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# Interactive Whiteboard Acceptance: Applicability of the UTAUT Model to Student Teachers

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**Abstract** A review of the literature shows that the model for the Unified Theory of Acceptance and Use of Technology (UTAUT) has received only limited validation in educational contexts. This limitation led to this study to determine the applicability of the UTAUT model with an educational perspective and to statistically explain the factors affecting student teachers' intentions to use interactive whiteboards. The research project comprised a cohort of 159 student teachers who undertook a questionnaire designed to measure their responses to performance expectancy, effort expectancy, social influence, facilitating condition and behavioural intention. Structural equation modelling was used as the main technique for data analysis. According to the result of the goodness-of-fit test, the findings led to the conclusion that the model was endorsed by the data. Overall, the model accounted for 59.6 % of the variance in intention of student teachers to use interactive whiteboards in their teaching. The findings also demonstrated the important distinction of performance expectancy, effort expectancy and user's experiences in interactive whiteboard adoption amongst student teachers. The theoretical and practical implications of the model are discussed.

**Keywords** Unified Theory of Acceptance and Use of Technology (UTAUT) · Interactive whiteboard · Educational technology

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Technologies are used widely in all levels of education. Many teaching tools have been developed for classroom use since the introduction of personal computers, and interactive whiteboards are becoming increasingly popular in educational settings (Betcher and Lee 2009). Studies have noted that IWBs are no longer an add-on feature, but an integral part of teaching and learning in Australian schools (Campbell 2010). An IWB is a stand-alone board that functions in conjunction with a computer. An IWB are multi-touch, multi-user interactive learning board that allows groups of children to work simultaneously on its surface. In Australia, IWBs have been adopted rapidly by schools since 2003 (Vincent 2007), this process being aided by encouragement from the Commonwealth Department of Education, Employment and Workplace Relation (DEEWR) and the related information communication technology (ICT) organizations. A growing body of research suggests that the use of IWBs improves teaching and learning for science (Hennessy et al. 2007; Higgins et al. 2007; Murica and Sheffield 2010).

## Rationale of the Study

Advocates assert that the use of IWBs is growing rapidly, and they are becoming one of the most important educational technology tools in the digital age (Higgins et al.

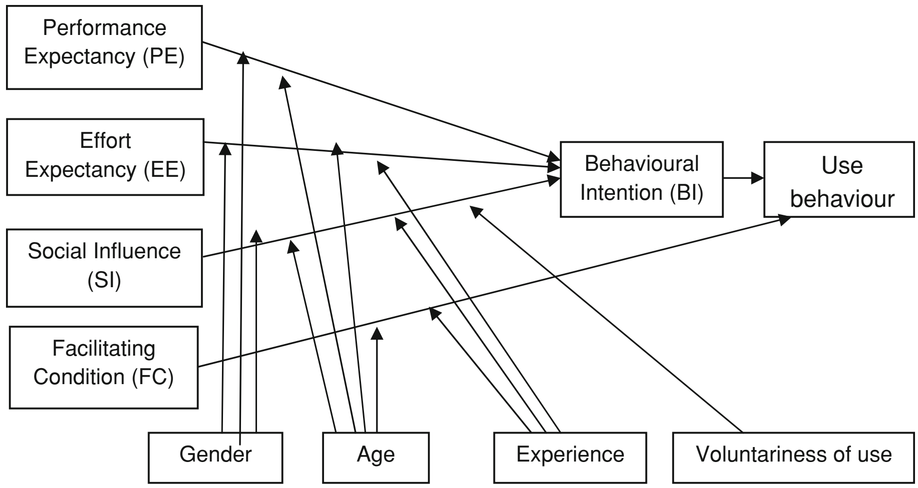



**Fig. 1** The UTAUT model (*Source* Venkatesh et al. 2003, p. 447)

2007). However, the claims that IWBs motivate learners, encourage collaborative study, create interesting classroom environments and enhance learning outcomes need closer scrutiny, especially in the context of teaching practices (Betcher and Lee 2009). The success of integrating IWBs into teaching and learning depends strongly on the engagement of teachers with the new technology (Murica and Sheffield 2010). As a consequence, it is important that student teachers become competent in using and managing IWBs because they are expected to be at the frontline of this reform when they enter the teaching profession. Findings from the present study provide information on this issue. The findings can also assist policymakers and teacher educators in designing curricula which not only improve the learning experiences of student teachers, but also ensure that future teachers are capable of integrating new technologies into their teaching practices. While the advantages of integrating IWBs into educational programmes have received extensive attention amongst researchers (Betcher and Lee 2009; Harlow et al. 2010; Murica and Sheffield 2010), few studies have been carried out to understand student teachers' behavioural intentions to use IWBs. Given the crucial role of student teachers in the process of technology implementation and the limited studies in this context, understanding the factors that drive their intention to use IWBs is a worthwhile issue of enquiry.

## Theoretical Basis of the Study

In the present study, the theoretical grounding for exploring factors influencing student teachers' use of IWBs is drawn from the model of the Unified Theory of Acceptance and Use of Technology (UTAUT), shown in Fig. 1. Developed by Venkatesh et al. (2003), this model has been tested in various studies of user behaviour, for example, e-government (Chan et al. 2010), mobile banking (Zhou et al. 2010), multipurpose smartcard (Loo et al. 2009) and mobile shopping (Yang 2010). Despite the credit being given to the UTAUT model for its ability to explain and predict behavioural intention and user behaviour regarding technology, there are some primary limitations relevant to the implementation of the current study. From the literature, it appears that limited validation of the UTAUT model has been achieved in regard to education, for example, in workplace e-learning (Cheng et al. 2011) and website use in higher education (Schaik 2009). The factors influencing technology integration are expected to be different based on technology type, its applications and the organisation involved. It is important to note that educators tend to be relatively independent and have considerable freedom to choose the teaching tools (technologies) for their activities (Teo et al. 2008). Findings from studies by Im et al. (2008) and Marchewka et al. (2007) have revealed that the technology type and its application were the significant factors regarding whether or not teachers would use that technology. In this regard, it is reasonable to expect that the factors influencing IWB use by student teachers are different from general information system usage contexts. Indeed, the writer who developed the UTAUT model urged future researchers to examine the model in different technologies, user groups and organisational contexts which could contribute to (and demonstrate) the overall generalisability of the model (Venkatesh et al. 2003).

Given the importance of exploring factors that influence the integration of IWBs into educational practices, and the need to determine the applicability of the UTAUT, the following research questions were proposed:

1. Is the UTAUT model an efficient and appropriate model to explain student teachers' intentions on whether or not to use interactive whiteboards?
2. Which determinants (performance expectancy, effort expectancy, social influence and facilitating conditions)

are significant in the UTAUT model in order to explain student teachers' intention to use interactive whiteboards?

## Review of the UTAUT Model and Research Hypotheses

Since the late 1980s, various theoretical models have been proposed to explore and explain factors that cause individuals to accept, reject or continue the use of new technology (Ajzen 1985; Ajzen and Fishbein 1980; Venkatesh and Davis 2000; Venkatesh et al. 2003). Lately, the UTAUT model has received empirical support for its ability to predict technology acceptance and adoption (Chan et al. 2010; Cheng et al. 2011; Loo et al. 2009; Schaik 2009; Yang 2010; Zhou et al. 2010). The model aims to explain users' intentions to use, or not use, an information system and their subsequent usage behaviour. This model explains 70 % of the variance in user intentions to use technologies and in so doing, it has been shown to outperform previous models (Venkatesh et al. 2003).

The UTAUT model is based on the synthesis of eight well-established theories and models to assess the likelihood of success for introducing a new technology (Venkatesh et al. 2003). These theories and models include the Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975), the Motivational Model (MM) (Davis et al. 1992), the Model of PC utilisation (MPCU) (Thompson et al. 1991), the Theory of Planned Behaviour (TPB) (Ajzen 1991), the Combined TAM and TPB (C-TAM-TPB) (Taylor and Todd 1995), the Technology Acceptance Model (TAM) (Davis 1989), the Innovation Diffusion Theory (IDT) (Moore and Benbasat 1991) and the Social Cognitive Theory (SCT) (Bandura 1986). Based on these theories, four core determinants of Information System (IS) usage behaviour are proposed: performance expectancy, effort expectancy, social influence and facilitating conditions.

'Performance expectancy' is defined as, 'The degree to which an individual believes that using the system will help him or her to attain gains in job performance' (Venkatesh et al. 2003, p. 447). This construct is derived from the notions of perceived usefulness (TAM and C-TAM-TPB), extrinsic motivation (MM), job-fit (MPCU), relative advantage (IDT) and outcome expectations (SCT) (Venkatesh et al. 2003). In the present context, performance expectancy refers to student teachers' belief that using IWBs will help them attain benefits relating to teaching and learning practices.

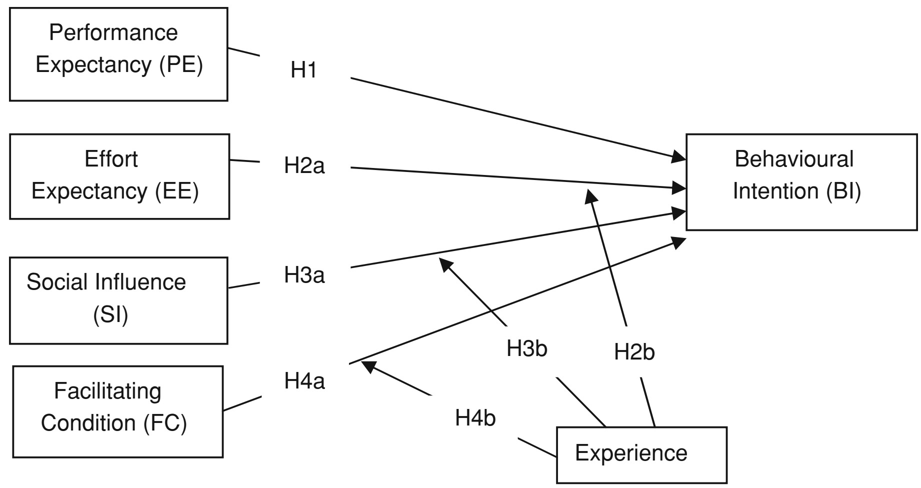
'Effort expectancy' is defined as, 'The degree of ease associated with the use of the system' (Venkatesh et al. 2003, p. 450). Perceived ease of use (TAM/TAM2), complexity (MPCU) and ease of use (IDT) captured the concept of effort expectancy in UTAUT (Venkatesh et al. 2003). Effort expectancy affects behavioural intention more saliently in the stage of early adoption (Venkatesh and Davis 2000). In the present context, effort expectancy refers to student teachers' belief that use of IWBs would entail little effort and be without annoying disturbances.

'Social influence' is defined as, 'The degree to which an individual perceives that important others believe he or she should use the new system' (Venkatesh et al. 2003, p. 451). It integrates the aspects of subjective norm (TRA, TAM2, TPB/DTPB and C-TAM-TPB), social factors (MPCU) and image (IDT) (Venkatesh et al. 2003). Social influence also affects behavioural intention more noticeably in the early stages of technology adoption (Thompson et al. 1994; Venkatesh and Davis 2000). In this study, social influence refers to the social factors which influence the intention to use IWBs and it includes support and encouragement from educators and the university.

The fourth of the determinants of IS usage is 'facilitating conditions' which refers to, 'the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system' (Venkatesh et al. 2003, p. 453). This construct is derived from the notions of perceived behavioural control (TPB/DTPB, C-TAM-TPB), facilitating conditions (MPCU) and compatibility (IDT). Venkatesh et al. (2003) noted that facilitating conditions influence behavioural intention more markedly amongst groups which are already experienced in technology use. In the present study, 'facilitating conditions' refer to the university environment and infrastructure that exert an influence over student teachers' desire to use IWBs.

As this investigation sought to explore the applicability of the UTAUT model in an educational setting, the authors adopted the same correlations as applied in the original UTAUT model with regard to the effects of performance, effort expectancy, social influence and facilitating condition on behavioural intention and/or use behaviour. However, since the student teachers' setting differed from the generic IS, this study deemed the model to be more accurate in treating behavioural intention as a dependent variable rather than as actual behaviour due to the fact that the adoption of IWBs in teacher-education programmes is still in its infancy, and most trainees possess little experience in using IWBs in the classroom. Besides, there is a growing corpus of research suggesting that behavioural intention predicts the actual behaviour with regard to technology use (Loo et al. 2009). Furthermore, many past empirical studies have used behavioural intention in explaining technology acceptance amongst student teachers (Teo 2011; Teo and Noyes 2011; Terzis and Economides 2011). Venkatesh et al. (2003) also postulated that behavioural intention is a critical predictor of technology use. Additionally, as 98.1 % of participants were female with ages between 18 and 21, the moderating factors of age and gender (as suggested in the UTAUT model) were

**Fig. 2** Proposed research model




excluded from the current study. In the current research, experience refers to student teachers' prior use of IWBs. Against this background, the following hypotheses were proposed, these also being shown in Fig. 2.

- H1 Performance expectancy has a positive effect on behavioural intention to use IWBs
- H2a Effort expectancy has a positive effect on behavioural intention to use IWBs
- H2b The effect of effort expectancy on behavioural intention will be moderated by experience with IWBs such that the effect will be stronger in the limited-experience group
- H3a Social influence has a positive effect on behavioural intention to use IWBs
- H3b The effect of social influence on behavioural intention will be moderated by experience with IWBs such that the effect will be stronger in the limited-experience group
- H4a Facilitating conditions have a positive effect on behavioural intention to use IWBs
- H4b The effect of facilitating conditions on behavioural intention will be moderated by experience with IWBs such that the effect will be stronger in the some-experience group

## Research Methodology

### Research Design

Data were gathered with a questionnaire containing questions on demographics as well as multiple statements regarding performance expectancy, effort expectancy, social influence, facilitating condition and behavioural intention. Methodologically, analyses were conducted using AMOS 17 and the usual steps for conducting structural equation modelling (SEM) were employed in the current study. From the literature, SEM is used widely to predict or explain the determinants of users' intentions regarding the use of technology in educational settings (Wang and Shih 2009; Schaik 2009; Zhou et al. 2010).

In order to assess the effects of the student teachers' prior experiences of IWBs, the subjects were divided into two groups: those with limited experience and those with some experience. The classification of the range of scores was achieved by calculating the mean of the total score from the three-item scale (Runyon and Harber 1991). Participants who scored 7.0 and below were categorised as the 'limited-experience' group, while those who scored 7.1 and above were described as the group with 'some experience'.

### Measures of the Constructs

Participants were required to furnish selected demographic information and respond to the 17 items on the five constructs in this study. The authors adapted existing items validated in the original UTAUT study (Venkatesh et al. 2003) in order to fit the technology type and setting of the current study. The UTAUT model was tested and found to have an $R^2$ of 70 %; this indicated that the model explains 70 % of the variance in intention to use information technology (Venkatesh et al. 2003). Besides, these items have been used in several previous studies of technology acceptance (Chan et al. 2010; Zhou et al. 2010; Yang 2010; Cheng et al. 2011). Performance expectancy, effort expectancy, social influence, facilitating condition and behavioural intention were measured using a four-point Likert scale with responses ranging from 'strongly disagree' (1) to 'strongly agree' (4), while users' prior experience of IWBs was measured by responses between 'never' (1) and 'always'(4). A four-point Likert scale was employed

**Table 1** Descriptive statistics of the study constructs

| Construct | Mean | SD |
|---|---|---|
| PE | 3.2 | .48 |
| EE | 2.8 | .58 |
| SI | 2.7 | .63 |
| FC | 3.2 | .64 |
| BI | 2.9 | .55 |

in order to minimise the social desirability bias (Garland 1991; Worcester and Burns 1975) because with the five-point scale, respondents tend to choose the mid-point (Matell and Jacoby 1972) (refer 'Appendix' for the questionnaire items). All items were presented in English.

## Participants and Data Collection Methods

During the second semester of 2010/2011, invitations to participate in this study were issued to student teachers enroled in science-related courses of the Bachelor of Early Childhood Education, Bachelor of Education (Junior Primary and Primary) and Bachelor of Education (Primary and Middle) programmes of a teacher-education institution in Australia. From these three programmes, 112, 17 and 20 student teachers, respectively, offered to participate. The samples represented about 95 % of enrolments in those programmes, and of the participants, 156 (98.1 %) were females aged between 18 and 21. The imbalance of gender participation was expected due to the cultural preponderance of female students in teacher-education institutions. Most participants (88.1 %) had not attended any formal IWB training or workshop, although 74.8 % reported having had some experience with IWBs for teaching and learning. Participation was voluntary and anonymous and no course credits were given. The participants were informed of the study's objective.

Table 1 presents the descriptive statistics for each of the constructs in the proposed model. It can be seen that all mean scores range from 2.7 to 3.2. The standard deviation (SD) values for all constructs were less than 1.0 and this indicates that the item scores had a relatively narrow spread around the mean (Teo and van Schaik 2009).

# Results

## Evaluation of the Measurement Model

Table 2 shows the results for the measurement model. The factor loadings of the individual items in the five constructs are all above .60, and it explained 66.78 % of the total variance. All standardised regression weights are above .50 and range from .582 to .868, and these values are considered appropriate and acceptable (Hair et al. 2010). In addition, all parameter estimates were significant at the $p < .05$ level, as indicated by the $t$ values (>1.96).

**Table 2** Results of the measurement model

| Latent variable | Item | Factor loading | SE | $t$ Value[a] | Average variance extracted[b] ($\geq$.50)[c] |
|---|---|---|---|---|---|
| PE | PE1 | .648 | .715 | 5.44 | .58 |
| | PE2 | .764 | .658 | – | |
| | PE3 | .900 | .684 | 9.98 | |
| | PE4 | .790 | .531 | 4.97 | |
| EE | EE1 | .833 | .621 | – | .61 |
| | EE2 | .826 | .612 | 8.16 | |
| | EE3 | .783 | .841 | 6.67 | |
| | EE4 | .664 | .683 | 6.50 | |
| SI | SI1 | .829 | .762 | – | .60 |
| | SI2 | .728 | .612 | 4.69 | |
| | SI3 | .752 | .554 | 4.60 | |
| FC | FC1 | .806 | .868 | 10.98 | .73 |
| | FC2 | .917 | .830 | 9.76 | |
| | FC3 | .841 | .799 | – | |
| BI | BI1 | .671 | .661 | – | .51 |
| | BI2 | .638 | .611 | 6.01 | |
| | BI3 | .817 | .582 | 5.55 | |

*SE* standard estimate

[a] $t$ value(critical ratio) shows whether the parameter is significant at the .05 level

[b] *AVE* average variance extracted = $(\sum\lambda^2)/(\sum\lambda^2) + (\sum(1 - \lambda^2))$

[c] Indicates an acceptance level or validity

– This value was fixed at 1.00 for model identification purposes

A confirmatory factor analysis was conducted to test the measurement model. The five absolute-fit indices which were used were as follows: the ratio of $\chi^2$ to its degree of freedom ($\chi^2/df$), Goodness-of-Fit (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and Standardised Root Mean Square Error of Approximation (RMSEA). All were employed in order to assess the measurement model in terms of goodness-of-fit. Absolute-fit indices measure how well the proposed model represented the observed data. According to Hair et al. (2010), the value of GFI and CFI should be more than .95 and that of the RMSEA should be less than .05 to be considered a good fit. For $\chi^2/df$, the value below 3 is considered acceptable (Kline 2005). Finally, the TLI value should be greater than .90 (McDonald and Ho 2002). Table 3 shows the fit indices for the proposed research model and its acceptable fit. All values are above the recommended thresholds for acceptable model fit. These results indicate that the measurement model achieved a good fit.

**Table 3** Good-of-fit indices for the measurement model

| Fit indices | Values | Criteria |
|---|---|---|
| $\chi^2$ Statistic | 148.69* | Insignificant, but significant *p* value can be expected. |
| $\chi^2/df$ | 1.430 | <3 |
| RMSEA | .05 | <.08 |
| GFI | .95 | ≥.90 |
| CFI | .90 | ≥.90 |
| TLI | .94 | ≥.90 |

* $p < .05$

**Table 4** Discriminant validity for the measurement model

| | PE | EE | SI | FC | BI |
|---|---|---|---|---|---|
| PE | (.76) | | | | |
| EE | .11** | (.78) | | | |
| SI | .15** | .07** | (.77) | | |
| FC | .07* | .22* | .10** | (.85) | |
| BI | .47** | .29* | .15** | .13** | (.71) |

Diagonal in parentheses: square root of AVE from observed variables (items); Off-diagonal: correlations between constructs

* $p < .05$; ** $p < .01$

**Table 5** Good-of-fit indices for the structural model

| Fit indices | Values | Criteria[a] |
|---|---|---|
| $\chi^2$ Statistic | 166.118** | Insignificant, but significant *p* value can be expected |
| $\chi^2/df$ | 1.51 | <3 |
| RMSEA | .05 | <.08 |
| GFI | .90 | ≥.09 |
| CFI | .93 | ≥.09 |
| TLI | .92 | ≥.09 |

[a] References were taken from: Hair et al. (2010), Kline (2005) and McDonald and Ho (2002)

** $p < .01$

Item reliability of each measure, composite reliability of each construct (CR) and average variance extracted (AVE) are the three primary measures for evaluating the convergent validity of a measurement model. Table 2 shows the results of factor loadings and AVE. All factor loadings were statistically significant and exceeded the recommendation set by Hair et al. (2010). The AVE for each measure is above .50. The CR of each construct was assessed using Cronbach's alpha. The composite reliability for all the factors in the measurement model ranges from .67 to .84 (refer 'Appendix') and exceeds the recommended threshold value (Hair et al. 2010). Through the discriminant validity assessment (Table 4), the model reflected that the constructors have a strong correlation to its indicators than to other constructs in the current measurement model.

## Evaluation of Structural Model

A similar set of model-fit indices, $\chi^2/df$, GFI, CFI, TLI and RMSEA, was employed to assess the structural model of the study. Table 5 shows the fit indices and their level of acceptable fit for the proposed structural model. All values are above the recommended thresholds for acceptable model fit ($\chi^2 = 166.118$, $p < .01$; $\chi^2/df = 1.51$; GFI = .891; CFI = .939; TLI = .924; and RMSEA = .057). For the $\chi^2$, a significant *p* value can be expected (Hair et al. 2010).

## Hypotheses Testing

Figure 3 shows the standardised path coefficients for the hypothesised model. A significant positive influence was found in the relationships between performance expectancy and effort expectancy towards behavioural intention ($\beta = .69$, $p < .00$ and $\beta = .32$, $p < .00$, respectively) which had an $R^2$ value of .596. That is, performance expectancy and effort expectancy explained 59.6 % of the variance in behavioural intention of student teachers to use whiteboards. Thus, hypotheses H1 and H2 (a) were supported by the data.

The study also investigated differences in experience. For the limited-experience group, the model explained 99.2 % of the variance in behavioural intention to use IWBs, and for the some-experience group, the figure was 67.6 %. Figure 4 shows the path coefficients for those groups. Based on the differences in the path coefficients of the two groups, it was considered worthwhile to investigate experience differences via path-by-path analysis. This was done by constraining each path coefficient to be equal across the two groups and by comparing the $\chi^2$ differences.

The results of the analyses of the path-by-path comparison for the limited-experience group and the some-experience group are shown in Table 6. Unexpectedly, only effort expectancy was found to be significantly different. Therefore, this shows that the path coefficients for PE → BI, SI → BI and FC → BI did not differ between the limited-experience and some-experience groups. Thus, hypotheses H3b and H4b were not supported (Table 7).

## Discussion

The current study empirically validated the UTAUT model by going a step further to explore its applicability in an educational setting. The findings have several vital implications for educational practice and for future studies of educational technology. Overall, the results show that the UTAUT model accounted for 59.6 % of the variance in behavioural intention of student teachers to use interactive

**Fig. 3** Standardised path coefficients (** $p < .01$)

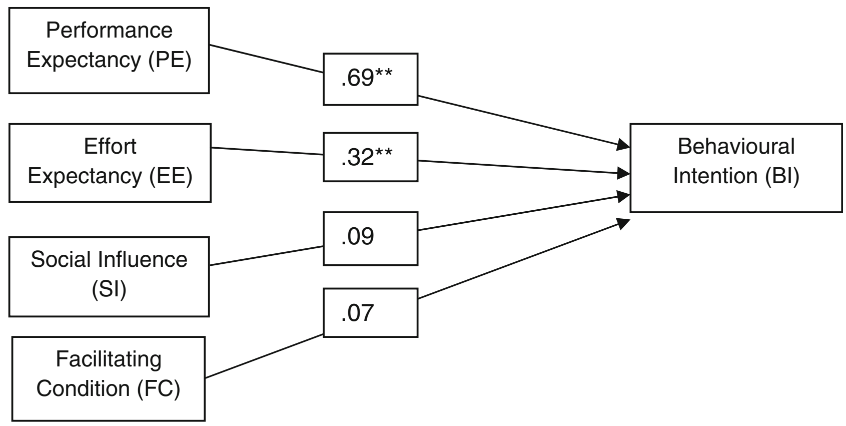



**Fig. 4** Standardised path coefficients for the limited-experience group and the some-experience group (** $p < .01$). Coefficients for limited-experience group are in the *shaded boxes*

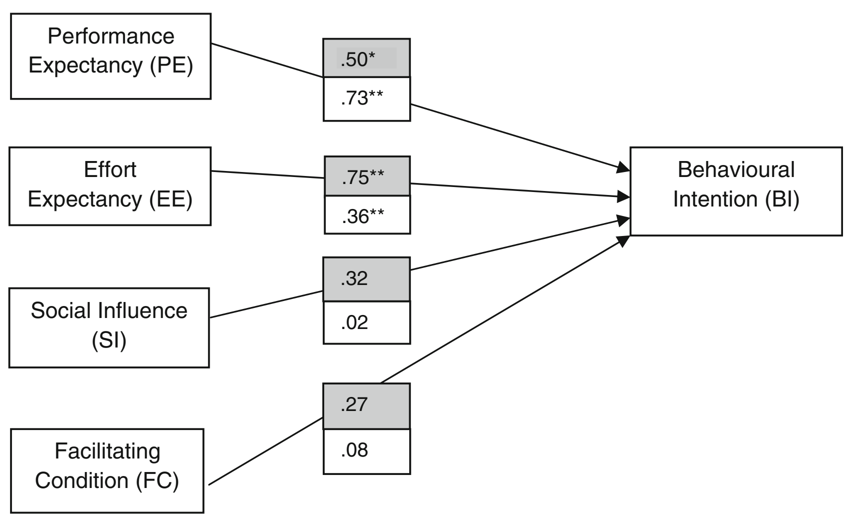



**Table 6** Path-by-path comparison for the some-experience group and the limited-experience group

| | $\chi^2$ | *df* | $\Delta\chi^2$ from revised model |
|---|---|---|---|
| Unconstrained[a] revised model[a] | 334.777 | 221 | |
| Constrained paths[b] | | | |
| PE → BI | 335.939 | 222 | 1.162 (ns) |
| EE → BI | 338.915 | 222 | 4.138* |
| SI → BI | 335.675 | 222 | .898 (ns) |
| FC → BI | 337.129 | 222 | 2.352 (ns) |

[a] Paths for the groups were allowed to be freely estimated

[b] The path specified was constrained to be equal across the two groups

* $p < .05$

whiteboards. According to the result of the test for goodness-of-fit, the findings demonstrate that the model was fully confirmed and validated by the data.

The results show that performance expectancy and effort expectancy had statistically positive effects in regard to the intention to use IWBs. These findings support the earlier studies by Venkatesh et al. (2003), Venkatesh and Zhang (2010) and Wang and Shih (2009). It should also be noted that this pattern was in the direction theorised in the original UTAUT model. From the effect sizes, the dominant determinant of behavioural intention is performance expectancy. This means that student teachers will engage with a technology such as IWBs when they see value and benefit in doing so. It is evident, then, that policymakers and curriculum designers should demonstrate to students the advantages of this equipment and provide training in its use.

The importance of effort expectancy has been demonstrated by the present study and is consistent with prior findings (Im et al. 2008; Schaik 2009). This means that higher levels of effort expectancy will result in a greater behavioural intention by student teachers to use IWBs. For

**Table 7** Hypothesis testing results

| Hypotheses | Path | Hypothesis | Results |
|---|---|---|---|
| Main effect | | | |
| H1 | PE → BI | Positive | Supported |
| H2a | EE → BI | Positive | Supported |
| H3a | SI → BI | Positive | Not supported |
| H4a | FC → BI | Positive | Not supported |
| Experience difference | | | |
| H2b | EE → BI | Limited experience > some experience | Supported |
| H3b | SI → BI | Limited experience > some experience | Not supported |
| H4b | FC → BI | Limited experience < some experience | Not supported |

IWBs to thrive as a teaching tool in future classrooms, student teachers should be provided with proper training that emphasises the pedagogical uses of interactive whiteboards rather than with familiarising student teachers with its technical functioning.

Contrary to expectations, social influence did not have a significant influence on student teachers' intention to use interactive whiteboards, a result contrary to the findings of prior studies (Chan et al. 2010; Cheng et al. 2011; Loo et al. 2009; Yang 2010; Zhou et al. 2010). This means that social influence is not an important determinant in the intentions of student teachers to use interactive whiteboards. This could result from the limitations of the UTAUT's applicability in different user populations and its levels of voluntariness. The results from the descriptive analysis indicated that all participants were at a relatively young age of 18–21 years, making them less likely to be influenced by others. Rhodes (1983) conducted a meta-analysis of age effects, confirming that affiliation needs increase with age. This means that social influence might have less or no influence on behavioural intention amongst the younger generation.

The result also indicates the insignificant relationship between facilitating conditions and behavioural intention, and this is in accordance with the finding of the UTAUT (Venkatesh et al. 2003). Indeed, the insignificant relationship between facilitating conditions and behavioural intention has been highlighted by Venkatesh (2000) who also observed that effort expectancy has a mediating effect on the relationship between facilitating conditions and behavioural intention. Thus, when the effort expectancy construct is present in the current research model, facilitating conditions become insignificant in predicting intention. This statement is consistent with what has been theorised in the TPB, MPCU, IDT and UTAUT models.

Additionally, this study further investigated the moderating role of a user's experience on the relationship between effort expectancy and behavioural intention. The findings revealed that a user's experience has a moderating effect on the relationship between effort expectancy and behavioural intention such that effort expectancy affected behavioural intention to use whiteboards more markedly for the limited-experience group than for the some-experience group. This means that ease of use is an important consideration by student teachers in the early stages of their IWB experience. This is consistent with the UTAUT model and prior empirical studies (Chan et al. 2010; Cheng et al. 2011; Yang 2010; Zhou et al. 2010). Recognising the significant moderating effect of users' experiences, it is important for teacher educators and curriculum designers to focus on developing positive perceptions of ease of use of interactive whiteboards during the early stage of implementation.

## Limitations and Future Research

Several limitations have narrowed the scope of the findings and the discussion. First, self-report items were employed to measure the variables for the present study. Thus, there is the possibility of bias in the findings because participants might give responses that they consider to be more socially desirable, especially when one of the researchers is the course coordinator. Second, most of the participants were females aged 18–21, but the researchers did not analyse the moderating effects of gender and age. These influences have the effect of limiting the generalisability of the results. This raises a potential research issue for future researchers who could usefully conduct studies to explore and understand the moderating roles of gender and age on student teachers' intentions, especially in regard to the use of interactive whiteboards. Third, the population of this study was confined to student teachers and so the findings might not reflect the perceptions or behaviour of experienced, practising teachers who are more likely to be exposed to new technology and to the relative benefits of that technology.

## Appendix

See Table 8.

**Table 8** Constructs, corresponding items and composite reliability

| Construct | Item | | Composite reliability |
|---|---|---|---|
| Performance expectancy (PE) (adapted from Venkatesh et al. 2003) | PE1 | I would find using IWBs useful for teaching science. | .80 |
| | PE2 | Using the IWBs for teaching and learning in the science classroom would enable me to accomplish tasks more quickly. | |
| | PE3 | Using the IWBs for teaching science would increase my productivity. | |
| | PE4 | If I use IWBs for teaching, I will increase my employment opportunities. | |
| Effort expectancy (EE) (adapted from Venkatesh et al. 2003) | EE1 | It would be easy for me to become skilful at using IWBs. | .81 |
| | EE2 | I would find it easy to use IWBs for teaching science. | |
| | EE3 | Learning to use the IWBs for teaching science would be easy for me. | |
| | EE4 | IWBs are difficult to understand. | |
| Social influence (SI) (adapted from Venkatesh et al. 2003) | SI1 | Educators who influence my behaviour would expect me to use IWBs for teaching science. | .66 |
| | SI2 | People who are important to me will think that I should use IWBs. | |
| | SI3 | This university has been helpful with learning to use IWBs. | |
| Facilitating conditions (FC) (adapted from Venkatesh et al. (2003)) | FC1 | I have the resources to practice with IWBs. | .84 |
| | FC2 | I have the knowledge and skills to use IWBs. | |
| | FC3 | When I need help to use the IWBs, someone is there to help me. | |
| Behavioural intention (BI) (adapted from Venkatesh et al. 2003) | BI1 | Whenever possible, I intend to use the IWBs for teaching science. | .67 |
| | BI2 | I think most of my teaching lesson will be conducted via IWBs. | |
| | BI3 | I plan to use the IWBs for teaching science during my teaching practicum. | |

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