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ABSTRACT

The Interactive White Board Technology (IWBT) holds many pedagogical promises and aims to elevate teaching to new heights in higher education. This research attempts to unveil many of the issues surrounding this technology. IWBT comes with a portfolio of redundant hardware components and software solutions that could intelligently facilitate the teaching process making it more rich, exciting and interactive. In addition, the touchable smart board adds more functionality and could encourage student participation and involvement in learning. However, the IWBT is recent and issues emanating from its use in teaching are unclear. This research takes a more proactive approach in developing different scenario integrating the IWBT in key technical concepts pertaining to different departments in the College of Information Technology. It is believed that adopting such approach could, at least, eliminate initial expected resistance amongst teachers and students. The research also solicits the views of teachers and students about the IWBT. Initial insights suggested that the IWBT could be used in teaching technical courses. However, its full success is contingent upon addressing certain factors highlighted in this research. The research highlights different contributions, contentions and future research areas.

Keywords

Interactive smart board, smart classroom, emergent disruptive technologies, integrative pedagogy.

INTRODUCTION

It is becoming more evident that most researchers agree on the fact that Information and Communication Technologies (ICT) can be used effectively as a cognitive tool as well as an instructional media (Baek et al., 2008). Therefore, ICT integration in teaching became a major focus for many educational institutions which allocated significant proportion of their budgets toward ICT adoption (Lowerison et al., 2006). Barak (2007) found that the literature pointing to other advantages concerning ICT use in the classroom such as designing new learning environments, integrating virtual models, and creating learning communities. In their review of the literature, Winer and Cooperstock (2002) found that the use of the different technologies is having a significant impact on the nature of the physical and pedagogical learning environment in higher education teaching. This meant that technology is being used to support enriched presentation environment and review capabilities rather than playing a primary teaching role, either synchronously or asynchronously.

Different examples of technology use in teaching were reported as well (Barak, 2007) such as having a course website, electronic forum, computerized modeling instruction, and web-based projects. Blackboard and WebCT tools and features (i.e., forums, chat) are used extensively by educators as well.

However, the implications here are threefold. Initially, although integrating technology into teaching and learning is increasing exponentially, non-anecdotal evidence of its effectiveness is lacking (Young, 2001). Generally, few studies have been conducted in terms of the factors relating to technology use in the classroom (Baek et al., 2008). Secondly, the available research that investigated the effective use of new technology in teaching is inconclusive (Salinas, 2006). Finally, Salinas (2006) raised the serious underutilization of technology in higher education classroom and that acceptance of this technology is not shared evenly among faculty where some instructors were skeptical about the effectiveness of these new technologies in teaching. This is aggravated by their attempt to introduce new innovations into old educational models. Barak (2007) highlighted the same and indicated that although instructors perceived ICT learning environments to play a significant role in education in the near future, they were unsure about ICT use in education. Instructors resisted change in that they opted to retain old and familiar teaching methods – this represented the most difficult barrier for effective ICT integration

It should be warned here that educators should develop accurate plans and strategies to integrate technology into teaching as educators may lack a clear understanding of the pedagogical principles underlying integrating these new technologies in the classroom (Salinas, 2006). Mounting evidence suggests that information processing, problem solving and utilizing visualization could only be achieved by the successful integration of ICT into the curriculum (Barak, 2007). This requires more collaborative, cooperative and integrative approaches by the different stakeholders involved in the education delivery process. Delialioglu and Yildirim (2007) concluded that technology use in education can be a ''double-edged sword'' if not properly planned and implemented. Evidence suggest that failing to assimilate ICT into key pedagogical concepts may lead to drastic consequences where i.e., educators risk using the new ICT as a fancy substitute for the overhead projector, and the Internet as an expansion of the school library (Salinas, 2006).

According to above mounting challenges and implications, it is understandable that a paradigm shift is needed in the pedagogical model of today's learning and teaching strategies. Thus, more controlled studies of ICT integration in teaching are needed that include accurate measures of achievement, and ways to carefully describe the methods of technology integration in order to study its products/outcomes (Lowerison et al., 2006). Such studies could encourage teachers (used interchangeably here with the terms: faculty, instructors, lecturers) be more open to the use of technology and hence, appreciate its value in improving classroom instruction and student understanding (Salinas, 2006).

Stemming from the above implications, this research will introduce a pedagogical tool represented here by the use of Interactive White Board Technology (IWBT) as an example for integrating ICT in teaching higher education courses. Thus, posing the following research question: How can we use IWBT more effectively in teaching different courses in the College of Information Technology (CIT). The CIT was the only college that adopted the IWBT in the university. Such research question necessitates an understanding into:

- How teachers use IWBT's different features in teaching CIT's courses?
- How to measure the impact of the IWBT on teaching in CIT?

Therefore, this research will assess the effective use of the IWBT in teaching information technology students different scientific and engineering courses. This is achieved by covering seven different tracks (degree programs) in CIT in the UAE University. These departments are: software engineering, e-commerce, information systems, computer engineering, network engineering, security and computer science.

INTERACTIVE WHITE BOARD TECHNOLOGY

There are many forms of IWBT but usually IWBT combines a whiteboard with a computer and a data projector and allows teachers and students control applications by touching the screen with their fingers or writing with a non-ink pen tool (Figure 1). A wireless response device can be integrated in the IWBT environment allowing students answer questions posed in the IWBT and showing the results. IWBT could be integrated with a sound amplification system for teachers who suffer from vocal strain and noise-related stress and for students with learning (i.e., hearing) disabilities.

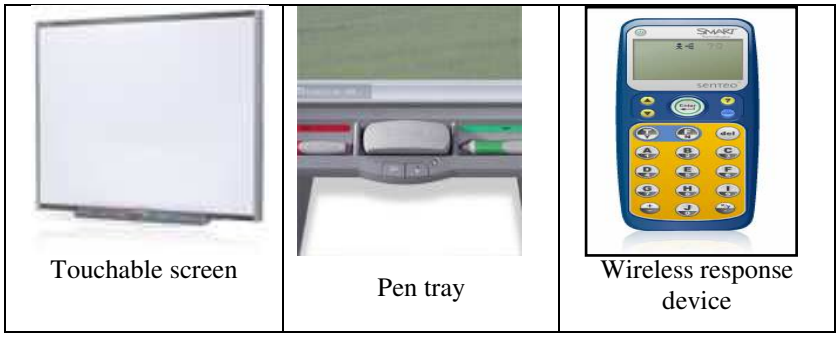

Figure 1. Interactive White Board Technology

The IWBT could encourage faculty develop their own classroom materials, to incorporate computer technology on a regular basis, and to encourage pedagogical changes in higher education classrooms. IWBT helps teachers reduce planning and prep time, personalize learning.

IWBT comes with software application which gives teachers quick access to all their lesson materials from one location. The software has two main sections: white boarding space, where the user can write and edit the contents, and a tab column, in which the user can select a page sorter, gallery or attachment tabs. The tab column, the user can view and organize thumbnails of the notebook pages that he/she created. While gallery tab allows user to access and store multimedia contents like images, sounds, videos, and animations.

THEORETICAL FRAMEWORK

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. The adoption and diffusion of information technologies by individuals and organizations is part of the process of information systems implementation (Kwon & Zmud, 1987; Moore & Benbasat, 1991, 1996). Innovation diffusion refers to the spread of

innovations through a community of firms over time whilst adoption refers to the decision (adopt/reject) within a firm to make full use of a new idea as the best course of action (Rogers, 1983, 1995). Rogers (1983, 1995) reviewed several thousand innovation studies and developed a framework that envisions a simple innovation diffusion sequence. The sequence leads from knowledge acquisition to persuasion of interest, followed by the adoption or rejection decision itself, implementation, and finally the confirmation stage of evaluating the actual outcomes compared with expectations. In view of the technological innovation theories, Rogers' (1995) model appeared to be the most widely accepted model by researchers in identifying 'perceived' critical characteristics for innovations in IS research (Kaplan 1999; Karahanna et al. 1999; Moore & Benbasat 1991, 1996). Rogers (1995) identified five significant characteristics of the innovation which influences its adoption:

- Relative advantage: the degree to which an innovation is perceived as being better than its precursor;
- Compatibility: the degree to which an innovation is perceived as being consistent with the existing values, needs and past experiences of potential adopters;
- Complexity: the degree to which an innovation is perceived as being difficult to use;
- Trialability: The degree to which an innovation may be experimented with before adoption.
- Observability: the degree to which the results of an innovation are observable by others.

In their review of adoption literature Premkumar and Roberts (1999), Thong (1999) and Tornatzky and Klein (1982) endorsed Rogers' (1995) innovation characteristics and found the first three factors consistently associated with innovation adoption. Accordingly, this research will examine these three factors but from within the ICT pedagogy literature.

Past studies found that facilitation factors vary according to the innovation type (Swanson, 1994). Thus, extending or adapting contexts and factors developed in earlier IS research on IWBT adoption is not a straightforward process, simply because IWBT introduces features of its own. Thus, it is important to revisit the above factors from within the pedagogical research. Baek et al. (2008) identified the factors influencing teachers' decisions about using technology in the classroom setting and examined the degree to which teaching experience affects these decisions. They discovered six factors which influenced teacher's use of technology in the classroom: adapting to external requests and others' expectations (we call those extrinsic factors), deriving attention (we call it intrinsic factor), using the basic functions of technology, relieving physical fatigue, class preparation and management, and using the enhanced functions of technology. They reported that although the majority of teachers intend to use technology to support teaching and learning, experienced teachers generally decide to use technology involuntarily in response to external forces while teachers with little experience are more likely to use it on their own will. In the same vein, Baek et al. (2008) identified some of the factors hindering the use of technology in the classroom: lack of time, software and hardware problems, keyboarding skills, knowledge of available information technology resources (we call it intrinsic factor), and unavailability of computer labs and computer lab technicians, as well as individual perceptions in finding the information technology frustrating, believing that changes are too fast to keep current, and not thinking information technology will enhance the subject area. These findings lead to a conclusion that leadership is needed to best support teacher's efforts when using technology and that there are many factors which need to consider beyond the physical environment to encourage teachers to use technology.

Enthusiasts to ICT use in teaching reported positive (source for information, visualization, and exercise and assessment) negative (time consuming, incorrect information, and technical problems) implications (Barak, 2007). Opponents, on the other hand, reported negative (preferring traditional teaching, fear of losing personal contact with students, and lack of familiarity) and positive (variety of teaching methods, student-enjoyment, and visualization of abstract concepts) implications. Upon trialing with the new ICT in teaching, the instructors reported the following four main benefits: ICT can promote individual-learning, instructor-to-student interactions, student-to-student interactions, and conceptual understanding.

METHODOLOGY

At the outset, this research is exploratory in nature as, according to our knowledge, there was no prior research to guide this research endeavor looking at IWBT use in teaching. Historically, researchers tended to categories methods hierarchically and argued that case studies were appropriate for the exploratory phase of an investigation only (Yin 1994). Yin's (1994) views are that case studies are the preferred research strategy to answer how and why type questions and using interviews would also be acceptable by the interpretivist school (Walsham 1995). The strength of case studies is their ability to capture a greater number of variables than is possible with any of the other strategies. Further, it is possible through this strategy to follow up areas of interest, which emerge in the course of the research, which have significance to the research propositions. This research adopts Yin's (1994) case study design in studying IWBT use in the case of CIT. Our unit of analysis here were both the teachers and students.

CIT has adopted the IWBT in all its classrooms, conference/meeting room, auditorium and laboratories. The adopted IWBT type depended on the size of the room and the type of application (conference, teaching, assembly). Teachers can write on the white board using different colors (digital ink) and they can even write over applications, websites and videos. Furthermore, it has the ability to convert the hand writing into text and if the users want to use the key board then there is a button located in the pen tray that gives them this option and the key board will be showed on the board and they can use it by touching the keys. The smart board has tools that give the user the ability to draw shapes that support what he is presenting, colure them and move them. In addition to this setup (Figure 2), CIT installed cameras in each class which is linked to the IWBT to record the whole lecture. The cameras has audio detecting feature to move along with the speaker in the classroom.

Figure 2. IWBT setup in CIT

However, before delving into case-study design details, there was a need to generate initial insights around the novel use of IWBT in CIT. Therefore, Focus Group (FG) research method is introduced here to fulfill this purpose. FG is the process of obtaining possible ideas or solutions to a problem from a group of participants by discussing it (Aaker et al., 1998). It is an attractive medium for public participation in the research process requiring no technical skills of the group members and usually not costly to implement (Blackburn & Stokes, 2000; Bloor et al., 2001). Morgan (1997) indicated that FG research is positioned somewhere between participant observation and in-depth interviews. Therefore, FG research plays a major part as an ancillary method, alongside and complementing other methods. In this research, FG is used as a pre-pilot work, to provide a contextual basis for the survey design used in the case study.

In undertaking FG research, this research followed certain basic steps (Blackburn & Stokes, 2000). Firstly, there is problem identification and definition (the research questions have been outlined earlier). Secondly, a sampling frame is identified; a group of six to ten or twelve (Blackburn & Stokes, 2000) or even up to 14 (Bloor et al., 2001) has become customary in FG research. Six teachers accepted to take part in our FG session. The third step involves identifying the moderator (facilitator) for the FG sessions. This role was undertaken by the researcher to facilitate discussions and all attempts were made in order not to intervene in discussions or controlling them. The last step involves generation and pre-testing of the interview guide, where the purpose here is to provide direction for the group discussion. Questions were ordered from the more general to the more specific (elucidate experience with using the IWBT, experienced advantages, disadvantages, and difficulties, students involvement, etc.). The session took place at one of the meeting rooms in CIT. Outcomes of this FG has helped in drafting the survey questions in this research.

Upon completing this phase, there was a need to develop more insights and involve more people from CIT. Here the case study design came to the fore. The researcher contacted teachers in CIT (70 faculty and instructors) and invited them to take part in answering a qualitative survey questionnaire (Appendix 1). Twenty five teachers showed interest and willingness to allocate part of their time to answer the questions. The researcher followed this phase with interviews with the different respondents to reassert their views and complete some of the missing information.

In ensuring issues of internal validity in case study design, that is the accuracy of information and whether it matched reality, a case study investigator needs to develop a sufficiently operational set of measures to collect the data (Yin, 1994). The literature review and developed framework and the FG have helped in this regard. In addition, the use of triangulation helps construct validity as it assesses the quality of the case research and overcome the potential bias. To meet the test of validity, this research conducted a literature review and developed a set of influencing factors. Relying on this literature review further assures the researcher's interpretations (accurate and objective). In analyzing the research data, Yin (1994) highlights that data analysis consists of examining, categorizing, tabulating, or otherwise recombining the evidence to address the initial propositions of a study. Following Yin's (1994) guidelines, the data collected from respondents were compared in order to identify patterns and to establish the chain of evidence. The researcher emailed each respondent a copy of the research report in order to ensure the validity of the research findings.

FINDINGS

Advantages

The reported advantages included larger IWBT display area and the ability to execute different applications at the same time. There are many advantages accruing from IWBT. IWBT is both touchable and interactive and such features assist teachers develop, integrate and deliver content. This could also further optimize the teacher's time and resources. For example, IWBT decreases paper work, integrates well with existing wireless technologies, allow teachers upload material from the Internet and display it to students. IWBT can help students participate in interactive and rich learning processes and cooperate with peers. Students can benefit from the different learning styles provided by IWBT features and software application where students could see, touch and hear the content of the lesson. There are dual boards in the IWBT which allows a teacher to project the presentation on one part and write on the other providing further explanations to the presented slides. The teacher could save these writings and send them to students i.e., emailed PDF files. Teachers could even write directly on presented content (applications, notes, slides, photos, etc.) adding further illustrations and explanations using the IWBT digital pens/markers (4 colors). Usually students are engaged in writing notes in the classroom but after the introduction of the IWBT, students will have more time to focus on the teacher's explanations and to engage in the different discussions. The saved notes of previous lectures could be used to make revisions as well.

However, not all IWBT features were used or explored in CIT. Teachers highlighted that some of the provided features were not applicable in higher education teaching level and may never be used by them. One respondent further commented "other features are not felt that they can contribute to the instructor's pedagogy". In addition, teachers felt that even the useful and rich features in IWBT need to be complemented with more features that pertain to the technical concepts taught within CIT. Adding more scientific features into existing IWBT software tools will further close the gap between the IWBT technology and CIT requirements. For example, Software Engineering teachers reported that having features such as Unified Modeling Language (UML) diagrams and other Object Oriented models will be useful additions to IWBT. Information Systems students requested showing software applications (i.e., ERP, Oracle, businesses web sites) on the IWBT display board where both teachers and students could work interactively on those applications.

Let's not forget that the cost of purchasing and maintaining the WBT is very expensive. For example, the bulb of the projector is expensive and costs around $300.

Complexity

All these advantages must be weighed against the fact that the IWBT tool represents a new technological innovation with multifaceted and overwhelming features and options. Such aspects challenge existing teaching norms and practices in CIT involving both teachers as deliverers and/or facilitators and students as recipients and/or involved in the learning process. Although all CIT's teachers are considered expert technologists, they were not used to deal with such amount of technological solutions in the classroom. For example, the much simpler features of IWBT (i.e., projector for the lesson's slides) seemed to promote its use in CIT. Using the other features in the IWBT which required mastering several techniques and IWBT features seemed quite challenging to teachers. Teachers reported some difficulties in recalling how to re-access the used IWBT feature again in the following class time. This is further aggravated when teachers do not use this feature for some time. Other respondents reported that the impending difficulty here is to understand how to use such feature(s) in teaching ICT courses in the first place. At a more extreme case, respondents reported that there are teachers that wrote on the IWBT whiteboard using traditional markers, which are difficult to erase.

Training sessions were delivered but respondents felt that those sessions were not comprehensive, some were offered in inappropriate times for some teachers. A respondent commented that "a 45 minutes tutorial didn't give teachers a very good

coverage on how to use the system and to overcome the difficulties that will face them while using the IWBT". It was recommended to maintain having these sessions as a good reminder for teachers about IWBT use. Also, these sessions should include instructions on how to deal with technical problems.

Compatibility

Every teacher has his/her own preferred ways of teaching and interacting with students and using the smart board or any of its supporting applications may not be one of those. I know people who still prefer the chalk over an ink marker! (One respondent in this research)

Due to the limited use of all IWBT features, it was not felt that IWBT would require a drastic change at the teaching style as such, but it may cause delays in the classroom once technical problems occur. Issue like one of the dual boards did not function properly, one of the projectors was not working, the smart board was out of focus and the time needed to synchronize it, identifying a clear font to comment on the displayed notes were reported as challenges. At a more extreme case, some teachers indicated using such features in the classroom could be lengthy process and this could be distracting for both students and teachers. This perspective highlighted the importance of providing better integration between IWBT and CIT courses in a nonintrusive way for both teachers and students.

As for making use of the touchable feature in the IWBT board, most responses reported moderate uses. For example, move application from one board to the other, move the keyboard within the same board, navigating between slides, move slide mover to the bottom. Others reported that the out-of-focus IWBT board constrained its use. One respondent commented "I need the pens to work properly. The board does not retain its calibration". Another used an alternate mean to navigate between slides "I usually use my own remote mouse/pointer device"

The majority of respondents made notes on the IWBT board but did not save them for stduents. One respondent commented "I do make notes, give examples, solve questions and ask students to solve questions on the smart board. However, I did not record any of the notes".

Although not all used both boards, respondents felt that this feature was useful. Teachers would show the slides of a lecture on one board and give examples, make notes and write questions on the other board to further explain what is displayed on the slides.

Except for the reported problems with displaying clear fonts and the out-of-focus display, most respondent were pleased with the quality of the display-resolution. Few reported the low display resolution problem which makes the IWBT inappropriate for displaying certain content that requires high resolution.

Respondents reported discomfort with the position of the projectors. Having to stand in front of the class, the projectors' strong lights are casted on the whiteboard which could harm the eyes of the teachers, usually forcing the teacher to stand between the two projectors. Also, this may force the teacher to stand in one corner of the class close to the PC and podium to run the i.e., slides by the PC mouse. This is also applicable in case the touching feature does not work. One responded commented "The light tends to get in your sight when you want to have eye contact with the students. However, it is not too bad". Others commented "I am very worried about my eyes' health". Also, when the teacher stands in front of the projectors and students, the teacher's shadow is casted on the display screen preventing students from seeing the content in the screen.

In the classrooms that face direct sunlight, teachers would close the curtains to avoid light reflections on the boards which affect the visibility of the notes on the board. However, teachers did not feel the need to dim the lights in the classroom as the projectors lights were strong enough to overcome regular lighting systems in the classroom. One teacher commented "diming the lights will just encourage the students to go to sleep"

As for video recording the teaching sessions, none of the respondents felt comfortable with that. Some felt that it was constraining and may violate their privacy and freedom commenting, "felt being watched or monitored".

Teachers felt comfortable in engaging students in IWBT interactive learning where teachers invited students to write her/his answers directly on the board and then discuss it with students using the other board. However, this is done one at a time as the IWBT is single user system. As for granting students the full access to IWBT, some teachers saw no harm on granting students the access to the IWBT provided there is a clear pedagogical justification. For example, granting it to senior students working on the same project and to give them a chance to prepare their presentations. Also, to students working on projects related to the IWBT or its applications. Others limited this permission to the class session only and to be implemented under the teacher's supervision.

Other issues relating to the failure of the IWBT equipments were highlighted by teachers (PC in the classroom, failure of one of the projectors, network failure). One respondent noted, "This is the worst issue related to smart boards…. These boards are not reliable…. I can assure you that I've never gone to a class that is error-free…. to the extent, I would prefer to use regular white boards". More specifically, respondent reported the following technical problems with the IWBT:

The projectors some time "freezes" and cannot be reset.

Touch-board: synchronization problem as reported above and sometimes it does not work properly.

Others: missing pens (taken by other teachers by mistake), the ink-line thickness is also a problem (even the thinnest option is too thick), displaying many software error messages, the desktops are not set up properly (display many software updates, installation, receiving error notifications while teaching).

Teachers cannot handle technical problems which necessitated the presence of technical staff to handle such issues with almost immediate response time. CIT dedicated two technicians to provide support for the IWBT. In assessing the received technical support, teachers reported that it was not sufficient. One respondent commented "the problems happen very frequently that when I report something not functioning, by the time it is fixed another problem appears. It sometimes takes more than a week to fix a projector that is not working". Another respondents noted, "Its glitches are frequent and asking for support during the class means NO CLASS in that day". It was suggested that the smart-board needs continuous maintenance and that the smart board should always be ready and functioning properly before classes start.

As for the compatibility of calling a technician to fix an IWBT technical problems during the class, most respondents highlighted that they avoided this procedure in order not to waste the class time. One respondent commented, "Initially, I used to call then I gave up!". Other teachers attempted to work around this problem during the class and reported after the class. For example, one teacher explained that if IWBT dual boards were not working then he either waits for a technician or search for an alternative classroom with working IWBT. The later rarely happened. It is usually one of the display boards that do not work and he continues his class working using one board only. In that case, he usually minimizes his "Power Point" slides to explain an example or concept and then maximize it back to continue the lecture.

As for security issues, the system was designed in CIT in a way that will require teachers to have a password to activate the PC in the classroom and another password to activate the IWBT projector (small touchable screen-pad on the podium). The reported concern involved teachers logging-in to the podium computer and forgetting to log-off when finishing the class as students could gain access to teacher's privileged information (emails, students' records, exams, and blackboard). Interviewees raised the important of logging off the PC station before leaving the classroom as all files and folders are saved in one place and any one can access them. Powering off the IWBT projector before leaving the class is a recommended practice in CIT as it could preserve the expensive IWBT components. Another concern was the instruction sheets left in the classrooms showing non-IT faculty how to access and use the system which includes the projectors' activation code and login information.

Theoretical contributions and implications

According to this review into TOT and ICT–pedagogical research, Table 1 shows the guiding theoretical framework in this research. This research will discuss the different factors in the framework vis-à-vis the research findings. As observed, most of the factors were distributed alongside two dimensions namely, relative advantage and compatibility. We found three factor relating to complexity namely, the keyboarding skills, lack of familiarity and believing that changes are too fast to keep current.

Advantage	**Incompatibility**

- using the basic functions of technology: a finding in this research - relieving physical fatigue: IWBT helped in presenting slides, making notes, showing Internet educational web pages, etc. - class preparation and management - using the enhanced functions of technology: not in the case of CIT. - source for information - visualization of abstract concepts - exercise and assessment - student enjoyment - variety of teaching methods - promote individual-learning - promote instructor-to-student interactions - promote student-to-student interactions - promote conceptual understanding	- lack of time - individual perceptions in finding the information technology frustrating, - believing that changes are too fast to keep current - Extrinsic: adapting to external requests and others' expectations: the decision was made to adopt the IWBT and teachers were expected to use the IWBT in teaching. - incorrect information - technical problems - preferring traditional teaching, - fear of losing personal contact with students - lack of familiarity
Disadvantages	**Complexity**
- not thinking information technology will enhance the subject area. - unavailability of computer labs and computer lab technicians - software and hardware problems - knowledge of available information technology resources cost	- keyboarding skills, - lack of familiarity and - believing that changes are too fast to keep current

Table 1. The research framework and findings.

In discussing the significance of the different factors in relation to the research findings, the majority of factors were supported in this research especially the different advantages, including:

- individual perceptions in finding the IT frustrating due to the different incompatibilities discussed in this research.
- lack of time: to use different IWBT features during the class; and to call a technician to solve a technical problem.
- knowledge of available information technology resources: lack of knowledge about detailed IWBT features; and exploring alternative or competing smart board technologies
- student enjoyment represented here in using multi teaching tools and engagement in learning in the classroom.
- preferring traditional teaching: there was a strong evidence to support this factor.
- lack of familiarity of the different IWBT features.

The factors that were not supported in this research:

- using the enhanced functions: mainly used the basic functions of IWBT only
- keyboarding skills: not an issue in CIT
- Intrinsic (deriving attention): this is an individual measure and was not tested in this research
- unavailability of computer labs and computer lab technicians: not an issue in CIT as CIT has different labs and computer lab technicians and technical support technicians as well.
- promote individual-learning: the "saving" feature in the IWBT helped students focus on the lesson and avoid taking notes. On the other hand, this factor is limited as students were not given access to IWBT.
- promote student-to-student interactions: this could be achieved if students were granted access to the IWBT
- fear of losing personal contact with students: it was not felt that IWBT will result in losing contact between teachers and students.
- incorrect information: not relating as such to the case of the IWBT technology.
- Cost was not viewed as a deterrents in the case of CIT.

The following factors were not fully supported in this research:

- believing that changes are too fast to keep current: this is a complexity factor related to the witnessed rapid technological changes. This aspect was not represented in our data and analysis. However, it could be related to CIT in the sense that the IWBT technology was introduced fast in CIT as the only teaching tool and the need to master different features and tools.
- not thinking IT will enhance the subject area: due to its limited use, teachers perceived IWBT to moderately enhance teaching in CIT.
- promote instructor-to-student interactions: as students are freed from taking notes, this allows for more interactions between instructor and student. However, most teachers did not save their notes or send them to students.
- class preparation and management: freeing students from taking notes and sowing Internet web pages should enhance both class preparation and management. However, it was perceived that using IWBT different features during the class was time consuming.

This research raises several theoretical contribution and implications. With the exception of the non-supported factors in this research, the remaining factors played important role in IWBT adoption and use amongst teachers in CIT. Future comparative research could further suggest the importance of the different factors in this research and allow for more insights. The three contextual factors extended from TOT proved very useful in indentifying what determines IWBT use and success in CIT. Future research could identify further contexts and factors and examine their impact on IWBT use. As for the factors that were not found amenable in this research, future research could look into these factors more specifically and produce more conclusive evidence about their impact on teaching. For example, to examine the intrinsic factors more closely to identify personal characteristics of teachers and how they influence IWBT use in the classroom.

The general belief amongst teachers in this research suggested that knowledge about IWBT use will enhance over time suggesting the gradual approach in assimilating the IWBT technology in teaching. It is suggested that training programs should be delivered consistently in order to encourage teacher's use of the different IWBT features. Designing more focused teaching scenarios (sample case-studies) could further serve this purpose well. These training programs could be video recoded to enable teachers and students gain access to training resources as when the need arises. Accordingly, training programs should focus on:

- IWBT functionalities and the usage. This should be an ongoing process and implemented gradually by adopting one feature at a time.
- Error management and problem fixing.
- Solving technical problems: calibration, having the two boards working by having a hotline for the support with a max of 5 min response time.

Providing a more proactive approach to address the availability of technical support could encourage further use of the IWBT. Such approaches could involve scheduling routine or daily check-up visits to all classes to make sure that all systems are functioning properly prior to commencing teaching. These visits could be scheduled either at the end or the beginning of the teaching day and maybe involve random check-ups visits during the teaching day.

This research is of importance to researchers, professional, policymakers, and educators. Researchers could make good use of this research to conduct comparative studies or to examine the adoption and integration of IWBT in different settings and countries. Educators could learn about this new technology and ways of putting it into effective use in teaching and hence, avoid many of the reported hurdles. Policymakers could introduce measures governing the adoption and diffusion of such complex technologies in education. It must be understood here that the IWBT is designed and developed generally to suit the needs of large number of potential adopters ranging from primary schools to higher education. Accordingly, it must be understood here that educator's needs and curriculum details of each category differ immensely. Hence, IWBT should be customized to match the specific needs of each category. Professionals could make use of this research to learn about the different insights highlighted in this research which could result into i.e., redesigning IWBT technology, know about education and its unique perspectives, design new and more effective training programs and marketing strategies.

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