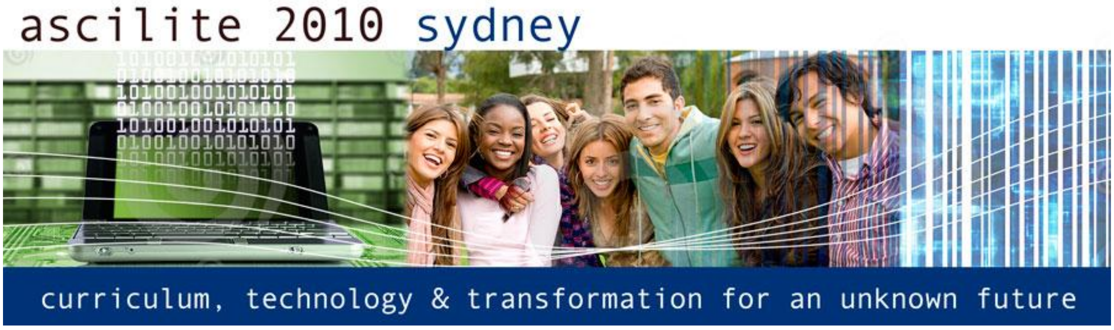

Examining the efficacy of the Theory of Planned Behavior (TPB) to understand pre-service teachers' intention to use technology*

Timothy Teo & Chwee Beng Lee
Nanyang Technology University
Singapore

This study examined pre-service teachers' self-reported intention to use technology by employing the Theory of Planned Behavior (TPB) as the research framework. One hundred and fifty-seven participants completed a survey questionnaire measuring their responses to four constructs in the TPB. These were administered at the beginning of the course in which technology was taught and used. Structural Equation Modeling (SEM) was used as the technique for data analysis. The results of this study showed that attitudes toward usage and subjective norms were significant predictors of behavioral intention to use technology while perceived behavioral control was not. Overall, this study found that the three explanatory variables in the TPB explained about 40% of the variance in behavioral intention to use technology.

Keywords: Theory of Planned Behavior, intention to use, pre-service teachers, structural equation modeling

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Introduction

For the last two decades, researchers have been studying acceptance of technology as it has been recognized as one of the key drivers to the improvement of teaching and learning. Researchers were keen to understand the conditions or factors that influence technology adoption and usage (Legris, Ingham, & Collerette, 2003) and several models were developed to help in predicting technology acceptance. Among these models, the Theory of Planned Behavior (Ajzen, 1991) is a widely-used and validated model.

As an extension of Theory of Reasoned Action (Ajzen & Fishbein, 1980), the theory of planned behavior (TPB) was proposed by Ajzen in 1991 and has been used by researchers over the past twenty years and shown to be able to predict a variety of intentions and behaviors. According to Ajzen (1991), a person's action is determined by behavioral intentions, which in turn are influenced by an attitude towards the behavior and subjective norms. In addition to attitude towards the behavior and the subjective norm in the theory of planned behavior, perceived behavioral control can influence intention as well. Perceived behavioural control influences the individual's decision through behavioral intention. In the TPB, behavioral intention is the most influential predictor of behavior. Behavioral intentions are factors that describe how hard people are willing to try to perform a behavior (Azjen, 1991). Attitudes toward use (ATU) guide behavior and are defined as the way individuals respond to, and are disposed towards, an object. This disposition may be negative or positive. Subjective norm (SN) is defined as one's perception of whether people important to the individual think the behavior should be performed.

In this study, subjective norm is the extent to which a person perceives the demands of the ‘important’ others on that individual to use technology. Perceived behavioral control (PBC) refers to the perceived ease or difficulty of performing the behavior and the amount of control one has over the attainment of the goals from said behavior. In the context of technology-based behaviors, PBC has been found to correlate well with perceived ease of use or difficulty related to a particular technology, which have been shown to be major factors predicting intention to use that technology (Compeau & Higgins, 1995).

This aim of this study is to examine the efficacy of the TPB (see figure 1) to explain pre-service teachers’ intention to use technology. We hypothesized that the three independent variables in TPB (ATU, SN, and PBC) will exert significant influence on the behavioral intention to use technology.

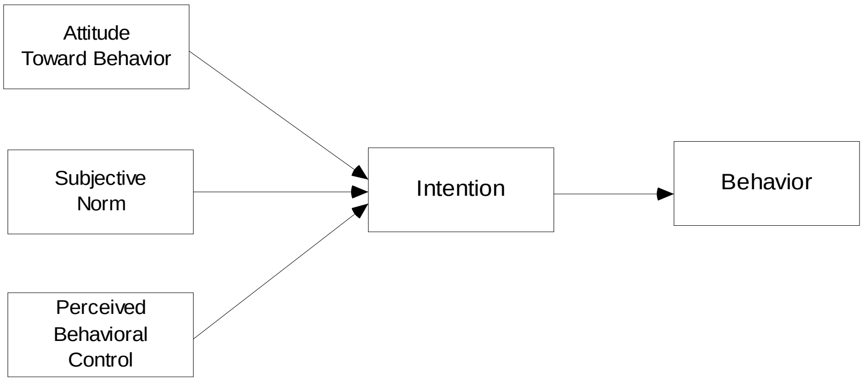

Figure 1: Theory of Planned Behavior (Ajzen, 1991)

Methodology

Research participants and data collection

We recruited 157 pre-service teachers enrolled at the National Institute of Education (NIE) to voluntarily take part in our study. The participants formed about 40% of the student population in the 4-year Bachelor of Arts (with Education) program. Among them, 72.0% were female and the mean age of all participants was 22.4 (SD=3.30). Before we administered the questionnaire, we briefed the participants on the purpose of this study and informed them that they could decline to participate in the study before or after they had completed the questionnaire. On average, each participant took less than 20 minutes to complete the questionnaire.

Measures

We used a survey questionnaire which was validated previously. In this survey, participants provided their demographic information and respond to 11 statements on the six constructs (see table 1). They are: attitudes towards usage (ATU) (four items), subjective norm (SN) (two items), perceived behavioral control (three items), and behavioral intention to use (BIU) (two items). Each statement was measured on a five-point Likert scale with 1=strongly disagree to 5=strongly agree.

Table 1: List of items and their sources

Construct	Item	
Attitudes Toward Usage (adapted from Compeau and Higgins, 1995)	ATU1	Computers make work more interesting.
	ATU2	Working with computers is fun.
	ATU3	I like using the computer.
	ATU4	I look forward to those aspects of my job that require me to use computers.
Subjective Norm (adapted from Ajzen 1991; Davis et al. 1989)	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.
Perceived Behavioural Control (adapted from Davies, 1989)	PBC1	My interaction with computers is clear and understandable.
	PBC2	I find it easy to get computers to do what I want it to do.

	PBC3	I find computers easy to use.
Behavioral Intention to Use	BIU1	I will use computers in future.
(Davis et al. 1989)	BIU2	I plan to use the computer often.

Results

Descriptive statistics

Our results show that the mean values of all variables are above the midpoint of 3.00. The standard deviations range from .66 to .75 and this indicates a narrow spread around the mean. The skew index ranges from -.32 to -.15 and kurtosis index ranges from -.19 to .54, which meets Kline's (2005) recommendations for the purposes of structural equation modeling.

Convergent validity

Fornell and Larcker (1981) proposed three procedures to assess for convergent validity of the measurement items: (1) item reliability of each measure, (2) composite reliability of each construct, and (3) the average variance extracted. The item reliability of an item was assessed by its factor loading onto the underlying construct. Hair, et al. (2006) recommended a factor loading of 7.0 to be acceptable indicative of validity at the item level. In this study, construct reliability was measured using Cronbach's alpha, with a value of .70 or higher being recommended (Nunnally & Bernstein, 1994). The third indicator of convergent validity, average variance extracted, measures the overall amount of variance that is attributed to the construct in relation to the amount of variance attributable to measurement error. Convergent validity is judged to be adequate when average variance extracted equals or exceeds 0.50, when the variance captured by the construct exceeds the variance due to measurement error. In Table 2, all factor loadings, except PBC2 were high and met the recommended guidelines, indicating that the convergent validity for the proposed constructs of the measurement model is adequate.

Table 2: Results of the measurement model

Latent Variable	Item	Standardized Factor loading (> .70)*	[a]Average Variance Extracted (> .50)*	Cronbach Alpha (> .70)*
Attitude Towards Usage			.69	.89
	ATU1	.85		
	ATU2	.88		
	ATU3	.82		
	ATU4	.76		
Subjective Norm			.84	.91
	SN1	.88		
	SN2	.95		
Perceived Behavioral Control			.65	.83
	PBC1	.83		
	PBC2	.68		
	PBC3	.90		
Behavioral Intention to Use			.88	.93
	BI1	.92		
	BI2	.96		

* Indicates an acceptable level of reliability or validity
[a]AVE: Average Variance Extracted. This is computed by adding the squared factor loadings divided by number of factors of the underlying construct.

Discriminant validity

Discriminant validity is present when the variance shared between a construct and any other construct in the model is less than the variance that construct shares with its indicators (Fornell et al., 1982). Discriminant validity was assessed by comparing the square root of the average variance extracted 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 exceed the correlations between a given construct and others in the model, this suggests that a construct is more strongly correlated with its indicators than with the other constructs in the model. In Table 3, the diagonal elements in the correlation matrix have been replaced by the square roots of the average variance extracted. Discriminant validity appears satisfactory at the construct level in the case of all constructs.

Table 3: Discriminant validity

Construct	ATU	SN	PBC	BIU
ATU	(.75)			
SN	.42**	(.91)		
PBC	.56**	.38**	(.79)	
BIU	.61**	.39**	.38**	(.87)

Notes:
(1) **p*< .01
(2) Diagonal in parentheses: square root of average variance extracted from observed variables (items); Off-diagonal: correlations between constructs

Test of the measurement model

The research model in this study was tested using the structural equation model approach, using the computer software program AMOS 7.0. A variety of indices was used in this study. These are absolute fit indices that measure how well the proposed model reproduces the observed data. In other words, the fit indices evaluate the overall discrepancy between the implied and observed covariance matrices. They include the χ^2 statistic, and the standardized root mean residual (SRMR). The next category of fit indices, parsimonious indices is similar to the absolute fit indices except that it takes into account the model's complexity. The root mean square error of approximation (RMSEA) is widely used for this purpose. Finally, the incremental fit indices assess how well a specified model fits relative to an alternative baseline model. Examples of incremental fit indices are the comparative fit index (CFI) and Tucker-Lewis index (TLI). Results of the model test revealed an acceptable fit. Except for the χ^2, all values satisfied the recommended level of acceptable fit ($\chi^2 = 65.147$, $p < .004$; $\chi^2/df = 1.714$; TLI = .967; CFI = .977; RMSEA = .068; SRMR = .038) (Hu & Bentler, 1999).

Test of the structural model

The test of the structural model test revealed the following results:

- Attitude towards use is a significant predictor of behavioral intention to use
- Subjective norm is a significant predictor of behavioral intention to use
- Perceived behavioral control is not significant predictor of behavioral intention to use
- A total of 39.2% of the variance of behavioral intention to use technology was explained by the three variables (ATU, SN and PBC).

Discussion and conclusion

Using the TPB as a research model, our study showed that attitudes towards computer use and subjective norm have significant effect on behavioral intention to use technology, while perceived behavioral control did not. Overall, the three variables (ATU, SN, & PBC) contributed about 40% of the variance in behavioral intention to use. This suggests that the TPB is fairly efficient as a model to predict the behavioral intention to use technology among pre-service teachers in Singapore. We can infer that when pre-service teachers have positive attitude, they would be inclined to use technology. This finding supports current research that found a close relationship between a positive attitude and intention to use technology (e.g. Teo, 2009).

Among the exogenous variables, behavioral intention was not significantly predicted by perceived behavioral control, as hypothesized in the TPB. This could be the case when perceived behavioral control (PBC) alone was not enough to motivate pre-service teachers to use technology. However, the results in this study showed that perceived behavioral control is significantly correlated with attitude and subjective norm. An examination of the interplay of the three exogenous variables (ATU, SN, and PBC) on behavioral intention to use is warranted to acquire greater insights into the TPB's propensity to explain technology usage intention.

There are some limitations of this study. First, the data was collected through self-reports and a single method of data collection which may have lead to the common method variance. To address this issue future research could employ the multi-trait multi-method (MTMM). Second, the sample in this study employed pre-service teachers as participants as their training may have influenced their responses. Future research may include additional variables to assess their impact on the TPB to explain the behavioral intention use technology. In addition, attempts could be made to unpack and clarify the role and properties of perceived behavioral control as a variable in the TPB.

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Author contact details:
Timothy Teo
timothy.teo@nie.edu.sg;
Chwee Beng Lee,
chweebeng.lee@nie.edu.sg
Nanyang Technology University, Singapore

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