Modelling the Influences of Beliefs on Pre-Service Teachers' Attitudes Towards Computer Use

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The purpose of this study is to examine the pre-service teachers' attitudes toward computers use. The impact of five variables (perceived usefulness, perceived ease of use, subjective norm, facilitating conditions, and technological complexity) on attitude towards computer was assessed. Data were collected from 230 pre-service teachers through self-report and structural equation modelling was used as the technique for analysis. Results showed that 64% of the variance in attitude towards computer use was explained by the five exogenous variables. In addition, perceived usefulness, subjective norm, and technological complexity were found to be significant influences on attitude toward computer use while perceived ease of use and facilitating conditions did not.

Key words: pre-service teachers; beliefs; attitudes towards computer use; structural equation modeling

Any initiative to integrate technology in the teaching and learning process depends strongly upon the support of teachers involved. It is reasonable to assume that if teachers do not believe that using computers will fulfil their own and their students' needs, they are likely to avoid using technology to discharge their professional duties. Of the factors that have been found to predict the teachers' intention to use technology is their attitude toward computer use (Teo, 2009). Whether these attitudes are positive or negative, they affect teachers' responses to computer use. This in turn affects how students view the importance of technology (computers) in schools (Teo, 2008). Regardless of the state of technological advancement in the schools, the degree of uptake of technology is strongly reliant on teachers having a positive attitude towards computer use (Huang & Liaw, 2005). On the relationship between attitude towards computer use and actual computer use, Shapka & Ferrari (2003) found that pre-service teachers with higher computer attitudes tended to possess more efficient strategy and focused in using the computer.

Attitudes towards computer use are influenced by different variables. Among these are the users' beliefs about various factors of technology use. These factors interact with one another to impact on attitude towards computers. Wong, Ng, Narwawi, and Tang (2005) examined the use of the Internet among 310 pre-service teachers and found that their uses of the internet was influenced by the support from their friends, their confidence level, attitude towards the internet, and perceived usefulness. Teo, Lee, and Chai (2008) and Teo, Wong and Chai (2008) found that pre-service teachers' attitude towards computer use to be significantly influenced by perceived usefulness, perceived ease of use, and subjective norm. The success of any initiatives to integrate technology in teaching and learning depends largely on teachers' support. In many instances, this support refers to teachers' intention to use technology. Teo and van Schaik (2009) found that, in addition to perceived usefulness, perceived ease of use, and subjective norm, facilitating conditions has a significant influence on attitude towards computer use indirectly through perceived ease of use. Furthermore, Teo (2010) found that technological complexity had a direct and significant influence on attitude towards computer use.

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From the literature, perceived usefulness (PU) refers to the extent to which a user's believes that using technology will increase or improve his/her job performance while perceived ease of use (PEU) is the degree to which a person believes that using a particular technology would be free of effort (Davis, Bagozzi, & Warshaw, 1989). Subjective norm (SN) is defined as a person's beliefs that most people who are important to him or her think he or she should or should not perform the behaviour in question (Fishbein & Ajzen, 1975) and facilitating conditions (FC) are factors that exist in the environment which a person believe have an influence over a his/her desire to perform a task (Teo & van Schaik, 2009). Finally, technological complexity (TC) refers to the degree to which a person believes that a system relatively difficult to understand and use (Thompson, Higgins, & Howell, 1991).

The aim of this study is to the impact of pre-service teachers' beliefs on their attitudes towards computer use (ATCU). A key reason for studying pre-service teachers' attitudes toward computer use is the ability of attitudes to predict future computer use. For example, Yildirim (2000) found that teachers who used computers more usually developed positive attitudes and this had promoted further use of the computer in their professional duties such as teaching and administration. The use of pre-service teachers in this study is intended to allow us to understand how future teachers might respond to technology. This study attempt to answer the following research question

1. To what extent do Perceived Usefulness, Perceived Ease of Use, Subjective Norm, Facilitating Conditions, and Technological Complexity impact on pre-service teachers' Attitude Towards Computer Use?
2. How much variance in Attitude Towards Computer Use is explained by Perceived Usefulness, Perceived Ease of Use, Subjective Norm, Facilitating Conditions, and Technological Complexity?

This study employs a structural equation modelling (SEM) approach to develop a model that represents the relationships among the six variables in this study: attitudes towards computer use, perceived usefulness, perceived ease of use, subjective norm, facilitating conditions, and technological complexity. Structural equation modelling was used as it allows a simultaneous examination of the interaction among the variables under study. In contrast to multiple regressions which measure only the direct relationships between the independent variable and the dependent variable while controlling for other variables, SEM is capable of analysing both the direct and indirect effects, hence the possibility of more accurate results to be obtained. In addition, to produce more reliable estimates, SEM models the measurement error separately for each observed variable, something that traditional techniques (e.g., multiple regression, MANOVA) do not. Figure 1 shows the research model for this study.

Method

Participants and procedure

Participants were 230 pre-service teachers enrolled at the National Institute of Education (NIE) in Singapore. Among the participants, 36.50% were male while 63.50% (146) were female. Their mean age was 25.56 (SD=4.40). Every participant had access to a computer at home and the mean years of computer usage is 10.30 years (SD=3.64). The reported mean of daily computer usage is 2.08 hours (SD=1.28). Participants who volunteered were given the survey questionnaire by this researcher to complete. They were briefed on the purpose of this study and their rights not to participate in or withdraw from the study after they had started completing the questionnaire. On average, each participant took not more than 20 minutes to complete the questionnaire.

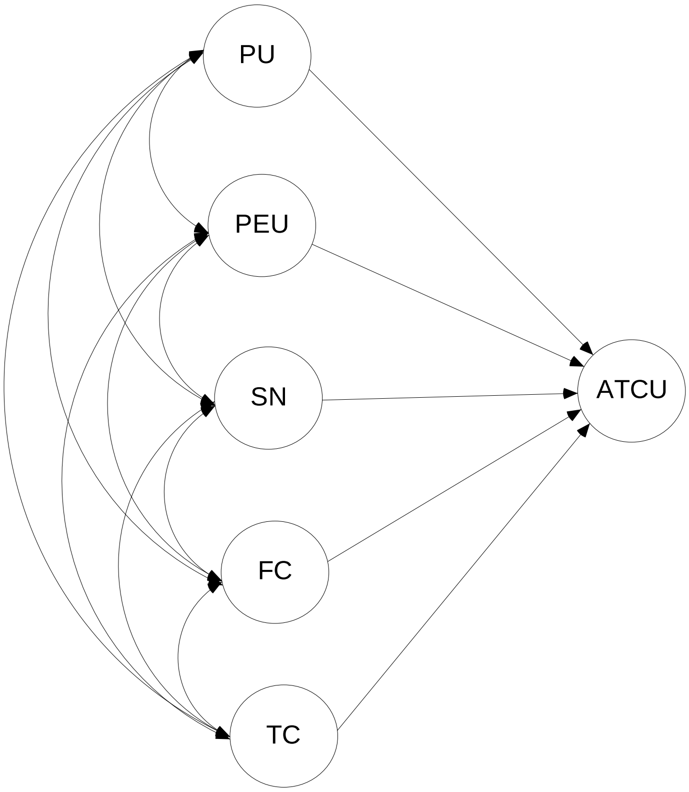

Figure 1: Research model

Measures

A multiple-item survey questionnaire was used. Participants who volunteered provided their demographics details and responded to 20 items on perceived usefulness (PU) (four items), perceived ease of use (PEU) (three items), subjective norm (SN) (two items), facilitating conditions (FC) (three items), technological complexity (TC) (four items) and attitudes toward computer use (ATCU) (four items). Each statement was measured on a five-point Likert scale with 1=strongly disagree to 5=strongly agree. These items were adapted from multiple published sources that have demonstrated the former's appropriateness and reliability in measurinrg the constructs employed in this study. The statistical details regarding reliability and validity are shown in the following sections. Items that were used in this study and their sources are listed in the Appendix.

Results

Descriptive statistics

The descriptive statistics of the items showed that all means are above the midpoint of 3.00 (except for FC3 which was 2.90), and the standard deviations range from .68 to 1.06. The skew index ranges from -1.26 to .07 and kurtosis index ranges from -.73 to 4.43. Following Kline's (2005) recommendations that the skew and kurtosis indices should be within ∣3∣ and ∣10∣ respectively, the data in this study are regarded as normal.

Test of the measurement model

In structural equation modelling, it is customary to test the measurement model before the structural model. The main purpose is to ensure that the chosen indicators for a construct are reliable and valid (measurement model) before testing the specified theory (structural model) (Anderson & Gerbing, 1988). The measurement model was assessed using confirmatory factor analysis (CFA) with AMOS 7.0 (Arbuckle, 2006) and using the maximum likelihood estimation procedure (MLE). While the MLE is a robust method for use in structural equation modelling (Schumacker & Lomax, 2010), it assumes multivariate normality of the observed variables. In this study, multivariate normality was examined using the Mardia's normalized multivariate kurtosis value. The Mardia's coefficient for the data in this study was 109.771, which is much lower than the computed value of 440 based on the formula $p(p+2)$ where p equals the number of observed variables in the model (Raykov & Marcoulides, 2008). As such, multivariate normality of the data was assumed in this study.

Table 1. Results for the measurement model

Item	UE	SE	t-value**	R^2	AVE (>50)[a]	Cronbach Alpha
Perceived Usefulness					.67	.89
PU1	1.061	.796	12.889	.634		
PU2	1.296	.876	14.432	.767		
PU3	1.236	.800	12.963	.640		
PU4	1.000	.787	---	.619		
Perceived Ease of Use					.64	.84
PEU1	.889	.769	12.068	.592		
PEU2	1.052	.820	12.900	.672		
PEU3	1.000	.808	---	.653		
Subjective Norm					.72	.81
SN1	.674	.696	7.495	.484		
SN2	1.000	.981	---	.963		
Facilitating Conditions					.56	.79
FC1	1.017	.760	8.870	.578		
FC2	1.087	.823	8.937	.678		
FC3	1.000	.658	---	.432		
Technological Complexity					.65	.88
TC1	1.050	.768	12.744	.590		
TC2	1.013	.811	13.662	.658		
TC3	1.160	.815	13.734	.664		
TC4	1.000	.827	---	.684		
Attitude Towards Computer Use					.63	.86
ATCU1	.920	.801	11.514	.641		
ATCU2	.971	.855	12.225	.730		
ATCU3	.905	.786	11.312	.618		
ATCU4	1.000	.722	---	.521		

** $p < .01$; [a] acceptable level of reliability or validity; --- values set at 1.00 for identification purpose
AVE= Average variance extracted ($\Sigma[\lambda_i^2]/n$); UE=Unstandardised Estimate; SE=Standardised Estimate

From Table 1, all items unstandardised estimates in the measurement model are significant at the $p < .001$ level. The standardised estimates are .70 and above, demonstrating convergent validity at the item level (Hair, Black, Babin, & Anderson, 2010). The average variance extracted (AVE) for all constructs are above .50 and above and all Cronbach alphas are .70 and above, demonstrating acceptable reliability (Nunnally & Bernstein, 1994) and convergent validity at the construct level (Fornell & Larcker, 1981).

Discriminant validity was assessed by comparing the square root of the average variance extracted (AVE) for a given construct with the correlations between that construct and all other constructs. If the square roots of the AVEs are greater than the off-diagonal elements in the corresponding rows and columns in a correlation matrix, this suggests that a construct is more strongly correlated with its indicators than with the other constructs in the model. In Table 2, discriminant validity appeared satisfactory; hence the constructs in the proposed research model are deemed to be adequate for further analyses.

Table 2. Discriminant validity for the measurement model

	PU	PEU	SN	FC	TC	ATCU
PU	(.82)					
PEU	.56**	(.80)				
SN	0.39**	0.29**	(.85)			
FC	0.17*	0.28**	0.32**	(.75)		
TC	0.33**	0.54**	0.24**	0.24**	(.81)	
ATCU	0.62**	0.55**	0.38**	0.23**	0.50**	(.79)

** $p < 0.01$. Diagonals in parentheses are square roots of the average variance extracted from observed variables (items); Off-diagonal are correlations between constructs.

Test of structural model

The model fit of the research model in this study was tested using AMOS 17.0. Researchers typically employ different indices to determine model fit (Brown, 2006). These include absolute fit, parsimony fit, and comparative fit. Absolute fit indices measure how well the proposed model reproduces the observed data. The most common absolute fit indices are the model chi-square (χ^2) and standardized root mean square residual (SRMR). Because the χ^2 has a tendency to indicate significant differences, Hair et al, (2010) recommended the use of the ratio of χ^2 to its degree of freedom be computed (χ^2 /df), with a ratio of 3.0 or less being indicative of an acceptable fit.

Table 3. Fit indices for the research model

Model fit indices	Values	Recommended Guidelines*
χ^2	354.656, p <.001	Not significant
χ^2/ df	2.288	= < 3.0
TLI	.907	= > .90
CFI	.924	= > .90
RMSEA	.075	= < .08
SRMR	.066	= < .08

* Hair et al., 2010; Schumacker & Lomax, 2010.

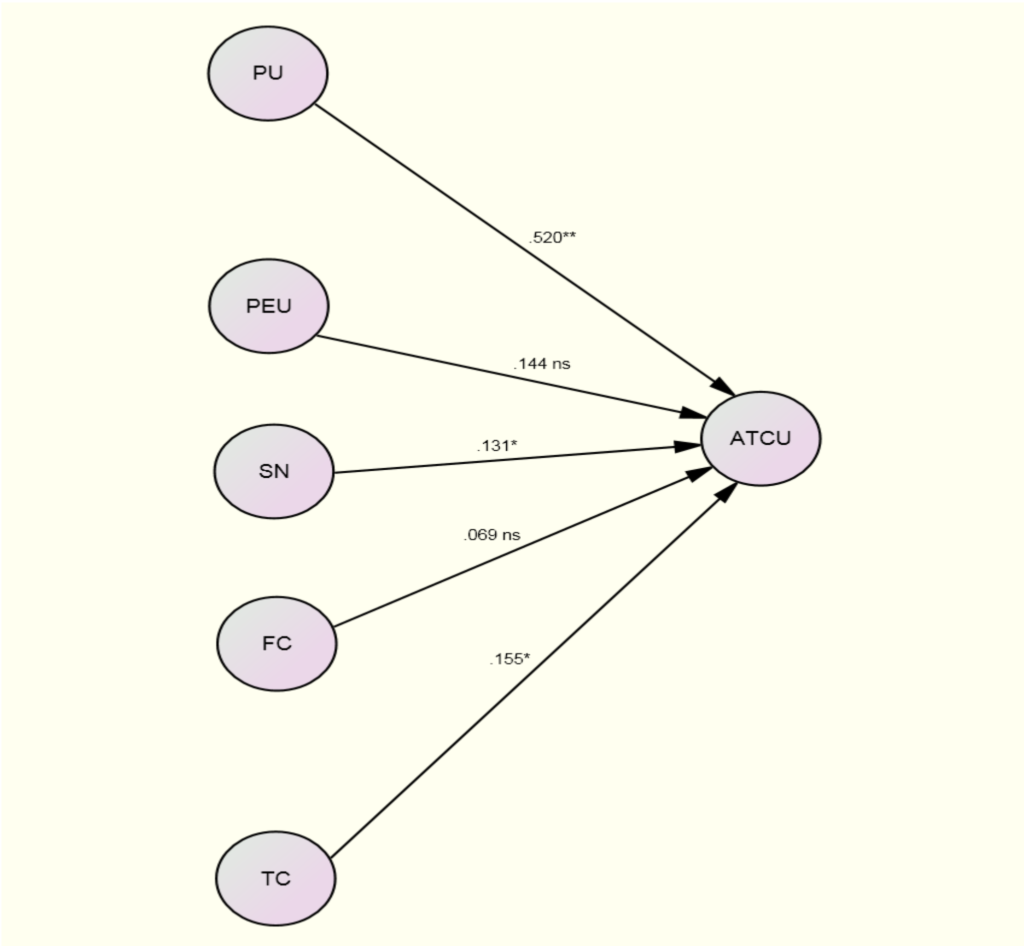

Figure 2: Path coefficients of the research model
* $p < .05$; ** $p <. 01$; ns=non-significant

Parsimonious indices are similar to the absolute fit indices except that it takes the model's complexity into account. An example of parsimonious fit index is the root mean square error of approximation (RMSEA). Finally, comparative fit indices are used to evaluate a model fit relative to an alternative baseline model. Examples of comparative fit indices include the comparative fit index (CFI) and Tucker–Lewis index (TLI). In this study, all the six fit indices mentioned above would be used. Table 3 shows the results of the test of the structural model in this study and the recommended level of acceptable fit. Figure 2 shows the path coefficients of the research model.

Discussion

The main aims of this study the extent to which PU, PEU, SN, FC, and TC impact on pre-service teachers' ATCU and the amount of variance in ATCU that was explained by PU, PEU, SN, FC, and TC. Using structural equation modelling, this study found that 64% of the variance in ATCU was explained by PU, PEU, SN, FC, and TC and this represent a good proportion. However, of the five exogenous variables (PU, PEU, SN, FC, and TC), only PU, SN, and TC had positive and significant influences on ATCU. PEU and SN did not influence ATCU significantly.

This study supports recent research that found perceived usefulness to be a key determinant on attitude towards computer use (e.g., Pituch & Lee, 2006). Perceived usefulness refers to the utilitarian aspect of computer use in that whether its use would result in higher productivity or not. It is reasonable to assume that when pre-service teachers have successful experiences in computer use (e.g., higher productivity); their attitude towards computer use would be positively reinforced. Subjective norm was found to be a significant influence on attitude towards computer use, implying that pre-service teachers' attitude was highly affected by their important referents. Venkatesh and Davis (2000) found that subjective norm was likely to have a significant influence on user's attitude in a mandatory setting, but it had no effect in a voluntary setting. It is possible that the pre-service teachers in this study had perceived the use of computer to be non-volitional through institutional encouragements for them to use computers for instructional, assessment or administrative purposes. Technological complexity had a significant influence on attitude towards computer use. This is a logical relationship and consistent with current research which found pre-service teachers' attitudes towards computer use to be influenced by how easy to difficult they had perceived the technology to be (Sime & Priestley, 2005).

This study provided some evidence to suggest that pre-service teachers' attitudes towards computer use are positively influenced by perceived usefulness, subjective norm, and technological complexity. When pre-service teachers possess positive computer attitudes, they tend to be more focused in their use of computers, an ingredient for successful computer usage (Shapka & Ferrari, 2003). To harness the positive impact of computer attitude on computer use, teacher educators and institutional management should provide facilitating conditions to ensure successful interactions with computers among pre-service teachers. Grainger and Tolhurst (2005) found that, of the many variables that influence computer use, attitude was very responsive to organizations factors such as strong leadership, operational excellence, positive ethos, collaborative culture, and well-motivated and caring staff.

A limitation of this study is the sole use of pre-service teachers from a single country. Due to the cultural and socio-political influences, the profile of this sample may not be representative of pre-service teachers in general and this impacts on the generalizability of the results. Caution should be exercised when applying the findings of this study to per-service teachers in other cultures and societies.

Future research could focus on comparing practicing teachers with pre-service teachers to understand differences, if any, in their attitude towards computer use and whether they are influenced by similar variables of interest. Longitudinal studies may be designed to trace the stages of attitudinal changes experienced by pre-service teachers when they become practicing teachers. Finally, it is useful to examine whether there are discrepancies between self-reports and actual practice and, if these exist, to identify the factors that explain the gap.

Appendix: Questionnaire items

Construct	Item	
Perceived Usefulness (adapted from Davies, 1989)	PU1	Using computers will improve my work.
	PU2	Using computers will enhance my effectiveness.
	PU3	Using computers will increase my productivity.
	PU4	I find computers a useful tool in my work.
Perceived Ease of Use (adapted from Davies, 1989)	PEU1	My interaction with computers is clear and understandable.
	PEU2	I find it easy to get computers to do what I want it to do.
	PEU3	I find computers easy to use.
Subjective Norm (adapted from Taylor and Todd, 1995)	SN1	People whose opinions I value will encourage me to use computers.
	SN2	People who are important to me will support me to use computers.
Facilitating Conditions (adapted from Thompson, et al., 1991)	FC1	When I need help to use computers, guidance is available to me.
	FC2	When I need help to use computers, specialized instruction is available to help me.
	FC3	When I need help to use computers, a specific person is available to provide assistance.
Technological Complexity (adapted from Thompson, et al., 1991)	TC1	Learning to use the computer takes up too much of my time. (R)
	TC2	Using the computer is so complicated that it is difficult to know what is going on. (R)
	TC3	Using the computer involves too much time. (R)
	TC4	It takes too long to learn how to use the computer. (R)
Attitudes Towards Computer Use (adapted from (Thompson et al. 1991; Compeau and Higgins, 1995)	ATCU1	Computers make work more interesting.
	ATCU2	Working with computers is fun.
	ATCU3	I like using computers.
	ATCU4	I look forward to those aspects of my job that require me to use computers.

(R): This item will be reverse-coded

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