

Using the Theory of Planned Behaviour to predict Bruneian teachers' intentions to use ICT in teaching

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Abstract: This study investigated use of the Theory of Planned Behaviour (TPB) (Ajzen, 1985) as a framework for predicting and explaining teachers' intentions and use of ICT in teaching. Instrumentation consisted of a six-part self-report questionnaire: (1) Demographic information, (2) Attitudes towards use of ICT (AB), (3) Subjective Norms (SN), (4) Perceived Behavioral Control (PBC), (5) Intention to use (I), and (6) Use of ICT (B). Structural equation modeling (SEM) using AMOS 4.0, was used to assess the strength of the relationships between the construct variables and the model fit. The results indicated that teachers' attitudes towards use of ICT and subjective norms significantly predict their intentions and that intentions significantly predict behaviour. However, perceived behavioural control was found not to have significant influence on intentions and behaviour. The TPB theoretical model explained 17% of the variance in teachers' intentions to use ICT and 24% of the variance in use.

Introduction

The application of Information and Communication Technology (ICT) in education is relatively recent in Brunei Darussalam. It is only during the last decade that the Department of ICT of the Ministry of Education, in its capacity as the monitoring authority, has been actively promoting the use of ICT in all aspects of education through its ICT master plan.

Among the goals of the ICT master plan were providing schools with the required infrastructure for ICT and training teachers for ICT implementation. There are now requirements for Bruneian teachers to use ICT in their lessons (see Suriani, 2002) but evidence from research (e.g. Sallimah & Leong, 2002) has shown that many teachers are not yet ready.

In order to encourage teachers to use ICT in teaching, it is crucial for the monitoring authority to understand how ICT is perceived and used by teachers in the classroom and what expectations are associated with the actual use. This is in line with the "new millennium" technology research agenda that recommends a focus on providing teachers with a rationale for the use of technology-based methods (such as using computer and ICT), and the relative advantage of these methods over other methods (Roblyer & Knezek, 2003). Access to such information is desirable at this early stage in order to most effectively plan and promote wide use of ICT and provide some justification for the costs of integrating ICT in school curriculum.

Previous researchers have noted the importance of studying the use of ICT in teaching (Mumtaz, 2000; Williams, Coles, Wilson, Richardson, & Tuson, 2000). However, most previous studies merely described teacher characteristics and frequency of ICT use. As ICT is now dramatically changing the learning and teaching environment, there is a need for studies that provide not only such transitory information but also identify fundamental mechanisms that explain the factors affecting the use of ICT. Therefore, this study attempted to take a rigorous theoretical approach to investigating some psychological determinants of ICT use.

Factors influencing teachers to use ICT

Previous research shows that some of the prevailing factors that determine teachers' use of computers and ICT in the classroom are found to be associated with teacher personal characteristics such as skills and competency (Preston, Cox, & Cox, 2000), teachers' confidence and development of their self esteem in using ICT and their pedagogical skills in incorporating ICT (Goldstein, 1997), motivation from *significant others* (Marcinkiewicz, 1996), and teachers' own technical expertise and professional experience in using computer applications, and their personal involvement in their profession .

Teachers' decisions to use ICT in the classroom are shown to be influenced by three factors: institution, resources and the teacher (Mumtaz, 2000). Veen (1993) showed that teacher factors outweighed the institutional factor. The teacher factors included their beliefs about what content should be included and the way it should be taught, and their beliefs about teacher roles in the classroom and the skills associated with competence in managing classroom activities, pedagogical skills and computer-handling skills (Veen, 1993).

The studies cited above identify factors that influence teacher decisions or intentions to use or actual use of ICT in teaching. However, none attempted to explain the potential relationships between teacher beliefs and teachers' intention to use and/or actual use of ICT in teaching. This study attempted to develop a theoretical structure that can explain teachers' use of ICT in teaching by focusing on psychological factors. A research model elaborated from Ajzen's (1985) Theory of Planned Behaviour (TPB), a widely applied theory of social psychology, was proposed and examined. A brief review of TPB is described in the next section.

Theoretical Framework

Ajzen's (1985) TPB was considered a useful theoretical framework for this study because of its success in predicting and explaining various human behaviours, and empirical data supports in usefulness (Armitage & Conner, 2001; Sutton, 1998). The TPB postulates that *behaviour* (B) may be predicted by *intention* (I) to engage in the behaviour and *perceived behavioural control* (PBC), which is a measure of the anticipated ease or difficulty of performing the behaviour. Intentions, in turn, are influenced by *attitudes* (AB) towards the behaviour and *subjective norms* (SN), which are the perceived social pressures to perform or not perform the behaviour. In application to the use of ICT in teaching, the TPB would suggest that teachers' use of ICT in teaching (B) may be predicted by their *intention* (I) to use ICT and their *perceived behavioural control* (PBC) of conditions relevant to their use of ICT. Teachers' intentions to utilise ICT may be influenced by their *attitudes* towards the use of ICT in teaching (AB) and the influences of those around them (SN).

In this study, teachers' *attitudes* towards classroom use of ICT were measured using items in which teachers rated their perceptions about the outcome of their using ICT in teaching, such as making their teaching more interesting, more diverse, and improving their teaching, and their feelings towards using ICT, such as enjoyment and desire to use more ICT materials.

Items related to *subjective norms* (SN) probed teachers' perceptions of pressures from significant others such as principals, colleagues, students, the profession more generally and the government's aspirations for ICT use across the curriculum.

Perceived behavioural control (PBC) were measured using items that represent teachers' *control beliefs* (cb), that is, the extent to which teachers perceive that the availability of resources and other factors such as support from parents, other teachers and technicians and time for planning and developing ICT resources may enable them to teach effectively using ICT.

Research Questions

This study used the TPB as a framework to examine how the theory constructs (AB, SN, and PBC) may be used to predict and explain teachers' intentions and use of ICT in teaching.

The following specific research questions were formulated to achieve the aims of the study:

1. How are teachers' attitudes towards use of ICT in teaching (AB), the influence of subjective norms (SN) and perceived behavioral control (PBC) with regard to ICT related to teacher intention to use (I) and actual use of ICT (B)?
2. To what extent does the TPB provide a basis for predicting and explaining teachers' use of ICT in their teaching?

Significance of the research

While previous studies have focused on reporting the distribution of teacher characteristics and factors affecting their use or non use of ICT in teaching, this study attempted to use a social-psychological theoretical model to provide empirical evidence that may predict and explain their behaviors.

From the perspective of the TPB, this study extends the applicability of the theory to studies of ICT classroom implementation.

Methodology

This study employed a survey questionnaire to obtain quantitative data that will be used to establish the basis for wider generalization. The data are used to test the constructs of the TPB (attitude, subjective norms, and perceived behavioural control) that underpin this research.

Participants and instrumentation

Data for the study were obtained from a 6-part Information and Communication Technology in Education (ICTE) survey questionnaire. The surveys were distributed to fifteen government secondary schools in Brunei Darussalam. The first part of the ICTE questionnaire consisted of 10 items relating to demographic characteristics. The subsequent parts elicited teachers' attitudes towards ICT implementation in the classroom (11 items), subjective norms (5 items) and perceived behavioural control (12 items) related to the use of ICT in the classroom. The next part of the survey consisted of items relating to teachers' intention to implement ICT in teaching (5 items) and the last part eliciting reports of teachers' actual behavior of ICT implementation (6 items).

Questionnaires were distributed to all 1300 secondary teachers from sixteen secondary schools in the Brunei-Muara District. The Brunei-Muara District was selected because of its geographical accessibility to the researcher. In other respects, such as demographics and resources, it is not visibly different from other districts. 816 questionnaires were returned constituting a 64% return rate. However, only 563 useable questionnaires, in which all items were completed, were analysed in this study.

Analysis of data

This study used a path-analytic model in conjunction with a causal theory, Theory of Planned Behaviour. A path-analytic model evaluates the predictor variables (attitudes towards the behaviour, subjective norms and perceived behavioural control) for the dependent variables: teachers' intention to implement ICT in teaching (I), and their actual classroom behaviour of implementing ICT (B).

Both reliability and validity of the items in the survey questionnaire were assessed using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Structural equation modeling (SEM) using statistical software (AMOS Version 4.0), was employed to assess the strength of the relationships between the variables and the model fit. Structural Equation Modeling allows the full model to be analysed. A full SEM model consists of a measurement model (which includes a set of connections between the observed and latent variable) and a structural model (which includes the model

components connecting the latent variables to each other). In this study, the observed variables are made up of the items of the questionnaire, whilst the latent variables are the theory constructs.

Exploratory factor analysis using SPSS was employed as a preliminary examination of the measurement model in order to investigate whether the a priori five-factor structure of the observed variables is the same as the proposed measurement model. For this study, the maximum likelihood (ML) extraction method was used with Promax rotations, a method of oblique factor rotations that allows for correlations among measures. A factor loading of .3 was used as the lower cut-off value as recommended for exploratory studies (Tabachnick & Fidell, 2000). According to the results, 61.46% of total variation was accounted for in this factor solution. The EFA test results indicated some of the items were loaded to their hypothesized factor. Those factors that exhibited double loading and factor loading lower than .3 were removed from the subsequent analysis.

Confirmatory factor analysis and structural equation modeling were conducted simultaneously using AMOS by specifying the model (see Figure 1) and estimating using the maximum likelihood (ML) technique. The final items and their respective factor loadings, used for SEM analysis are shown in Table 1.

Table 1: Questionnaire Items and Factor Loadings

Measure and variable	Factor Loading	ICTE Questionnaire Item
AB		
More	.61	I would like to use more ICT in my teaching.
Interest	.97	Using ICT in my teaching makes my lessons more interesting.
Improve	.95	Using ICT improves the presentation of materials in my lessons.
Diverse	.65	Using ICT in my teaching makes my lessons more diverse.
Enjoy	.50	I enjoy teaching using ICT.
SN		
Colleague	.62	My use of ICT is influenced by my colleagues' opinions.
Principal	.91	My use of ICT is influenced by my principal's opinions.
Student	.92	My use of ICT is influenced by my students' opinions.
Profession	.86	My use of ICT is influenced by my professions' opinions.
government	.80	My use of ICT is influenced by my government's opinions.
The following factors would enable me to teach effectively using ICT:		
PBC		
Resource	.69	Resources (educational software)
Professed	.70	Professional development opportunities on using ICT in teaching.
Internet	.62	Access to the Internet.
Quality	.81	Quality software
Physical	.77	Physical classroom structures
I		
Intend	.88	I intend to use ICT in presenting my lessons this month.
Prepare	.89	I am likely to use ICT in preparing for my teaching this month.
Instruct	.89	I intend to instruct my students to use ICT materials during my lessons this month.
B		
Assign	.79	I assign students with computer –related tasks that involve students retrieving and analysing information from the internet
Design	.73	Students in my classroom design either web-based or multimedia presentations to showcase their research on topics I assign in class.
Netuse	.70	My teaching often requires students to use the internet for research purposes such as to seek out a solution.
Webuse	.64	I utilize the newest software and web-based innovations in my instructions.

Results

The first research question sought to examine the strength of each of the TPB constructs (AB, SN, and PBC) in predicting intention (I) and behaviour (B). To this end, the structural model (illustrated by ellipses with broken-lined arrows connecting the latent variables in Figure 1) is examined. The standardized regression weights (B), denoted by the number accompanying the path arrows in Figure 1, which indicate the strength of relationships, are shown in the specified SEM model and are tabulated with additional detail in Table 2.

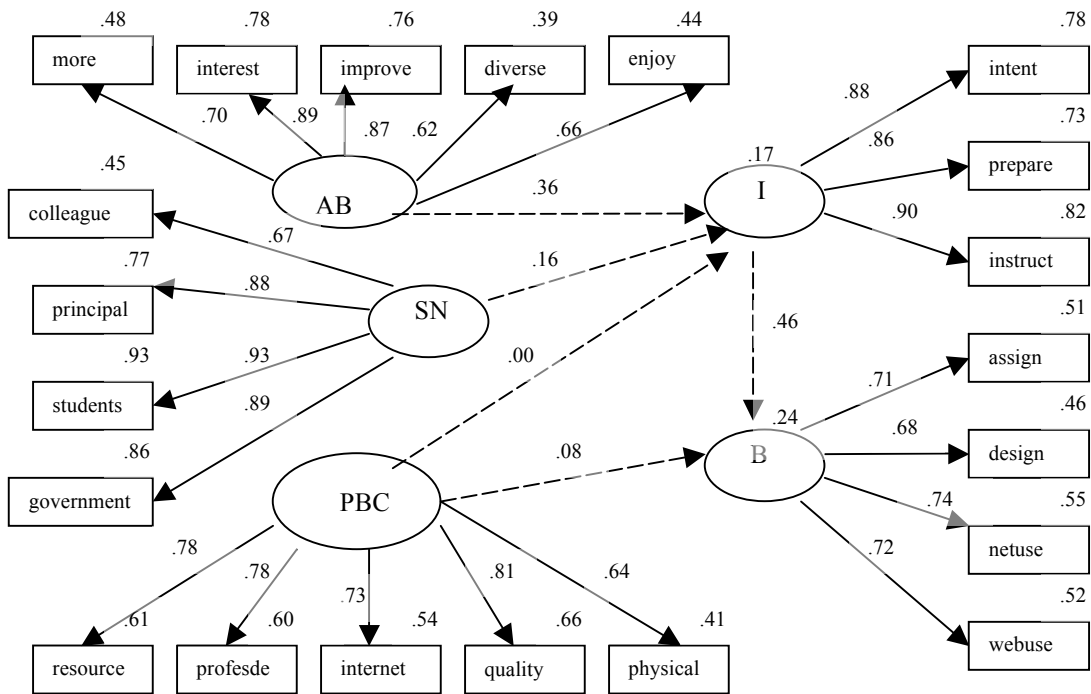


Figure 1. TPB Model. Model specification, standardized estimates and squared multiple correlations

SEM analysis depends upon assumptions of normality and linearity (Tabachnick & Fidell, 2000). These assumptions were evaluated using SPSS. A relatively straight line in a normal probability plot of standardized residuals and a rectangular pattern of distribution of residuals in a scatter plot point to the absence of multicollinearity and singularity. There were no outliers or missing data. This evidence supports the use of SEM. The structural equation model assessed the effects of three independent variables (AB, SN, and PBC) and two dependent variables (I and B).

As shown in Table 2, attitude towards the behaviour ($B = 0.36$, $p < 0.000$) and subjective norms ($B = 0.16$, $p = 0.000$) significantly predict teachers' intentions, and teachers' intentions also predict behavior ($B = 0.46$) significantly at $p < .001$. Perceived behavioural control does not predict intention ($B = 0.00$) or behavior ($B = 0.08$) significantly at $p < 0.001$. The standardized regression weights for the other observed variables are significant at $p < 0.000$, hence confirming the reliability and validity of the items in measuring the respective constructs.

Table 2: Standardized Regression Weights (B) for model paths

Model Path		B
Intent	<---	Attitude .355
Intent	<---	Sub_Norm .162
Intent	<---	PBC .000
Behaviour	<---	PBC .080
Behaviour	<---	Intent .464
Interest	<---	Attitude .885
Improve	<---	Attitude .873
Diverse	<---	Attitude .622
Enjoy	<---	Attitude .664
Colleague	<---	Sub_Norm .674
Quality	<---	PBC .813
Design	<---	Behaviour .682
Netuse	<---	Behaviour .742
Webuse	<---	Behaviour .720
Intend	<---	Intent .884
Principal	<---	Sub_Norm .879
Assign	<---	Behaviour .714
Prepare	<---	Intent .857
Instruct	<---	Intent .903
More	<---	Attitude .696
Students	<---	Sub_Norm .925
Resource	<---	PBC .779
Profesde	<---	PBC .776
Internet	<---	PBC .733
Physical	<---	PBC .641
Government	<---	Sub_Norm .887

The squared multiple correlation coefficients (denoted by the number at the top right hand corner of the relevant ellipses in Figure 1) indicate the amount of variance explained by the variables. It can be seen that AB, SN and PBC explained only 17% of the variance in intentions (I), whilst AB, SN, and PBC explained 24% of the variance in behaviour (B).

The second research question sought to examine the extent to which the TPB provides a basis for predicting teachers' intentions and use of ICT in their teaching. To this end, the measurement model (*illustrated by rectangles of observed variables with arrows connecting them to the ellipses of latent variables in Figure 1*) was assessed using the overall fit indices provided by AMOS. The result of the model assessments is presented with the criteria for acceptable model fit (Bagozzi & Yi, 1988) in Table 3.

Table 3: Assessment of Model Fit for TPB

Fit	Measurement Model For TPB	Recommended values for acceptable fit
Chi-square (χ^2)	$\chi^2_{181}=465.70$ (p = 0.000)	Small chi-square (p > 0.05)
Normed chi-square (χ^2/df)	2.57	Lower than 2.0
Goodness-of-Fit Index (GFI)	0.93	Over 0.9
Adjusted Goodness-of-Fit Index (AGFI)	0.91	Over 0.8
Normed Fit Index (NFI)	0.93	Over 0.9
Tucker-Lewis Index (TLI)	.95	Over 0.9
Root Mean Square Residual (RMSEA)	0.053	Lower than 0.08

The TPB model meets most of the “goodness of fit” indices as indicated in Table 3. Hence the model as shown in Figure 1 is found to be an acceptable fit to the data. It can predict 17% of the variance in teachers’ intentions to use ICT and 24% of the variance in actual use.

As is evident from the values in Figure 1, teacher attitudes towards use of ICT (AB) and subjective norms (SN) predict teachers’ intention (I) and teachers’ intentions predict behaviour or actual use (B). Perceived behavioural control (PBC) is unable to significantly predict either intentions or behaviour.

Conclusions and recommendations

An understanding of the influence of teachers’ attitudes and their perceptions of the opinions of significant others on their use of ICT in teaching can be an important for prediction of their use of ICT in teaching. This study attempted to develop such an understanding by employing Ajzen’s theory of planned behaviour (TPB), which is a widely applied social-psychological model.

The assessment results of the model indicated a good fit in explaining and predicting teachers’ intentions and behaviour. Teachers’ attitudes towards use of ICT and subjective norms significantly predict their intentions and subsequently intentions significantly predict behaviour. However, perceived behavioural control was found not to have significant influence on intentions and behaviour. A possible explanation for the lack of predictive power of the PBC in this study is that there was a lack of variability in teachers’ responses to the relevant items. Most teachers responded positively to the five items on PBC of the questionnaire. It is recommended that future studies take precautions against the absence of item variability by seeking to develop more sensitive measures of PBC.

Although the TPB model was shown to be a “good fit” for explaining intention and behaviour of teachers in using ICT, it performs comparatively poor in terms of explaining power, which meta-analyses shows that TPB model explains 40%-50% average of the variance in intention and 19%-38% average of the variance in behaviour (Sutton, 1998). In this study, the TPB explains 17% of the observed variance in intentions and 24% of the observed variance in behaviour. Nevertheless, these findings show that a combination of teachers’ attitudes, subjective norms and perceived behavioural control explain a small percentage of teachers’ intentions to use ICT in teaching and their actual use. A possible explanation is that there may be other latent variables which may contribute to teacher decisions about ICT use, such as the effect of demographic variables (Ajzen & Fishbein, 1980), other variables such as past behaviour/habit, moral norms, self-identity, and affective beliefs (Conner & Armitage, 1998). It is recommended that future research include these variables in investigations.

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