Adoption Vs. Usage of Interactive White Board Technology By Teachers in Higher Education Institutions

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Abstract

This research investigates teaching faculty's adoption and usage of Interactive White Board Technology (IWBT) in teaching in UAE University (UAEU). The research extended the technological innovation theories and proposed a model made of different contexts. The research model was partially supported and highlighted interesting insights pertaining to adoption and usage of IWBT in teaching. Contrasting findings pertaining to the same factors across adoption and usage proved to be both insightful as well as challenging at the same time. Implications arising from significant and insignificant factors lead to a conclusion that IWBT is evolving in UAEU. The research discusses theoretical as well as professional contributions and implications emerging and portrays different research areas in this field.

Keywords:

Interactive White Board, technological innovation theories, disruptive technologies, integration, pedagogy.

INTRODUCTION

The Interactive White Board Technology (IWBT) is considered an effective interactive learning approach and is being used in teaching and grading and expected to alter current pedagogical system and means of exchanging information with students and (Stoica et al., 2011). IWBT represents a tool and an environment that promotes dialogue and knowledge building amongst students (Warwick et al., 2010). As for teachers, the IWBT made the lessons more enjoyable and for students, the IWBT resembled an opportunity to actively participate in a lesson and to internalize inputs in a more appropriate manner (Gursul & Tozmaz, 2010).

There are many forms of IWBT but usually IWBT combines an electronic touchable whiteboard connected to a network-computer and a data projector. IWBT allow teachers and students control applications by touching the screen with their fingers or writing digitally with a non-ink pen tool. The touch-sensitive nature of IWBT facilitates more efficient presentation and more professional delivery of multimedia resources (Smith et al., 2005).

Although integrating technology into teaching and learning is growing, non-anecdotal evidence of IWBT effectiveness in teaching and how to implement a successful IWBT classroom is lacking (Lopez, 2009). In their review of the literature, Gursul and Tozmaz (2010) found that results of using the IWBT are controversial where while some researchers reported on IWBT's advantages and its impact on the lesson and learning others noted its minimal impact. Slay et al. (2008) reported the same and found IWBT research divided into two areas: investigate the use of IWBT in particular subject areas; and soliciting teachers' and learners' perspectives on the IWBT technology. Somyürek et al. (2009) concluded from their literature review that such limited research reported scant successes with IWBT and failed to clearly state the problems and solutions and the successful implementation of IWBT in teaching (Lopez, 2009). Warwick et al. (2010) noted that the introduction of new technologies in teaching did not address its link to pedagogy as such. Accordingly, researchers like Salinas (2006) and Somyürek et al. (2009) warned that educators may lack a clear understanding of the pedagogical principles underlying integrating these new technologies in the classroom and hence, encouraged them to develop accurate plans and strategies to integrate technology into teaching. This is further aggravated by the attempt to introduce new innovations like the IWBT into old educational models (Warwick et al., 2010). Therefore, the process of assimilating IWBT into teaching is not a straight-forward process and fraught with many challenges.

Gursul and Tozmaz (2010) noted that existing IWBT research focused on the effective use of IWBT in the classroom and its impact on student's academic achievement and largely ignored teachers' opinions about IWBT. This is an important direction in this research focusing on teacher's attitude and usage of IWBT. Further, Korucu et al. (2011) noted the importance of addressing whether teachers are capable of using IWBT or not. To

elevate the argument one level up Warwick et al (2010) concluded that technology alone cannot change classroom teaching and learning but rather requires mediation by the teacher. Therefore, it is not surprising that researchers like Lopez (2009) asserted that innovative technologies like the IWBT must be introduced as a disruptive innovation, where it should not compete with existing current curriculum and instructional practices but rather to challenge the teachers' ability to discover new features in IWBT and use them to devise new ways of teaching.

THEORETICAL FRAMEWORK AND HYPOTHESES

In search for appropriate frameworks to guide this research endeavor identify potential determinants of technology adoption the Technological Innovation Theories (TOT) appeared to be more prevalent amongst researchers. In their review of adoption literature, Thong (1999) and Tornatzky and Klein (1982) endorsed Rogers' (1995) innovations model and found the first three factors (relative advantage, complexity and compatibility) consistently associated with innovation adoption. Thus, extending or adapting contexts and factors developed in earlier IS research to IWBT adoption is unwarranted because IWBT introduces features of its own. Accordingly, this research will examine these three factors but from within the IWBT pedagogy literature in order to develop the guiding theoretical framework (Table 1). The research added individual characteristics of teaching faculty as a determinant context of IWBT adoption and usage. Those are made of different factors like age, gender, qualifications; own a laptop, nationality and number of years serving in UAEU. Accordingly, Hypothesis 4 is posed: individual characteristics are expected to impact IWBT usage positively.

METHODOLOGY

UAEU is the first National (federal) university in UAE. It was established in 1976. The University's founding mission was to realize the aspirations of the society, deepen social ambitions, and consolidate the structural foundations. As of 2011, the UAEU has over 12,000 students, primarily based in Al Ain city. UAEU have over 650 teaching faculty members and offers bachelor degrees, postgraduate courses, PhD programs and Continuing Education Programs for the community at large. FIT adopted the IWBT in all its classrooms, conference/meeting room, auditoriums and laboratories. The adopted IWBT type/model depended on the size of the room. FIT installed cameras in each class linked to the IWBT (on/off recording) to optionally record the whole lecture. The cameras have audio detecting feature to focus on recording the one that speaks in the classroom

Data for the study was collected in 2011 by means of a survey questionnaire based on the research model in Table 1. Standard measures were used (where available) during the design of the measures adopted in this research. An online version of the survey was created and posted on the university's web site targeting all teaching faculty and instructors. 228 responses were received. The effective response rate was 35.1 percent and this seemed adequate in line with prior adoption research (Thong, 1999). The questionnaires were coded and keyed into the SPSS statistical software tool.

TESTS

Non-response bias was tested by comparing early participants with late participants in terms of the basic demographic data of participants (gender, age, qualifications, etc.) using T-test statistics at the five percent significance level ($p<0.05$). The t-value, degree of freedom, and two-tail significance for the equal variance estimates were used to determine whether differences exist between the different adopting categories. Non-response bias was not a problem in this research as the two-tail test was found to be non-significant ($p>0.05$).

Testing for reliability can be achieved by calculating the Cronbach alpha. Thong (1999) used a higher value for Cronbach alpha (0.7). All the reliability coefficients met the generally accepted guidelines of 0.7 and above to qualify as a reliable measure. Validity was assessed through content, convergent and discriminant validity (Premkumar & Roberts, 1999; Thong, 1999). Convergent and discriminant validity will be evaluated using factor analysis. According to the principal axis factoring (PAF) results, the high loadings on the single factors gave convergent validity, while getting no cross loadings gave divergent validity as did the fact that no measures were highly correlated. An examination of the correlation matrix indicates that a considerable number of correlations exceed 0.3 and thus the matrix was suitable for factoring. The Bartlett test of sphericity is significant ($p<0.05$) and that the Kaiser-Meyer Olkin measure of sampling adequacy (0.913) is far greater than 0.6. Inspection of the anti-image correlation matrix reveals that all our measures of sampling adequacy are well above the acceptable level of 0.5. The communalities of the different items show high results. The total variance is explained at 4 stages. Thus, the four extracted factors explain 73.5 percent of the total variance. Four factors were identified as explaining the variance under consideration by this research (having eigen values greater than 1). The eigen values column represent the sum of squared loadings for a factor. It represents the amount of

variance accounted for by a factor. Using PAF and oblique rotation (direct oblimin) provides a far more interpretable solution. Pure variables have loadings of 0.3 or greater on only one factor. All variables correlate with their corresponding factors and hence confirms the factor structure of the different scales.

Table 1. Theoretical IWBT adoption framework

Advantages	**Compatibility**
Gursul and Tozmaz (2010): - It can draw the attention of students by increasing the visuality - It provides the students with the opportunity for active participation. - Retention of Learning - It enables what is explained in a lesson to be recorded and to be continued in the next one. - It makes lessons enjoyable - It makes it easy to give a lesson Baek et al. (2008): - relieving physical fatigue - class preparation and management - using the enhanced functions of technology Slay et al. (2008); Smith et al. (2005): - flexibility - versatility - multimedia ability (Schmid, 2008), - efficiency - interactivity - lesson participation - collaboration - idea-sharing - ability to save and post drawings and writings on the board Lopez (2009): - digital learning classroom promotes positive social norms - learner-centered pedagogy Schmid (2008): - multimedia platform - enhancing interaction in combination with remote devices - supporting collaborative learning - Facilitation of learning - Saving teacher's time	Baek et al. (2008): - lack of time (Barak, 2007; Gursul & Tozmaz, 2010) - finding the information technology frustrating, - using the basic functions of technology - fear of losing personal contact with students (Barak, 2007) - lack of familiarity (Barak, 2007) - student-enjoyment (Barak, 2007) - Extrinsic: adapting to external requests and others' expectations - Intrinsic: deriving attention Slay et al. (2008): - associated cost of IWBT technologies, - the technical reliability of the IWBT - motivation - ability to face the class whilst teaching which allows teachers to maintain class control - to be more in touch with the learners by maintaining eye-contact than when using a laptop Schmid (2008) - individual cognitive limitations (cognitive overload) - reactions to different multimedia content - spoon-feeding - appeal to various learning styles Somyürek et al. (2009): - The lack of printers and scanners connected to the IWBT - Visibility problems because of where IWBT are located in classrooms
Hypothesis 1: Relative advantages is expected to impact IWBT usage positively	Hypothesis 2: Compatibility is expected to impact IWBT usage negatively
Complexity	**Top management support**
Somyürek et al. (2009): - lack of technical competency on how to use IWBT - lack of pedagogical competency on how to integrate them into classroom activities - lack of a school plan on the use of IWBs - lack of both technical and pedagogical in-service trainings and how to integrate IWBT into the learning processes - Lack of digital educational materials to highlight the advantages of multimedia (Gursul & Tozmaz, 2010) - Lack of support and maintenance Virus problems causing the IWBT to run inefficiently (Gursul & Tozmaz, 2010)	Somyürek et al. (2009): - lack of measures to monitor the use of IWBT - failure of school administrations to encourage: teachers use the IWBs, scheduling of ICT installed classrooms, and sharing of digital educational materials among the teachers. At the outset, the majority of research looked at top management support to encourage adoption (Premkumar & Roberts, 1999; Thong 1999).
Hypothesis 3: Complexity is expected to impact IWBT usage negatively	Hypothesis 4: Top management support is expected to impact IWBT usage positively.

ADOPTION VERSUS USAGE

When asked whether teaching faculty adopt or not adopt IWBT, 93 percent were found adopters and 7 percent did not adopt IWBT. Usage as a measure provided more accurate depiction of IWBT penetration in UAEU. The majority of the surveyed teaching-faculty are frequent users of IWBT. This is an indication of the large-scale diffusion of the IWBT in the UAEU where there is no other alternative to the IWBT in the classrooms. Interestingly, 7 percent of the teaching faculty did not use the IWBT and 21 percent used the IWBT occasionally.

DEMOGRAPHIC DETAILS ABOUT TEACHING FACULTY

The average age of the surveyed teachers is 44.5 years. On average they have been working in UAEU for 1.7 years. The majority of respondents to the survey were male (80%) and holders of PhD followed by Master degree. The majority of ethnicities in the sample came from Arab countries followed by westerners and Emiratis respectively. Almost all respondents owned a laptop. However, the UAEU contributes to this result as it grants laptops to teaching faculty in certain Faculties (i.e., Engineering, Science, Information Technology). Faculty representation in the sample came largely from the Faculty of Science followed by the Faculty of Humanities and followed equally by both the Faculty of Business and Economics and the Faculty of Engineering.

HYPOTHESES TESTING AND ANALYSIS

IWBT adoption

The null hypothesis (H0) could be rejected for only these variables (complexity, compatibility, age and number of years working in UAEU) in this category. Those are the differentiating factors between adopters and non-adopters of IWBT. The null hypothesis could not be rejected for the remaining factors and hence, deemed irrelevant to IWBT adoption. Hence, the data did not show a difference between adopters and non-adopters of IWBT with respect to these factors. Except for teaching faculty's age which appeared with positive coefficients, complexity, compatibility, and number of years working in UAEU appeared with negative coefficients in Table 2. Thus, teaching faculty viewed IWBT as incompatible and as not complex and they are expected to impact IWBT adoption negatively. The number of years working in UAEU appeared to impact IWBT adoption negatively as well. On the other hand, teaching faculty age seemed to impact adoption positively.

Table 1: Multiple regression analysis for IWBT adoption

The regression model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**R square**	**Adjusted R square**	**Std. error of the estimate**
Regression	18.182	4	4.546	4.854	.001	.080	.064	.967
Residuals	208.818	223	.936					
Total	227.000	227						

Coefficients:

Factor	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta		
(Constant)	-1.934E-15	.064		.000	1.000
Complexity	-.223-	.071	-.223-	-3.139-	.002***
Compatibility	-.192-	.070	-.192-	-2.723-	.007***
Age	.148	.069	.148	2.145	.033**
No of Years working in UAEU	-.160-	.068	-.160-	-2.337-	.020**

* p<0.1, ** p<0.05, *** p<0.01

IWBT usage

The null hypothesis (H0) could be rejected for only these variables (complexity, compatibility, age, original nationality and number of years working in UAEU) in this category. Those are the differentiating factors between users and non-users of IWBT. The null hypothesis could not be rejected for the remaining factors and

hence, deemed irrelevant to IWBT usage. Except for teaching faculty's age which appeared with negative coefficients, complexity, compatibility original nationality and number of years working in UAEU appeared with positive coefficients in Table 3 and thus, expected to impact usage positively. Thus, teaching faculty viewed IWBT as compatible and as complex to usage. Belonging to a certain nationality and the number of years working for the UAEU are expected to impact IWBT usage positively. Age is expected to impede IWBT usage negatively.

Table 3: Multiple regression analysis for IWBT usage

The regression model	Sum of Squares	df	Mean Square	F	Sig.	R square	Adjusted R square	Std. error of the estimate
Regression	6.293	5	1.259	3.599	.004	.075	.054	.591
Residuals	77.637	222	.350					
Total	83.930	227						

Coefficients:

Factor	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.435	.134		18.210	.000
Age	-.085-	.042	-.140-	-2.006-	.046**
No of Years working in UAEU	.075	.045	.123	1.668	.097*
Original Nationality	.096	.057	.117	1.679	.095*
Complexity	.108	.043	.177	2.482	.014**
Compatibility	.143	.043	.235	3.306	.001***

* p<0.1, ** p<0.05, *** p<0.01

DISCUSSION AND CONCLUDING REMARKS

Theoretical contributions and hypotheses

This research was delimited to the specified factors in this research. This research used standard measures where possible in developing the survey questionnaire. Further, most of IT research (Premkumar & Roberts, 1999; Thong, 1999) looked at adoption as a proxy for IT success. However, attempting to capture the depth of the adoption criteria of IT or its use in business through dichotomous adoption (yes/no) measures is inconclusive (Zhuang & Ledere, 2003). This research introduced both adoption and usage measures to assess the depth of IWBT penetration in pedagogy in UAEU. Though both produced interesting insights, it is obvious that "usage" as a measure produces more effective results here as mere adoption is not an effective indication of IWBT success. Researchers could capitalize on this research's framework and measures by adding further insights which could shed more light into the IWBT phenomenon in tertiary teaching in UAEU and elsewhere.

Hypothesis 1 and 4 were not supported in this research. Top management support was not represented in this research as a determinant of IWBT adoption and usage. IWBT advantages were quite obvious to all respondents and hence, the impact of the relative advantages on adoption and usage seemed to be insignificant. These equal views about IWBT advantages amongst all respondents represent a challenge here as upon using IWBT, it is expected to foresee more significant advantages. The concern here is that both groups across adopters/non-adopters and users/non-users had equal views about IWBT advantages which may lead to a conclusion that IWBT is used minimally in UAEU. Minimally in the sense that IWBT's basic features were used in the classroom (c.f. Al-Qirim, 2011). This makes this research's results in line with the literature. For example, Gursul and Tozmaz (2010) found modest (23 percent) use of IWBT in the classroom by teachers who reported using the IWBT as a combination of computer and projection; carrying out such interactive activities as matching, dragging and painting; and using it for normal board activities (Solving questions, writing…etc.). Other advanced uses of IWBT were minimally reported by the same teachers: explaining things which would otherwise be impossible to do so in classrooms through animation (13 percent); Making children play games related to the subject of a lesson (9 percent); and using ready symbols and drawings found in the Internet and smart-board program (9 percent). In the same vein, Korucu et al. (2011) found teachers agreeing on the positive impact of interactive materials in the classroom despite its scarcity and limited use in the classroom. Such teachers reported difficulty in using IWBT and interactive materials (including visual and animation content) and in creating it. Although most of those teachers raised the importance of having IWBT in all classrooms, they did not prefer using interactive material and viewed IWBT as not having a positive effect on the courses they teach. These insights could be used to justify this research's implications above and at the same time, could represent an extension to this research by any future interpretive research.

Hypothesis 3 was supported in this research. Interestingly, adopters perceived IWBT to be not complex while users found IWBT complex to use. One justification for such differences is attributed to the fact that, at the outset, IWBT does not appear to be as complex but upon using it in the classroom, many of the complex aspects started to emerge as detailed above. This is an interesting contrast here. The same argument applies to Hypothesis 2 which was significant in this research. Adopters perceived IWBT to be incompatible with the way they like to work while users found IWBT to be compatible with them. This is an interesting contrast as well. One justification for such differences is attributed to the fact that, at the outset, IWBT seemed to be quite disruptive to existing teaching practices which may muster an initial resistance in the case of IWBT adoption. When usage becomes immanent and not optional, faculty seemed to tread along and cope with IWBT features. This modest view is posited alongside the above complexity and irrelevant advantages of IWBT.

Hypothesis 5 was partially supported in this research. Only age and nationality of faculty and number of years working in UAEU impacted adoption and usage significantly. Other demographic characteristics did not appear significant here further noting the lack of differences across gender, owning a laptop (all own a laptop), education level (almost all holds PhD), and belonging to a certain faculty/college. Interestingly, age of faculty impacted adoption positively and the longer the faculty works for the UAEU impacted adoption negatively. Upon usage of IWBT these results seemed to be reversed. It seems the age of the faculty seemed to impede usage and this is in line with the literature. As older faculty delve into further use of IWBT in teaching, the more they had to abandon earlier practices and to cope with more advanced IWBT features. This appeared to be a challenge for older faculty. Younger faculty are expected to be more technology oriented and savvy compared with older faculty who are not expected to be brought-up with technology and contemporary methods of teaching. On the other hand, faculty's seniority in UAEU seemed to impact IWBT usage positively as it seems their tenure-ship is dependent on IWBT usage. In addition, faculty's nationality appeared to be a positive determinant of usage of IWBT and hence, belonging to a certain nationality may motivate or impede usage. This is an interesting insight as the social fabric in UAE is made of diverse range of nationalities covering most of the countries in the world.

Professional contributions

IWBT is considered a disruptive technology (Lopez, 2009) as its full realization depends on its full integration in pedagogy. Gursul and Tozmaz (2010) contended that once IWBT is integrated correctly into the curriculum and this process is continuously employed, the IWBT could prove to be a revolutionary invention for schools. In reality this represents the greatest challenge for most educators in the world. This was evident in this research analyses and the challenges faced in interpreting the research results. Due to the lack of knowledge about the effective use of IWBT and how to integrate it in teaching, management, professionals and policymakers need to highlight IWBT features and advantages to faculty and other users. Korucu et al. (2011) contended the same and highlighted the importance of striking a match between teachers and IWBT capabilities for IWBT to succeed in education which could be bridged by providing in-service training. Gursul and Tozmaz (2010) found that teachers with limited knowledge in technology would refrain from using the IWBT. They suggested that corresponding authorities should provide digital educational materials; qualified staff to help teachers use the IWBT; and IWBT should be integrated into teachers' lesson plans. This could be achieved by providing more advanced training programs showing the effective use and integration of IWBT in teaching. Further, as each course has its own specifics in terms of concepts and requirements, forming committees looking at such requirements could devise an integration formula or protocol that suits the needs of each course (c.f., Al-Qirim et al., 2010). Such efforts require the collaboration of technologists, educators and students to fulfill such integrated tasks. All of the above entails a bigger role to be played by top management to encourage and facilitate IWBT adoption and usage amongst faculty in UAEU. In line with Somyürek et al. (2009) concerns, management should put measures to encourage teachers' use of IWBs and to share digital educational materials and to monitor the use of IWBT. Leadership is highly envisaged here even at the one college level.

By addressing IWBT complexities and incompatibilities, UAEU could further IWBT adoption and usage. Technical mishaps (software and hardware failure) that surrounded the IWBT in the classroom represent a great challenge for teachers. Teachers must be trained at least to address most impending IWBT's technical problems that may arise (impede) during a class session or alternatively, to provide technical staff on-site to maintain the continued functionality of the IWBT in the classroom. Although the installed IWBT in each class in UAEU includes dual white boards and projectors which adds some redundancy and class-continuity in case of a failure, technology providers should add further reliability and availability aspects into their IWBT's equipment to ease the life of teaches inside the classroom. Faculty noted that they did not foresee the IWBT to be an effective management and control tool inside the class. Remedying such challenges is important before elevating to the next level.

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