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On-line learning adoption intention: Comparing the predictive power of two competing models

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Abstract: *Adopting the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM), the paper tries to compare the predictive power of the two competing models. Organisational investments in information technologies have increased significantly in the past two decades. These investments specifically aim to increase individual productivity and thus, contribute to organisational productivity. In Malaysia, a number of educational institutions are experimenting with e-learning. Given the need to understand more clearly the social, individual, technological, and attitudinal antecedents of adoption intention, the theory of planned behaviour and the technology acceptance model were compared. TAM conceptualises that two belief elements, perceived usefulness and perceived ease of use, are important determinants of technology usage intentions and in turn usage behaviour. TPB defines relationships among beliefs, attitude toward a behaviour, subjective norm, perceived behavioural control, behavioural intention, and behaviour. In this study, TPB and TAM were applied to explain user's intention to adopt electronic mode of learning.*

A total of 300 students who were introduced to e-learning were surveyed after a few months of exposure to the system. The purposive sampling method was used to select the participants. Multiple Regression Analysis has been used to determine the key influences on behavioural intention. It was found that both TAM and TPB predict e-learning adoption intention well, although the predictive power of TAM is more robust than TPB. Research findings are discussed.

Keywords: *Technology Acceptance Model; Theory of Planned Behaviour; E-learning; Malaysia.*

Introduction

Online learning is being utilized in a number of educational programs worldwide. The pedagogical merit of on-line learning, which stems from its distance and time insensitivity, collaborative learning, promoting constructivist approaches, etc., have resulted in the growing popularity of this mode of learning today. E-learning adoption is more commonly modelled to integrate advanced technologies into the conventional on-campus teaching methods in a complementary manner. Beller (1998) echoes the importance of integrating new technologies and suggests that learning technologies provide universities with the opportunity for improved and more effective teaching through the integration of electronic multimedia learning materials,

special simulations and demonstrations, accessibility to a variety of knowledge databases and experts, continuous contact with instructors and peers, better utilization of lessons for discussion and amplification.

There have also been some reservations about e-learning. For example, Goodridge (2002) reports that from customer to analyst to investor, the consensus is that e-learning still has a few things of its own to learn. Among the frequently mentioned problems are document security (Sparta, 2002), academic standard of online courses, students technological needs, the place of face-to-face interaction (Bushweller, 2002), cultural issues of global e-learning (Sakurdi, 2002), poor grades for e-learners (O'Connell, 2002), and drop-out (Islam, 2002). An understanding of the social, technical, organisational, and individual factors that drive adoption intention will help in the effort to make this model of learning more acceptable.

Literature

Two models of technology usage were employed in this research: The Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB).

The Technology Acceptance Model (TAM)

TAM has been widely used to predict user acceptance and use, based on perceived usefulness and ease of use. Davis (1989) and Davis et al. (1989) developed TAM by adapting the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), to understand the causal chain linking external variables to IT usage intention and actual use in a workplace. TAM was developed under contract with IBM Canada Ltd. in the mid-1980s where it was used to evaluate the market potential for a variety of then-emerging PC-based applications in the area of multimedia, image processing, and pen-based computing in order to guide investments in new product development (Davis & Venkatesh, 1996). Many IT studies have replicated TAM or used TAM instrument (which has empirically proved to have high validity) extensively to investigate a range of issues in the area of user acceptance (e.g., Igarria et al., 1997; Mathieson, 1991; Ndubisi et al., 2003; Venkatesh, 2000).

Davis' list of external variables includes: objective system design characteristics, training, computer self-efficacy, user involvement in design, and the nature of the implementation process. These are theorised to influence behavioural intention to use, and actual usage, indirectly through their influence on perceived usefulness and perceived ease of use. Davis (1989, p. 320), defines perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her productivity", and perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort".

The Theory of Planned Behaviour (TPB)

TPB has been widely applied across a range of disciplines including marketing/consumer behaviour (Berger, 1993), leisure behaviour (Ajzen & Driver, 1992) and medicine (Randall & Gibson, 1991), among others. Organisational psychologists (e.g., Mathieson, 1991; Taylor & Todd, 1995) have also applied TPB to study adoption of new technologies. TPB defines relationships between attitudes, norms, and perceived behavioural control as determinants of intentions and behaviour (see Figure 1). Although intention was included in the original conceptualisation of TPB, the availability of objective measures of behaviour could also allow the

omission of intention from the model and study the effects directly on behaviour. The key determinants in the theoretical model are defined as follows:

Attitude Towards Behaviour (A) “refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question” (Ajzen, 1991, p. 188). In a technology adoption context, the key behaviour of interest is use of the system. Therefore, attitude towards behaviour is a potential user’s affective evaluation of the costs and benefits of using the new technology. There is significant evidence (e.g., Davis, 1989; Davis et al., 1989; Mathieson, 1991; Taylor & Todd, 1995) to suggest that the most critical belief underlying an individual’s attitude towards the behaviour of adopting a new technology in the workplace is her/his perceptions about the usefulness of technology.

Subjective Norm (SN) “refers to the perceived social pressure to perform or not to perform the behaviour” (Ajzen, 1991, p.188). In the context of technology usage, subjective norm has manifested itself as peer influence and superior influence (Mathieson, 1991; Taylor & Todd, 1995). Giving that subjective norm in the workplace technology adoption context is tied to peer influence and superior’s influence (Mathieson, 1991; Taylor & Todd, 1995), it is expected that intention to adopt e-learning will be closely linked to the extent users can be influenced and respond to informational input from their course leaders, school authority, and adopting peers.

Perceived behavioural control (PBC) is defined as “...people’s perception of the ease or difficulty of performing the behaviour of interest” (Ajzen, 1991, p. 183). Consistent with this basic definition, prior research studying technology adoption and usage behaviour has related this construct primarily to constraints to technology usage (Taylor & Todd, 1995), particularly the ease/difficulty of using the new technology. Following from the definition of perceived behavioural control presented above, TPB research (e.g., Sparks, Guthrie, & Shepherd, 1997) has provided evidence indicating that perceived difficulty, especially as it is related to internal constraints, is the most important factor underlying perceived behavioural control.

As stated earlier, the primary theoretical frameworks for this research are Ajzen’s (1985, 1991) Theory of Planned Behaviour (TPB) and Davis’ (1989) and Davis et al’s (1989) Technology Acceptance Model (TAM). The study’s framework is shown as Figure 1.

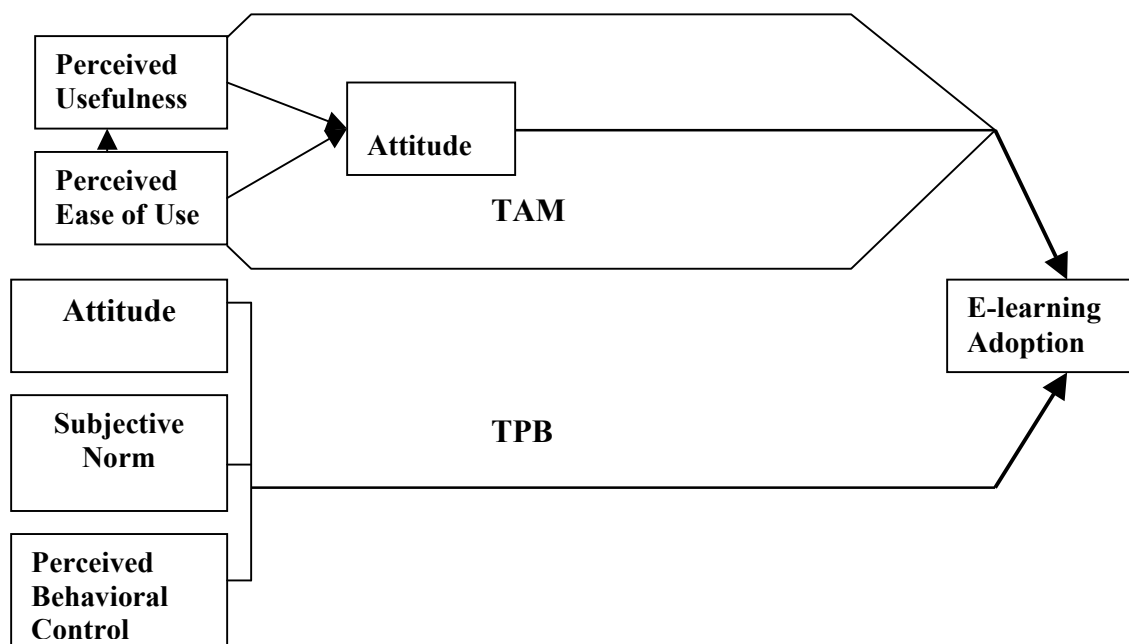


Figure 1: The schema of the research model

Methodology

Malaysian students who have recently been introduced to e-learning were surveyed. The purposive non-probabilistic sampling method was used in sample selection to ensure that only students who have participated in the e-learning experimentation program (one semester) of a Malaysian public university were included. To qualify for inclusion, a student must have spent at least a semester in the University prior to the introduction of e-learning. This ensures that respondents have a fair knowledge of the University's programs, infrastructures, and academics to help in their judgment. A total of 301 qualified business students from the University's two campuses responded to the survey, of which 300 were usable. Several aspects pertaining e-learning are explored including software feature and characteristics, perceived ease of use, perceived usefulness, attitude, perceived behavioural control, and subjective norms.

A structured questionnaire was used in this research. Respondents were surveyed using a seven-part questionnaire. Part 1 measures e-learning adoption intentions by adapting items from Davis et al. (1989). Part two and three measure usefulness and ease of use perceptions with four items each, adapted from Davis et al. (1989). Part four measures attitude towards e-learning with four items adapted from Davis et al. (1989). Part five and part six adapted items from Taylor and Todd (1995) to measure subjective norms and perceived behavioural control respectively. Demographic variables were captured in part seven with single item measures. Questionnaire items (except for demography) were measured on a seven point Likert-scale anchored at both extremes to 1 (*strongly disagree*) and 7 (*strongly agree*). The mid-point (4) represents the state of *unsure* or *neutral*. "Perceived usefulness and perceived ease of use" are TAM variables and "subjective norms and perceived behavioural control" are TPB variables. Attitude is used for both TAM and TPB. The Multiple Regression Model was employed to test for the model's relationships.

Results

The results in Table 1 show that mean score for each dimension is high. Alpha values are also high, indicating that the items of the variables are reliable. Alpha coefficients for all dimensions exceed the .60 lower limit of acceptability (Hair et al. 1998).

Table 1: Descriptive and Reliability Analysis Results

Variables	No. of Items	Mean	SD	Coefficient α
Usage Intention	2	7.68	1.65	0.80
Usefulness Perception	4	16.45	3.49	0.92
Ease of Use Perception	4	15.08	1.39	0.80
Attitude	4	17.27	2.28	0.72
Subjective Norm	2	6.60	1.86	0.90
Perceived Behavioural Control	5	20.11	5.21	0.70

Predictors

The results show that both TAM and TPB are good predictors of intention. Table 2 shows the results of the analysis.

Table 2: Predictive Power of TAM and TPB

Technology Acceptance Model			Theory of Planned Behaviour		
Predictors	Beta coefficients		Predictors	Beta coefficients	
Perceived Usefulness	.279***		Subjective Norms	.371	
Perceived Ease of Use	.206***		Perceived Behavioural Control	.171**	
Attitude	.235***		Attitude	.429***	
R² = .338	F = 50.02	Sig. F = .000	R² = .241	F = 30.11	Sig. F = .000

** p < .01 *** p < .001

TAM dimensions contribute significantly ($F = 50.02$; $p < .001$) and predict 34% of the variations in e-learning adoption intention, while the dimensions of the theory of planned behaviour predict 24% of variations and contribute significantly ($F = 30.11$; $p < .001$) to behavioural intention. Total variance explained by TAM is more than that explained by TPB by .097.

It is further observed that all three TAM constructs, perceived usefulness, perceived ease of use, and attitude are strong predictors of adoption intention. The respective impacts are established at 0.1% significance level. TPB constructs exhibit less influence on intention. Only two out of the three dimensions namely, perceived behavioural control and attitude are significantly associated with intention to adopt. Even then, perceived behavioural control is only significant at 1% level. Subjective norm has no significant relationship with intention to adopt.

Comparing the significance of the resulting dimensions

Intuitively, it can be concluded that the coefficients of the TAM dimensions contribute more significantly than those of TPB, however this claim should be established statistically. To investigate whether these dimensions contribute equally to the variations in adoption intention, more tests are needed. In order to ascertain whether or not there is a statistical difference between the coefficients of these dimensions in the regression model, the coefficients of a set of dimensions are compared, while assuming the coefficients of the remaining dimensions to be zero (Chattergee & Price, 1991).

Perceived usefulness (PU), perceived ease of use (EOU) and attitude (ATT) are significant at 0.1% significance level. Perceived behavioural control (PBC) and subjective norms (SN) are either significant at 1% significance level or not significant at all, thus the statistical differences between the last two dimensions and the three earlier ones are readily established. Since only PU, EOU and ATT are significant at .001 levels, we verify their statistical differences. For example, the coefficients of PU and EOU are compared while assuming the coefficients of ATT dimension to be zero, and so on. To verify whether the coefficients of PU and EOU are equal, we test whether the models 1 (full model) and 2 (reduced model) below are equal. Model 2 defines a new variable representing the sum of the two dimensions of concern.

$$Y = b_0 + b_1PU + b_2EOU + E \quad (1)$$

$$Y = b_0 + b(PU + EOU) + E \quad (2)$$

Where Y represents IT Usage

- b_0 represents the constant
- b_1 represents the strength of PU
- b_2 represents the strength of EOU
- b represents the strength of the sum of PU and EOU
- E is the error term.

Table 3: Results of Full and Reduced Regression Models

Constant	Variables			R ²	F	Sig.
.457 (5.958)*** .445 (6.445)***	PU	EOU	(PU+EOU)	.0290	61.403	.000
	.368 (6.714)***	.260 (4.742)***	.535 (10.985)***	.0286	120.663	.000
.433 (5.806)*** .427 (6.157)***	PU	ATT	(PU+ATT)	.333	73.076	.000
	.357 (6.374)***	.303 (5.408)***	.572 (11.963)***	.327	143.120	.000
.455 (8.408)*** .439 (7.354)***	PU	SN	(PU+SN)	.237	46.505	.000
	.485 (9.330)***	.008 (.145)	.512 (10.278)***	.262	105.635	.000
.468 (7.004)*** .483 (4.784)***	PU	PBC	(PU+PBC)	.253	49.136	.000
	.453 (8.639)***	.132 (2.515)*	.551 (11.226)***	.304	126.025	.000
.472 (5.887)*** .469 (6.277)***	EOU	ATT	(EOU+ATT)	.272	55.383	.000
	.285 (5.190)***	.332 (6.059)***	.510 (10.209)***	.260	104.218	.000
.496 (7.943)*** .477 (7.973)***	EOU	SN	(EOU+SN)	.187	34.328	.000
	.418 (7.942)***	.068 (1.286)	.429 (8.229)***	.184	67.716	.000
.480 (7.570)*** .497 (6.429)***	EOU	PBC	(EOU+PBC)	.209	38.289	.000
	.404 (7.366)***	.123 (2.241)*	.473 (9.153)***	.224	83.772	.000
.485 (7.324)*** .497 (7.370)***	ATT	SN	(ATT+SN)	.226	42.918	.000
	.459 (8.858)***	.079 (1.525)	.428 (8.109)***	.183	65.762	.000
.494 (6.316)*** .525 (5.684)***	ATT	PBC	(ATT+PBC)	.242	45.720	.000
	.432 (8.299)***	.174 (3.350)**	.470 (9.020)***	.221	81.362	.000
.522 (8.597)*** .514 (8.467)***	SN	PBC	(SN+PBC)	.137	22.696	.000
	.004 (.066)	.369 (6.485)***	.361 (6.578)***	.131	43.271	.000
Notes: PU – Perceived Usefulness. EOU – Perceived Ease of Use. ATT – Attitude. SN – Subjective Norms. PBC – Perceived Behavioural Control. Figures in parentheses are t-statistics. *p < .05 **p < .01 *** p < .001						

PU and EOU are compared. The R square for model 1 is determined to be $R^2_y = 0.290$, and R square for model 2 is $R^2_z = 0.286$ (see Table 3). The F values is given by the following formula:

$$F = \frac{(R^2_y - R^2_z)/(y - z)}{(1 - R^2_y)/(n - y - z - 1)}, d.f. = y - z, n - y - z - 1$$

In this study, n = 300, y = 2, and z = 1.

Substituting the above values into the F formula, we find an F value of 1.6729, which is insignificant at the 0.1 level. This indicates that there is no significant difference between the coefficients of perceived usefulness and perceived ease of use. These two dimensions do, therefore contribute equally to the variations in e-learning adoption intention.

PU and ATT are compared next. The R square for model 1 is determined to be $R^2_y = 0.333$, and R square for model 2 is $R^2_z = 0.327$. Again substituting these values in the above formula, the F value is found to be 2.6714, which is also insignificant at the 0.1 level. This also indicates that there is no significant difference between the coefficients of perceived usefulness and attitude. Thus, they both contribute equally to the variations in intention to adopt.

Lastly, EOU and ATT are compared. The R square for model 1 is $R^2_y = 0.272$, and R square for model 2 is $R^2_z = 0.260$. After the necessary substitutions, the F value is found to be 4.8960, which again is insignificant at the 0.1 level. This is an indication that there is no significant difference between the coefficients of perceived ease of use and attitude.

It can therefore be concluded that while perceived usefulness, perceived ease of use, attitude, and perceived behavioural control are significant in explaining the variations in e-learning adoption intention, the first three dimensions contribute more significantly to these variations than the fourth dimension. It is also concluded that perceived usefulness, ease of use, and attitude have equal significance in explaining the variations in intention.

Implications

This research has theoretical and managerial implications. Theoretically, the research provides evidence for the preponderance of TAM dimensions over those of TPB in predicting intention to adopt e-learning among Malaysian students. Perceived usefulness, ease of use and attitude are more salient determinants of adoption intention than perceived behavioural control and subjective norms. Also noted in the research is that subjective norms is not a predictor.

Managerially, both e-learning applications marketers and adopting institutions can use the outcome of this research as a valuable input when designing strategies to enhance e-learning diffusion. By understanding the key factors that determine adoption, they can respectively develop better marketing strategies as well as better management of e-learners. Useful and easy to use systems must be put in place. In addition, effort must be made to develop a favourable attitude in users towards online learning, and to eliminate or reduce to the barest minimum, constraints to technology adoption, which could result from lack of confidence, negative influence by course leaders, etc.

Limitations and future research

Limitations and further research are summarised as follows:

- This study focuses on students in one university in Malaysia. It therefore has not covered students in other universities. Although the objective of this research (which is to test the outcome of the university's e-learning experimentation vis-à-vis intention to adopt and intention drivers) is achieved, future research should address other locations within and outside Malaysia.
- Future research may focus on lecturers, who are another user group apart from students.
- Other models of technology usage apart from TAM and TPB can be applied by future research in this area. For example the decomposed theory of planned behaviour (DTPB) will

be particularly interesting to examine since it has been proven by for example, Taylor and Todd (1995), to be a better predictor of technology usage than the TAM and TPB.

Conclusion

This paper juxtaposes and compares two competing models, the Technology Acceptance Model and the Theory of Planned Behaviour, to understand their predictive power on intention to adopt e-learning among Malaysian students. The results show that both models can predict e-learning adoption intention, although, the Technology Acceptance Model is a better predictor than the Theory of Planned Behaviour. This finding corroborates that of Mathieson (1991), which compared TAM with TPB via an experimental study on usage of spreadsheets and calculator.

It is further observed that perceived usefulness, perceived ease of use, attitude, and perceived behavioural control are important determinants of on-line adoption intention, albeit the last dimension is not as robust as the first three. Moreover, perceived usefulness, ease of use, and attitude are equally significant in explaining the variations in intention to adopt on-line learning. Subjective norm is not a predictor.

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