., 1992; Szajna, 1994; Hu et al., 1999); or comparing TAM with other models (Mathieson, 1991; Plouffe et al., 2001); or extending TAM with additional antecedents and constructs (Venkatesh, 2000; Koufaris, 2002; Chau & Hu, 2002). However, it is immaterial whether these two determinants were used as core or as partial factors, most of the TAM related studies found them both to be significantly correlated and fundamental to predicting technology acceptance and use.

Moreover, with the continual rise in computer use, one obvious question becomes whether men and women are equally as likely to use computer. Studies (Venkatesh & Morris, 2000; Slyke et al., 2002) found that gender is a significant predictor of intention to use new software and of intention to shop on the web. If there exists gender differences, how should we develop effective implementation strategies for encouraging successful adoption and use of information technology?

Hence, the focus of the study is on identifying the factors affecting teachers' computer acceptance, using TAM as the framework and in an effort to highlight any gender differences in teachers' computer acceptance. Implications of the results of this research on teachers' computer training are discussed.

METHOD

Data Collection

The study targeted pre-service teachers who are mostly fresh degree holders, joining the one-year full-time Postgraduate Certificate in Education program at a university. According to past experience, majority of these graduates will become in-service teachers and work locally. It is believed that a study to these subjects would be a good understanding to the future use of in-service teachers. Data were collected using a user-reported self-assessment approach, deemed appropriate be-

cause of considerable literature support for its use in intention-based studies. At the beginning of the semester in October 2001, 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 leave for school experience. Group representatives collected the questionnaires and sealed in an envelope and returned to the researcher for collection, with 186 (66%) of the total number of distributed surveys eventually returned.

Instrument

Use of TAM to investigate student teachers' computer acceptance is advantageous because of its well-researched and validated measurement instrument. Specifically, the questionnaire designed to include five items of perceived usefulness (PU1-5), five items of perceived ease of use (PEOU1-5), two items of intention to use (ITU1-2) (Appendix 1). All items are measured in a 7-point Likert's scale, with 1 as strongly disagree and 7 as strongly agree. Subjects are asked to report their self-reported usage. Duration of use was measured in hours and was coded into seven categories ("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's scale. At the same time, subjects are also asked to state demographic data in the first part of the questionnaire, including sex, age range, major teaching areas (including social science, humanities and natural science), access to computer at home and if there is any previous formal computer training experience.

RESULTS

Demographic Statistics

Respondents are 24.9% male and 75.1% female, which is consistent with the composition of the studied population. About two thirds of the respondents are fresh graduates and is around 22 to 24 years of age. The age range of the respondents are from "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 have no teaching experience. Details of respondents' full-time teaching experience in primary or secondary schools are ranging from "no" (87.5%), "less than 1 year" (7.6%), "1-2 year" (3.8%), and "3-5yr" (1.1%). Major teaching areas of the respondents are "Chinese" (21.5%); "English" (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%). The majority of the respondents (98.4%) have access to computers at home. About one third of the respondents do not have formal computer training, although some respondents reported more than 33 hours, with reported training as follows: "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%).

Reliability and Validity of the Measurement Items

The descriptive statistics of the measurement items are measured with respect to mean values and standard deviations. It shows that all the items show generally positive perceptions towards computer use, all mean scores over 4. The mean scores range from 4.60 to 5.79 while the standard deviations range from 1.148 to 1.505. All constructs satisfied the criteria of reliability (alpha > 0.80). The correlations analysis shows discriminant validity where the coefficients of inter-items within each measurement construct are much higher than correlations across constructs.

The factor components were then analyzed by a principal component factor analysis, with Varimax rotation method. The components generated confirm the corresponding constructs as predicted by the model. The first component have factor loadings range from 0.662 to 0.805; the second component have factor loadings from 0.566 to 0.875; the third component have factor loadings from 0.871 to 0.880; while the eigenvalues for the three components are 5.436, 1.879 and 1.349

respectively; showing a significantly high loading values for each construct. The percentages of variance explained by the components range from 7.581 to 41.834.

Overall Model

LISREL was used to perform the analysis towards the testing models. Figure 1 shows the resulting path coefficients of the overall 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 pre-service 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 of t value equals to 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 use and perceived usefulness factors account for 38% of the variance in actual usage.

This finding is consistent with prior research (Hu, 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, p331-332).

Gender Differences

The model was then analyzed by LISREL on male only and female only data in order to find out the gender differences of the effect of each construct to the model.

Table 3 summarizes the path coefficients for each causal path in the model. Both data sets 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). In fact, perceived ease of use is non-significant of intention to computer use for men. For the case of women, the strong direct significant effect of perceived ease of use in determining intention to use shows that was hindered by the overall model, which is consistent to prior research findings.

DISCUSSION

Results of the overall model show that perceived ease of use is insignificant as a direct factor influencing intention to use. However, it is significantly correlated with perceived usefulness, and hence, is an
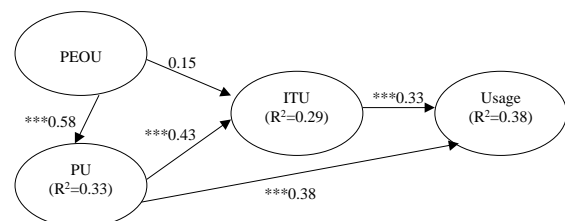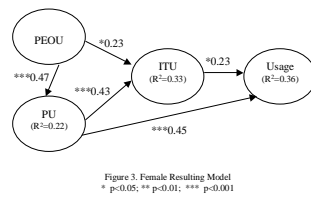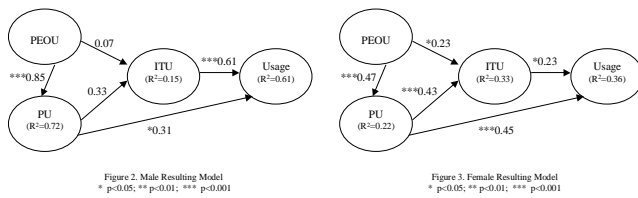

Figure 1. Overall Resulting Model
* p<0.05; ** p<0.01; *** p<0.001

Figure 2. Male Resulting Model
* p<0.05; ** p<0.01; *** p<0.001

Figure 3. Female Resulting Model
* p<0.05; ** p<0.01; *** p<0.001

antecedent to perceived usefulness. On the other hand, perceived usefulness is significantly correlated to intention to use and self-reported usage. This can be explained by noting that if the system is easy to use, a user may find the system more useful, and hence, has a motivation to use it, so that in the end, actual usage behavior happens as an indirect result of ease of use.

This result is consistent to what Davis (1989, p.333-334) firstly developed when using the TAM approach. He found that the usefulness-usage relationship was relatively stronger than the ease of use linkage to actual or intended usage. Examined by joint direct effect in regression analysis, the usefulness-usage relationship remains large, but further diminishes substantially the ease of use-usage relationship. This important finding shows that users are driven to adopt an application primarily because of the functions it performs for them, and only secondarily based on how easy or hard it is to get the system to perform those functions. In another words, ease of use is an antecedent of the causal relationship, ease of use→ usefulness→ usage, rather than a direct determinant in the model.

In this study, the results in perceived ease of use actually is more strongly exemplified through the examination of gender differences in the results of the survey. From the male respondent results, perceived ease of use is insignificant as a driver of intention to use. Perceived usefulness is also insignificant for intention to use but is directly significant to actual usage. Both intention to use and perceived usefulness account for 61% of variance in usage. This is strong in both explanatory power and predictive power of the model; however, perceived ease of use is only an antecedent of perceived usefulness that contributed indirectly to the overall model. From the female model results, both perceived ease of use and perceived usefulness significantly correlated to intention to use, accounted for 33% of variance of intention to use as a whole. Perceived ease of use is strong but is still less strong compared with perceived usefulness. These results are consistent with prior TAM results generally and suggests similar implications for training implementation strategies.

If perceived ease of use is an antecedent of perceived usefulness, as with male respondents, the major concern of a user to a system would be whether the system is useful to his or her job performance; ease of use would become only a relatively unimportant secondary concern. Budgeting design, promotion and training should emphasize system usefulness. If the drivers of intention to use and actual usage are more consistent with our female respondent group with a more balanced importance of multiple TAM model factors, then implementation needs to address both usefully and ease of use in design, promotion, and training implementation.

However, this finding has not been effectively addressed in most studies following the TAM approach. Mathieson (1991, p.185) and Venkatesh (1999, p.252) found both perceived ease of use and perceived usefulness significant and strong. Perceived ease of use has been found significant but weak (Venkatesh & Davis, 1996, p.462; Venkatesh, 2000, p.357; Plouffe et al., 2001, p.217). It was also found statistically insignificant (Adams et al., 1992, p.239; Hu et al., 1999, p.104; Chau & Hu, 2002, p.305). TAM has received fairly extensive attention from information systems researchers and practitioners. However, the question that has not adequately been addressed in this prior research is when is perceived ease of use likely or unlikely to have a significant correlation with intention to use? Under what circumstances might ease of use even be found to exert greater importance than intention to use or perceived usefulness on actual usage? How might external factors on demographic

variables, attitudes toward targets, or personality traits matter in driving differences in behaviors in different contexts?

CONCLUSION

This study applies the TAM model to education context to assess pre-service teacher computer acceptance. Besides the findings consistent with previous studies that perceived ease of use and perceived usefulness contribute to the prediction of intention and hence usage of computer; significant gender differences were found. Further studies should be carried out to investigate the conditions and circumstances of perceived ease of use as a fundamental determinant in predicting computer acceptance. Further studies on the antecedents of perceived usefulness and perceived ease of use are also needed to address the impact of external factors and industry context on different perspectives and priorities in determining actual and intended usage of new technological innovations.

REFERENCES

Adams, D.A., Nelson, R.R. and Todd, P.A. (1992). Perceived Usefulness, Ease of Use, and usage of Information Technology: A Replication, *MIS Quarterly*, 16(2), pp.227-247.

Chau, P.Y.K. & Hu, P.J.H. (2002). Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories, *Information & Management*, 39, pp.297-311.

Chin, W.W. and Todd, P.A. (1995). The Use, Usefulness, and Ease of Structural Equation Modeling in IS Research: A Note Caution, *MIS Quarterly*, pp.237-246.

Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, *MIS Quarterly*, 13:3, pp.319-340.

HKSAR (2002). *The Economy*, accessed at http://www.info.gov.hk/info/sar5/eecon2.htm on October 2, 2002.

HKSAR (2002). *Topical Information: Provision of Education*, accessed at http://www.info.gov.hk/info/education.htm on October 2, 2002.

Hu, P.J., Chau, P.Y.K., Liu Sheng, O.R. and Tam, K.Y. (1999). Examining Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology, *Journal of Management Information Systems*, 16(2), pp.91-112.

Kaufaris, M. (2002). Applying the Technology Acceptance Model and Flow Theory to Online consumer Behavior, Information Systems Research, 13(2), pp.205-223.

Mathieson, K. (1991). Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior, Information Systems Research, 2(3), pp.173-191.

Plouffe, C.R., Hulland, J.S., & Vandenbosch, M. (2001). Research Report: Richness Versus Parsimony in Modeling Technology Adoption Decisions – Understanding Merchant Adoption of a Smart Card-Based payment System, *Information Systems Research*, 12(2), p.208-222.

Sluke, C.V., Comunale, C.L. & Belanger, F. (2002). Gender Differences in Perceptions of Web-based Shopping, *Communications of the ACM*, 45(7), pp.82-86.

Szajna, B. (1994). Software Evaluation and Choice: Predictive Validation of the Technology of the Technology Acceptance Instrument, *MIS Quarterly*, 18(3), pp.319-324.

Venkatesh, V. (1999). Creation of Favorable User Perceptions: Exploring the Role of Intrinsic Motivation, *MIS Quarterly*, 23(2), pp.239-260.

Venkatesh, V. & Davis, F.D. (1996). A Model of the Antecedents of Perceived Ease of Use: Development and Test, *Decision Sciences*, 27(3), pp.451-481.

Venkatesh, V. (2000). Determinants of perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model, Information Systems Research, 11(4), pp.342-365.

Venkatesh, V. and Morris, M.G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their roles in technology acceptance and usage behavior, *MIS Quarterly*, 24(1), pp. 115-140.

APPENDIX I. MEASUREMENT ITEMS

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.

APPENDIX II. DESCRIPTIVE STATISTICS AND CRONBACH'S ALPHA

	Mean	Standard Deviation	Cronbach's Alpha values
Perceived Usefulness (PU)			
PU1	5.19	1.230	0.8759
PU2	4.92	1.325	
PU3	5.21	1.245	
PU4	5.19	1.300	
PU5	5.37	1.246	
Perceived Ease of Use (PEOU)			
PEOU1	4.72	1.326	0.8629
PEOU2	4.60	1.289	
PEOU3	4.99	1.148	
PEOU4	4.75	1.215	
PEOU5	5.04	1.505	
Intention to Use (ITU)			
ITU1	5.79	1.167	0.8510
ITU2	5.68	1.191	

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