
Educational technology in Abu Dhabi public schools: teaching with interactive whiteboards (IWBs)

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Abstract: The main purpose of this study was to evaluate Abu Dhabi public school teachers' perceptions of interactive whiteboards (IWBs) and find out how this technology is used in the classroom setting. This study was conducted at the Teacher Training Institute in Abu Dhabi, UAE during professional development sessions in January 2019. One hundred twenty-three teachers (Grades K-12) from numerous public schools completed structured pre and post-training surveys and were participants of group discussions. The result of the study highlighted a positive attitude and a great deal of satisfaction among most teachers towards IWBs. Preparing lessons, teaching, engaging, and motivating students, as well as assessing with IWBs all appeared to be beneficial for public school teachers. The research stressed the main benefits of IWBs usage and provided suggestions for professional development sessions on IWBs to be more effective for teachers' practice.

Keywords: interactive whiteboards; public school teachers; technology; professional development sessions; assessing with technology.

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1 Introduction

The diffusion of new technology potential into all aspects of education to improve educational outcomes is an on-going process. Moreover, interactive whiteboards (IWB) are rapidly integrated within school settings, replacing black or whiteboards. The main actors of this process are teachers that are responsible for linking the technology integration process to pedagogy. Thus, it is extremely important to understand teachers'

perceptions of the IWBs and provide them with support, training, and collaboration (Samsonova, 2018; 2019). The present research investigates Abu Dhabi public school teachers' perceptions and classroom practices with IWBs. The study traces the experiences of educators working in different grades and teaching different subjects (Math, English, Arabic, Science, Social Studies, and Technology).

1.1 IWBs in the Emirate of Abu Dhabi

Educational technology, such as IWB, tablet PC, and iPad, is increasingly recognised and widely introduced in private and public schools in the United Arab Emirates (UAE). New technologies are being used in growing numbers of schools. In 2010, Abu Dhabi Department of Education and Knowledge (ADEK) announced the launching of the New School Model (NSM) which aimed to improve the education system in the emirate (Abu Dhabi Department of Education and Knowledge ADEK, 2019). The model was based on technology, a resource-rich environment, and a student-centred approach. E-learning was announced as a key approach towards successful teaching and learning that needed to be aligned with the Abu Dhabi Economic Vision 2030, where ICT skills play an essential role as a foundation for more advanced learning. In the NSM, ADEK proposed that educators continuously find new ways of using technology and eLearning in the classroom. IWBs are part of developmentally– appropriate technology and tools that can enhance other educational resources.

Many studies were conducted about the use of IWBs in classrooms and schools worldwide. However, after extensive review, it has been found that there is very little said about using IWBs in UAE. Most studies are focused on a higher education perspective (Al-Qirim, 2016; Ishtaiwa and Shana, 2011). Abu Dhabi schools in general and public schools, in particular, were not widely studied in terms of IWB usage. Since Abu Dhabi public schools are very unique, the results of the current study might be interesting for other public schools in the UAE and probably other Middle Eastern countries.

2 Literature review

The existing research highlighted that digital learning in the classroom promoted positive social norms and learner-centred pedagogy. IWBs provide many advantages for students and teachers. For them, it offers high-level interactivity in the classroom (Alshawareb and Abu Jaber, 2012; Bidaki and Mobasheri, 2013; Emeagwali and Naghdipour, 2013; Tosuntaş et al., 2015). Murcia's (2014) exploratory case study examined the types of interactivity that occur when IWBs are used during the science inquiry process. In this research, two Australian teachers were working with 25 11-year-old students developing and implementing interactive pedagogies and notebooks. The video data and classroom observations allowed the researchers to classify the types of interactivities occurring in the classroom: (a) technical interactivity (when teachers used the IWB tools); (b) physical interactivity (when students manipulated objects on the IWB), and (c) conceptual interactivity (when students and teachers aligned their actions with the given IWB task and engaged in classroom dissociation).

Both teachers used IWB for different purposes. At times, students were passive in the IWB learning experience as they watched videos or listened to the teacher talk. It has been concluded that IWBs support teaching and learning experiences by: (1) engaging

and eliciting learners' prior knowledge through conceptually appealing and visually multimodal interactive displays; (2) generating explanation and exploration opportunities; (3) providing opportunities through higher-level questioning for learners to transfer their knowledge to different and new contexts; (4) creating opportunities for students to generate their concept representations; (5) reviewing learning by flexibly moving throughout interactive learning sequences.

IWBs enhance the social and subject interactions between students and teachers (De Vita et al., 2014; Mata et al., 2016). Hadadi et al. (2014) studied the pedagogical practice of 11 teachers from two different schools. They explored the teachers' pedagogical needs as they integrated IWBs into the curriculum. The research suggested that students' collaboration occurred through complex web interactions between the IWB affordances and that the teachers play the role of mediators and task designers. The authors underlined the IWBs importance in creating an appropriate environment for a shared understanding between students and teachers. To conclude, IWBs facilitate the collective meaning-making process in class work (Hadadi et al.; De Koster et al., 2013; Kerawalla et al., 2013; Maher, 2012; Mellingsaeter and Bungum, 2015).

IWBs and communication and information technologies in general lead to an increase in students' motivation and they encourage their attention (Arpacık et al., 2018; Begolli and Richland, 2015; Fraser and Garofalo, 2015). Ozerbas (2013) studied how IWB usage affected the level of 50 sophomore university students' motivation for four weeks. 25 students in the experimental group used IWBs and 25 students in the control group used only the computer projector. The study results indicated a significant difference between the motivational levels of groups, and this difference was for the experimental group. Comparing the post-test motivation scores of those groups, the researchers observed a mean difference of 18.16. The students' report showed that increasing their grades with IWBs usage was what contributed to the beliefs that IWBs attract students and encourage active participation during lessons.

The IWBs users highlight the positive and negative sides of IWBs usage (Corbo, 2014; Tertemiz et al., 2015; Türel and Johnson, 2012). Mostly, teachers and students are satisfied and have positive attitudes towards IWBs (Aytekin et al., 2012; Bakadam and Asiri, 2012; Şad and Özhan, 2012). The use of IWBs supports teachers by helping them enhance students' concentration, active learning, creativity and engagement (Erbaş et al., 2015; Fessakis et al., 2013; McCrea, 2014; Ozerbas, 2013). Also, IWBs might make a big difference in learners' achievement (Amiri and Sharifi, 2014; De Vita et al., 2018; Katwibun, 2014; Tunaboşlu and Demir, 2017).

Alshawareb and Abu Jaber (2012) found that there were no significant differences between teachers' attitudes according to gender and specialisation, such as the art and science fields. However, educators with more than 15 years of experience hold higher positive attitudes than teachers with five years of experience. Lecturers holding higher degrees such as MA or PhD tend to have more positive thoughts toward IWBs and use them more frequently than educators with lower education levels. Similar findings were determined in Tatli and Kiliç's (2016) research. It has been found that some teachers experienced problems related to a lack of pedagogical knowledge, issues with technical skills, and access to materials required for efficient IWB use (Korkmaz and Cakil, 2013).

IWBs are most beneficial if the teachers know how to use technology (Bourbour et al., 2015; Erbaş et al., 2015; Lopez and Krockover, 2014). Educators require special training to prepare materials needed for IWB usage (Bakadam and Asiri, 2012; Korkmaz and Cakil, 2013). Moreover, insufficient numbers of professional development classes and experts in schools for immediate technical assistance with IWB challenges were

identified as problems (Akkoyunlu and Baskan, 2015; Hennessy and London, 2013). As a solution to this problem, Türel and Johnson (2012) suggested collaboration with colleagues. To conclude, professional development has been found as the most efficient way for IWB technology integration (Hennessy et al., 2015; Peled et al., 2015; Whyte et al., 2014).

3 Research methodology

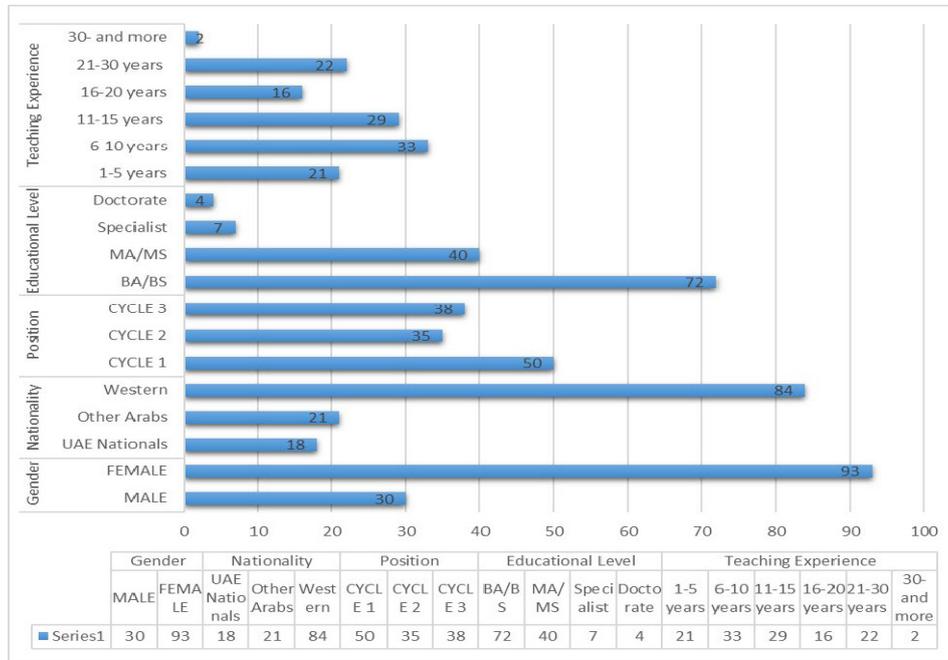
3.1 Overview

The site of the study was a Teacher Training Institute in Abu Dhabi, UAE. The UAE Ministry of Education (MoE) is constantly offering professional development forums for teachers working in government schools. These typically last one week and include several 2-hour Professional Development (PD) sessions on different topics that can be chosen by teachers based on their priorities. One of the teachers' forums occurred in January 2019. The PD session entitled "Education Technology: Teaching with Interactive Whiteboards (IWBs)" was offered during the morning block. At the beginning of the PD, it was announced that PD participants had an opportunity to take part in a study on IWBs.

3.2 Participants

Out of 167 teachers that chose a PD session on IWBs, 123 agreed to be study participants. The contributors were teachers (Grades K-12) from several public schools of the Abu Dhabi Emirate, UAE. Please see Figure 1 below.

Figure 1 Study participant demographics



3.3 Research questions

The study aimed to answer the following questions:

- 1 How can IWBs be used in classrooms?
- 2 How do IWBs affect planning/preparation of lessons?
- 3 How can IWBs be used to ensure that all children are motivated and engaged in learning?
- 4 How can IWBs be used for assessing students' learning?
- 5 To what extent was the PD session on IWB useful for your future professional activities?

3.4 Data collection tools

A combination of qualitative and quantitative approaches were used to collect data needed to answer the research questions. The instruments included questionnaires with closed and open-ended questions that were created based on the research questions, the literary review, and the researcher's experience in the field. They contained the following key sections:

- 1 demographic information;
- 2 views of IWBs as a teaching and learning tool;
- 3 use of IWBs;
- 4 the usefulness of the IWB PD session.

For the purpose of the study, special Google Form Surveys were created and shared through the Nearpod application that included an online survey link. The participants who agreed to be a part of the study provided their emails to schedule post survey member-checking. After completing demographic information, the participants were asked to answer closed and open-ended questions about IWBs. They subsequently participated in the PD session and a discussion about IWBs.

The research assistant recorded the main points of the discussions. Also, the participants were asked to share websites that they use with IWBs on a poster paper. Finally, at the end of the PD, the participants were asked to answer the second part of the survey with the same open-ended questions about IWBs and open-ended questions about the usefulness of the IWB PD session.

3.5 Data analysis

SPSS software was used to analyse the data from the questionnaires and discussions. A weighted average was obtained for questions with a five-point Likert Scale. Moreover, data collected from discussions were analysed, applying the phenomenographic approach that can be used to classify participants' expressions (Levin and Wadmany, 2006).

4 Results and discussion

4.1 Teachers' views of IWBs

Teachers were given the opportunity to express their levels of satisfaction with IWBs. As shown in Table 1, teachers found IWBs to have an impact on student learning, engagement, and motivation, classroom interactions and thought that IWBs are useful in teaching. One of the teachers elaborated on this idea, saying: *"It is a useful resource to promote learning in the classroom. Students can use the technology to interact with the content displayed. Lesson plans can become interactive and engaging for learners to gain 21st Century skills."* Another teacher participant stated: *"I cannot teach without IWB! I must have something to project videos and lesson materials. I use it to conduct interactive lessons through the use of educational software such as simulations and games; I also use it to allow students to actively engage with content through the use of PowerPoint presentations they can interact with."*

Table 1 Teachers' level of satisfaction with IWBs $n = 123$

<i>Interactive whiteboards (IWBs)</i>	<i>Weighted mean</i>
IWBs impact on student learning	4.58
IWBs impact on classroom interactions	4.36
IWBs impact on student engagement and motivation	4.51
IWBs usefulness in teaching	4.39

These outcomes are similar to views expressed in other studies where it is articulated that teachers perceived IWBs as a user-friendly tool that makes significant contributions to teaching practices (Bakadam and Asiri, 2012; Davis, 2018; Mata et al., 2016; Tosuntaş et al., 2015). Hence, the use of the IWBs provided for whole-class learning with the students' interactions where the teacher played the facilitator's role (Berson et al., 2014; Maher, 2012). Moreover, IWBs serve as instructional enrichments that facilitate active learning engagement in a learner-centred environment (Fessakis et al., 2013; McCrea, 2014; Mariz et al., 2017; Samsonova, 2018, 2019; Yang and Teng, 2014). Comparing traditional and innovative schools, De Koster et al. (2013) provided examples of the IWBs being used to support whole-class teaching with active students' role in controlling the classroom dialog as well as the IWBs content. Katwibun (2014) concluded that it is essential for teachers to integrate the IWBs with pedagogy and learning theory that caters to students' individual needs in order to guide the learners' academic achievement.

4.2 Teachers' use of IWBs

Table 2 shows the themes that emerged from the pre and post-training surveys and discussions based on the first research question. There are slight differences in the themes that occurred before and after the PD sessions. The analysis of the table will follow below.

Table 2 Emergent themes before and after PD sessions (part I)

<i>Research question</i>	<i>Emergent themes before PD</i>	<i>Emergent themes after PD</i>
Q 1: How can IWBs be used in classrooms?	1 Use it every day	1 Use it every day
	2 Use as a projector for :	2 Use as a projector for:
	• Videos (BrainPOP and YouTube)	• Videos (YouTube)
	• Textbooks	• PowerPoints
	• Pictures	• Notebook lessons
	• PowerPoints	• Games
	• Prezi	• Pre and post assessments
	• LMS	• Pictures
	• Games	• Rubrics
	• Animations	• Rewards
	• Weather charts	• Motivation charts
	• Examples of work	
	• Lesson objectives	
	• Worksheets	
• Real world examples		
• Assessments		
• Attendance		
3 Use for differentiation and scaffolding	3 Use for differentiation and scaffolding	
4 Write or draw on it:	4 Write or draw on it:	
• Lesson objectives	• Starter Activity	
• Dates	• Big Idea	
• Questions		
• Group interactions		
5 Use for classroom management:	5 Use it for classroom management	
• Class Dojo	• Edmodo	
6 Allow students to present their own lessons	6 Allow students to present their own lessons	
7 Use for collaborating work in groups	7 Use for collaborating work in groups	
8 Use Interactive Pen	8 Allow learners to be active participants	
9 For shared work		
10 Save work on screen	9 Use it to get students more engaged	
11 IWBs are not interactive	10 Make classroom more student-centred	
12 IT support	11 Will use shared websites and resources	
13 NO support		
14 Do not have IWBs		

4.2.1 IWBs applications in classrooms

In the pre-training surveys and discussions, most teachers stated that they use IWBs every day. In general, the educators identified the following as the most common ways to use interactive whiteboards in their classrooms: (a) as a projector; (b) as a typical classroom board; (c) for students' presentations; (d) for differentiation; (e) for classroom management; and (f) for whole and small group interactions. *"It is a visual tool, to help explaining concepts via pictures/videos that the students have limited or no knowledge of"* – one of the teachers elaborated. Another teacher mentioned: *"I use it to conduct interactive lessons through the use of educational software such as simulations and games; I also use it to allow students to actively engage with content through the use of PowerPoint presentations they can interact with."* IWBs support in converting the classroom into a student-centred setting, as one educator explained: *"With teacher support, my students create their own simple presentations."*

As one of the participants explained, differentiation activities based on students' needs can be supported by IWBs as well: *"With the use of the IWBs, it helps with differentiation and the varied learning activities within the curriculum. The sound and hands-on interactions are beneficial for the students. Teacher-lead lessons present role-modelling assignments, which lead to individual knowledge."* In addition, the DoJo website was mentioned by multiple participants as a most useful behaviour management system; some participants stated that it is a school requirement to use DoJo for behaviour and teacher-parent communications.

Previous studies also mentioned that many instructors do not use the full potential of IWBs. Bakadam and Asiri (2012) declared that most teachers use IWBs for Internet research and as overhead projectors, avoiding many other advantageous IWB features because of limited IWB technology knowledge. Supporting this fact, studies by Bidaki and Mobasheri's (2013) and Šumak et al. (2017) stated that there are connections between being a good ICT user and using IWB regularly in the classroom. Korkmaz and Cakil (2013) stated that in order to overcome this problem, teachers required special IWB training and preparation of materials needed for the IWB usage; for example, videos, presentations, and visuals related to the state curriculum. These conclusions were supported in a study by Rosetti (2012), where IWBs were used more often when offered with ready-made lessons. Consequently, the researcher suggested the development of resources such as ready-made lessons and websites where teachers could download and post lessons to support the integration of IWBs into classrooms. Other similar findings were: 1) using IWB for differentiated learning since a number of learning styles can be addressed incorporating IWBs (Cabus et al., 2017; Samsonova, 2018, 2019); 2) incorporating classroom management software in teaching (Samsonova, 2018); and 3) using IWBs for whole and small group interactions (Mellingsaeter and Bungum, 2015; Yang and Teng, 2014). Bidaki and Mobasheri (2013) and Arpacik et al. (2018) also pointed out that IWBs might help to minimise teacher-talking time, improving some student skills: namely (a) discussion and (b) teamwork.

A surprising finding was that many participants mentioned that their students create their own PowerPoints and present them on IWBs, converting the classroom into a student-centred space. Similar conclusions were made in Samsonova's (2018) research study. Studying the elementary teachers' uses and perceptions about IWBs, the author found that meeting 21st century expectations; educators try to become advocates of new educational techniques and incorporate more and more student-centred teaching strategies with IWBs.

4.2.2 School support

After answering the pre-training survey questions and participating in a discussion about IWB usage, some of the participants mentioned that they do not have IWBs in their classrooms or that their IWBs are not interactive. Also, there were two opposite opinions about school and administrative support. Some teachers stated that they have support. For example, one participant stated: *“IT teachers assist when needed. I can usually resolve technical difficulties myself. Otherwise must create a ticket for a technician to come out and it takes several days.”* However, there were thoughts about some difficulties to obtain support in school. For instance, one teacher said: *“If I have technical difficulties, no one helps me, and I have to continue the lesson without using the smartboard. It’s hard sometimes because it does not always work consistently. When the board isn’t working, we must submit a help ticket, and someone will come in 1–2 weeks”*. Another participant explained: *“No IT department within schools to fix technical issues within the school.”*

Supporting these findings, current research states that most educators insist on the need to have training seminars, troubleshooting guides, or whiteboard tutorials to help them get the most out of IWB technology (Akkoyunlu and Baskan, 2015; Bakadam and Asiri, 2012; Bidaki and Mobasher, 2013; Samsonova, 2018, 2019; Tosuntaş et al., 2015). Korkmaz and Cakil (2013) stated that educational technologists that supervise and support teachers’ proficiency at all levels of IWB usage are needed. Tertemiz et al. (2015) stated in a similar study that institutional support is needed and mentioned the importance of immediate technical assistance.

4.2.3 IWBs: Planning and lesson preparation

Table 3 displays the themes that emerged from the pre and post-training surveys and discussions based on the second research question. It can be concluded from the pre-training surveys that IWBs support teachers with lesson preparation. They are easy to use, and they save time as is reported in Table 3. These findings were supported by survey data. For instance, a participant mentioned: *“IWBs form a major part of my teaching strategies and structuring my lessons. It is easy to use. All the documents, lessons, videos are in one place. Easy to access and use.”* Similar findings were reported in Samsonova’s (2018, 2019) study, where she found that teachers see IWBs as a tool that “enhances their lesson preparation and it is easy to use for lesson planning.” Besides, the participants cited that

“IWBs motivate them to develop and incorporate more digital resources in their lessons” (p.24). However, some participants mentioned that IWBs do not affect their planning.

4.2.4 Engaging and motivating students with IWBs

The use of IWBs supports teachers by helping to enhance the students’ motivation, participation, and concentration levels as well as increasing the frequency of interactions among students and teachers, and between the students within the classroom (Yang and Teng, 2014). For example, Erbas et al. (2015) explored the effects of using the NuCalc graphing software and IWBs compared to the traditional direct instruction-based environments on learners’ achievements and attitudes toward technology and mathematics. 65 high school graduates participated in this study.

Erbas et al. (2015) found that students were themselves motivated to learn materials and engaged with learning tasks when IWBs were used. They indicated that students were more attentive in class when the IWBs were used. Moreover, interviewing primary students, Tertemiz et al. (2015) found that IWBs increased students' learning motivation by attracting their attention; students perceived IWBs as exciting, and the IWB's usage between or during classes increased the students' motivation to learn. In a similar studies, Şad and Özhan (2012) and Arpacık et al. (2018) reported what students liked the most about IWBs: (a) visual presentation; (b) test-based; (c) time saving; (d) hygiene; (e) multi- media; and (f) better learning. Furthermore, interactivity was named the most significant property of the IWB.

Table 3 Emergent themes before and after PD sessions (part II)

<i>Research question</i>	<i>Emergent themes before PD</i>	<i>Emergent themes after PD</i>
Q 2: How do IWBs affect planning/ preparation of lessons?	1 It helps with lesson planning 2 Saves time 3 Use it for scaffolding and differentiation 4 Does not affect	1 It helps with lesson planning 2 Resources can be shared and reused 3 Need to build up a shared teacher bank 4 Plan for assessments 5 Add fun ways to teach 6 Plan more student- focused lessons 7 Plan small group competitions

Table 4 Emergent themes before and after PD sessions (part III)

<i>Research question</i>	<i>Emergent themes before PD</i>	<i>Emergent themes after PD</i>
Q 3: How can IWBs be used to ensure all children are motivated and engaged in learning?	1 Display: <ul style="list-style-type: none"> • Pictures • Videos (YouTube) • Movies • Highlighting and writing in different colours • Effects 2 Create interactive lessons 3 Use learning games 4 Use differentiated tasks 5 Use competitions 6 Use interesting information 7 Give and display rewards 8 Use behaviour management system 9 Conduct student-led lessons 10 Allow each student to use the board during the lesson	1 Display: <ul style="list-style-type: none"> • Pictures • Videos • Assessments and scores immediately • Rewards 2 Create interactive lessons 3 Use learning games 4 Use differentiated tasks 5 Use competitions 6 Use interesting 7 Give and display rewards 8 Use behaviour management system 9 Conduct students led lessons 10 Make material engaging 11 Add group work and collaboration

A complete description of approaches on students' engagement and motivation with IWBs based on the third research question is reported in Table 4 and included:

- 1 Display motivating and engaging activities on the board. A teacher cited: *"It's an easy way to display classroom activities while allowing students to be actively involved in the lesson."* Also, another participant said: *"I ensure all children participate in activities whether it to be watching a video or answering questions based on what they are learning in the textbooks."*
- 2 Make lessons interactive. A participant said: *"I don't think any school can exist today without integrating technology. It makes teaching more effective, realistic, and easy for students to understand. Students interact with the curriculum content. I can address the needs of visual learners and auditory learners."*
- 3 Use learning games, differentiated tasks, competitions and rewards, and other interesting information. One of the teachers cited: *To ensure all children are motivated, I try to use the IWB for a variety of things throughout my lessons. For example, I may begin the lesson with the textbook projected, then a video, and then end the lesson with a game."* Another teacher added: *"Students enjoy coming up to the board to select their questions in Jeopardy. They play interactive games to reinforce skills. There are videos and pictures in PPT to keep students engaged."*
- 4 Use a behaviour management system. A participant mentioned: *"I use Dojo to interact with parents, display videos and presentations."*
- 5 Make the classroom more student-centred using IWBs. A teacher-participant quoted: *"Children are fascinated and attracted by technology. They like the use of IWBs. During instructions, they have been asked to come over and handle accessories that come along with IWBs."*

4.2.5 Assessments with IWBs

Table 5 specifies the themes that occurred from the pre and post-training surveys and discussions based on the fourth research question. In the pre-training surveys and discussions, the teachers showed their interest in incorporating the use of IWBs into assessment practice in several ways. In general, they believe that IWB's affordances offer a proper channel to assess learners efficiently and smoothly. One participant said: *"I pause the display and ask learners questions. I can call on learners to come to the front of the class, ask them questions, and allow them to talk."* Another added: *"I can create an assessment and project it on the IWBs. I also use it for informal assessments like games."*

Several websites that can be used for the assessments on IWBs were shared during PDs. For example, a teacher indicated: *"I use it with Plickers for an online assessment tool that provides immediate feedback on created assessments or surveys."* And another shared: *"I design actively engaging assessment activities using websites like Socrative .com and Google forms in which I allocate certain questions to certain students to answer."* However, even though many surveys indicated the use of various techniques to assess with IWBs, some of the study participants mentioned that they have no time to assess or do not use this option at all.

Similar findings were reported in Samsonova's (2018; 2019) research study. The author found that public school teachers used informal, formal, and summative assessments with IWBs. Participants in her study stated that "IWBs encourage intervention and questioning at a range of levels, as well as closed, open, and interest questions, besides with evaluative responses and probing questions" (p.26).

Table 5 Emergent themes before and after PD sessions (part IV)

<i>Research question</i>	<i>Emergent themes before PD</i>	<i>Emergent themes after PD</i>
Q 4: How can IWBs be used for assessing students' learning?	1 Use as a projector for : <ul style="list-style-type: none"> • Questions • Assessments • Exit tickets • Short quizzes • Tests • Follow up questions • Multiple choice questions • Surveys • Matching • Websites 2 Use for group work 3 Use testing knowledge games 4 Use for peer-correction 5 Use for self-assessment 6 Use for a whole class 7 Do not use this option 8 Do not have time to assess	1 Use as a projector for : <ul style="list-style-type: none"> • Questions • Assessments • Exit tickets • Short quizzes • Tests • Follow up questions • Multiple choice questions • Surveys • Websites • Graphic organisers • Exit Cards • Hand signals • Talk to your neighbour • Exit questions 2 Use for group work

4.3 PD on IWBs: key benefits

The final research question was about the usefulness of PD sessions on IWBs. Post-training survey results indicate teachers' perceptions of the various benefits resulting from a professional development session on IWBs. The results are detailed below:

- 1 The PD caused participants to reflect on the ways of using IWBs and offered new methods.
- 2 The PD offered a review of grade and age-appropriate interactive strategies using IWBs and interactive tools.

- 3 The PD and the discussion presented new ways to evaluate and plan with IWBs (see *Emergent Themes after PD* Tables 3 and 5). One of the teachers stated: *“I will give students assessment activities that are meant to check their understanding. I will design learning activities that allow students to learn concepts actively as they click and move items on the board to mimic science phenomena like an atom.”*
- 4 The PD kept everyone engaged.
- 5 During the PD session, participants had an opportunity to collaborate with fellow teachers.
- 6 The PD and the discussion have helped to realise how to make everyday lessons more efficient.
- 7 The PD inspired teachers to incorporate more IWBs activities through lessons (see *Emergent Themes after PD* Tables 2, 3, 4, and 5).
- 8 All great websites and ideas shared would be implemented in future classroom practice (see Table 6). As was mentioned by one of the teachers: *“I will use the websites presented to me with IWBs. I used it more for a data projector. Now I can use it for much more.”*

Generally, the results from the open-ended questions on the benefits and usefulness of PD on IWBs raised awareness about the multiple education technology tools available for the usage in their classrooms and the importance of collaborating with colleagues. Türel and Johnson’s study (2012) disclosed that teachers believed IWBs facilitate instruction and learning under the following conditions:

- Collaboration with colleagues (IWB skills improved as teachers used the IWBs more often, and mainly they learned from their colleagues);
- Teacher’s daily use of IWB to advance IWB competency; and
- Training in practical instructional approaches using IWBs.

Maximising the IWB potential requires supporting teachers in obtaining a considerable amount of consistent experience, which would be needed to apply their pedagogical and technical professional learning. Yang and Teng (2014) stated that the versatile and abundant teaching and learning resources provided to teachers integrating IWBs led to changes in their pedagogy. The use of the IWB assisted teachers in making their lessons not only more vivid, lively, exciting, and fun but also more comprehensible to students (De Koster et al., 2013; Yang and Teng, 2014).

However, current research on IWB usage in higher education does not support these findings. Benoit’s (2018) mixed-methods case-study of IWBs usage in a Canadian college found that, despite having plenty of professional development opportunities, most instructors underutilised IWBs. More than 70% of participating instructors stated that they used the software in less than 25% of the lesson time. Only a few college programs demonstrated greater IWB utilisation, which may not be enough to establish the importance of IWBs in a disciplinary context.

Table 6 Shared websites

<i>Creating lessons with technology</i>	<i>Teaching with technology</i>	<i>Assessing with technology</i>
NEARPOD https://nearpod.com	TOPMARKS https://www.topmarks.co.uk/	EDMODO https://www.edmodo.com/
TES https://www.tes.com/tes-sons	ABCYA http://www.abcya.com/	VOCAROO https://vocaroo.com/
PROMETHEAN WORLD https://www.prometheanworld.com/	WEEBLY http://interactivesite.weebly.com/	TEACHER AIDE PRO http://www.teacheraidepro.com/
PREZI https://prezi.com/	STARFALL https://www.starfall.com/h/	PLICKERS https://www.plickers.com/
	ARCADEMICS https://www.arcademics.co.m/	CLASSMARKER https://www.classmarker.co.m/
	MATH PLAY http://www.math-play.com	ZIPGRADE https://www.zipgrade.com/
	SHEPPARD SOFTWARE http://www.sheppardsoftware.com/	KAHOOT https://kahoot.com/b/
	KHAN ACADEMY https://www.khanacademy.org/	ALEKS https://www.aleks.com/
	TINY TAP https://www.tinytap.it/	SOCRATIVE https://socrative.com/
	TURTLE DIARY https://www.turtlediary.co.m/	SCHOOLGY https://www.schoolgy.com/
	BRAINPOP https://www.brainpop.com/	QUIZZZ https://quizzz.com/
	TEACH YOUR MONSTER TO READ https://www.teachyourmonstertoread.com/	QUIZLET https://quizlet.com/

4.4 Suggestions to improve PDs on IWBs

The overall feedback from teachers was positive. Nevertheless, the study participants suggested the following improvements:

- 1 PDs should allow teachers to interact with technology during the session.
- 2 Extra handouts providing PD information would be helpful.
- 3 Extra technology tools are needed for teachers to try out/explore suggested websites.
- 4 Usage of grade/subject specific examples would be more useful.
- 5 The PowerPoint containing PD information should be sent to teachers.
- 6 It is necessary to set up an online Teacher Community (Facebook or Twitter, or create a website) to continue sharing ideas.
- 7 Additional PDs on how to use certain applications are needed.

5 Conclusion

The main focus of this research study was to evaluate Abu Dhabi public school teachers' perceptions and usage of IWBs as well as the usefulness of PD sessions on IWBs. The findings highlighted mostly positive associations with IWBs, offered lots of significant approaches for using IWBs in teaching and learning, and pointed to some key benefits and suggestions on how to make PD sessions on IWBs more meaningful and effective for teacher practice. Future studies using experimental design are needed based on PD suggestions offered in this study by the teacher – participants. Likewise, Hennessy (2017) conducted a literature review on teachers' experience and strategies with IWBs and concluded that there is no systematic analysis of the effectiveness of professional development sessions in terms of supporting IWB integration.

References

- ADEK (2019) *ADEK new school model*. Available online at: <https://www.adek.abudhabi.ae/en/Students/PS/Pages/New-School-Model.aspx> (accessed on 10 May 2019).
- Akkoyunlu, B. and Baskan, G. (2015) 'School principals' opinions on the FATİH project in Turkey', *Procedia-Social and Behavioral Sciences*, Vol. 174, pp.1497–1502.
- Al-Qirim, N. (2016) 'Smartboard technology success in tertiary institutions: the case of the UAE University', *Education and Information Technologies*, Vol. 21, No. 2, pp.265–281.
- Alshawareb, A. and Abu Jaber, M. (2012) 'Teacher's attitudes towards using interactive whiteboards in the teaching and learning the process in Jordan', *International Journal of Instructional Media*, Vol. 39, pp.319–330. Available online at: <http://go.galegroup.com.ezproxy.gvsu.edu>
- Amiri, R. and Sharifi, M. (2014) 'The influence of using interactive whiteboards on the writings of EFL students regarding adverbs', *Procedia-Social and Behavioral Sciences*, Vol. 98, pp.242–250.
- Arpacık, Ö, Kurşun, E. and Göktaş, Y. (2018) 'Using interactive whiteboards as an assistive technology for students with intellectual disability', *Journal of Education and Future-Eğitim Ve Gelecek Dergisi*, No. 14, pp.1–14.

- Aytekin, A., Fahad AbdulAziz, H. Hisham Barakat, A.S. and Abdelrahman, M. (2012) 'Saudi secondary school teachers' attitudes' towards using an interactive whiteboard in Turkish classrooms', *Online Journal of Educational Technology*, Vol. 11, No. 3, pp.286–296. Available online at: <http://eric.ed.gov/?id=EJ989220>
- Bakadam, E. and Asiri, M.J.S. (2012) 'Teachers' perceptions regarding the benefits of using the interactive whiteboard (IWB): the case of a Saudi intermediate school', *Procedia – Social and Behavioral Sciences*, Vol. 64, pp.179–185.
- Begolli, K.N. and Richland, L.E. (2015) 'Teaching mathematics by comparison: analogue visibility as a double-edged sword', *Journal of Educational Psychology*, Vol. 108, No. 2, pp.194–213.
- Benoit, A. (2018) 'Investigating the impact of interactive whiteboards in higher education: a case study', *Journal of Learning Spaces*, Vol. 7, No. 1. Available online at: <http://libjournal.uncg.edu/jls/article/view/1631/1230>
- Berson, I., Cross, M., Ward, J. and Berson, M. (2014) 'People, places, and pandas: engaging preschoolers with interactive whiteboards', *Social Studies and the Young Learner*, Vol. 26, No. 4, pp.18–22. Available online at: <http://www.socialstudies.org/system/files/publications/yl/2604/260418.pdf>
- Bidaki, M.Z. and Mobasheri, N. (2013) 'Teachers' views on the effects of the interactive white board (IWB) on teaching', *Procedia – Social and Behavioral Sciences*, Vol. 83, pp.140–144.
- Bourbour, M., Vigmo, S. and Samuelsson, I.P. (2015) 'Integration of interactive whiteboard in Swedish preschool practices', *Early Child Development and Care*, Vol. 185, No. 1, pp.100–120.
- Cabus, S.J., Haelermans, C. and Franken, S. (2017) 'SMART in Mathematics? Exploring the effects of in class level differentiation using SMART board on math proficiency', *British Journal of Educational Technology*, Vol. 48, No. 1, pp.145–161.
- Corbo, D.C. (2014) *Qualitative Study of Student and Teacher Perceptions Utilizing Interactive Whiteboards in Middle School Classrooms*, Northcentral University.
- Davis, J.W. (2018) 'The educational contribution of interactive whiteboards', *International Journal of Conceptual Structures and Smart Applications (IJCSSA)*, Vol. 6, No. 1, pp.63–76.
- De Koster, S., Volman, M. and Kuiper, E. (2013) 'Interactivity with the interactive whiteboard in traditional and innovative primary schools: an exploratory study', *Australasian Journal of Educational Technology*, Vol. 29, No. 4, pp.480–495.
- De Vita, M., Verschaffel, L. and Elen, J. (2014) 'Interactive whiteboards in mathematics teaching: a literature review', *Education Research International*, pp.1–16.
- De Vita, M., Verschaffel, L. and Elen, J. (2018) 'Towards a better understanding of the potential of interactive whiteboards in stimulating mathematics learning', *Learning Environments Research*, Vol. 21, No. 1, pp.81–107.
- Emeagwali, O.L. and Naghdipour, B. (2013) 'Exploring the usage and user-perception of interactive white boards in higher education in north Cyprus', *Procedia-Social and Behavioral Sciences*, Vol. 83, pp.272–276.
- Erbas, A.K., Ince, M. and Kaya, S. (2015) 'Learning mathematics with interactive whiteboards and computer-based graphing utility', *Journal of Educational Technology and Society*, Vol. 18, No. 2, pp.299–312. Available online at: http://www.ifets.info/journals/18_2/22.pdf
- Fessakis, G., Gouli, E. and Mavroudi, E. (2013) 'Problem solving by 5–6 years old kindergarten children in a computer programming environment: a case study', *Computers and Education*, Vol. 63, pp. 87–97.
- Fraser, V. and Garofalo, J. (2015) 'Novice mathematics teachers' use of technology to enhance student engagement, questioning, generalization, and conceptual understanding', *Journal of Technology and Teacher Education*, Vol. 23, No. 1, pp.29–51. Available online at: <http://www.editlib.org/p/114712/>
- Hadadi, A., Abbasi, H. and Goodarzi, A. (2014) 'Developing competencies for using the interactive whiteboard to implement communicative language teaching in the English (foreign language) classroom', *Procedia-Social and Behavioral Sciences*, Vol. 98, pp.618–620.

- Hennessy, S. (2017) 'International experiences with integrating interactive whiteboards: policy, practice, pedagogy and professional development', *Life in Schools and Classrooms*, Springer, pp.633–650.
- Hennessy, S. and London, L. (2013) 'Learning from international experiences with interactive whiteboards: the role of professional development in integrating the technology', *OECD Education Working Papers*, No. 89, pp.1–33.
- Hennessy, S., Haßler, B. and Hofmann, R. (2015) 'Challenges and opportunities for teacher professional development in the interactive use of technology in African schools', *Technology, Pedagogy, and Education*, pp.1–28.
- Ishtaiwa, F.F. and Shana, Z. (2011) 'The use of interactive whiteboard by pre-service teachers to enhance Arabic language teaching and learning', *Learning and Teaching in Higher Education: Gulf Perspectives*, Vol. 8, No. 2.
- Katwibun, H. (2014) 'Using an interactive whiteboard in vocabulary teaching', *Procedia-Social and Behavioral Sciences*, Vol. 116, pp.674–678.
- Kerawalla, L., Petrou, M. and Scanlon, E. (2013) 'Talk factory: supporting "exploratory talk" around an interactive whiteboard in primary school science plenaries', *Technology, Pedagogy, and Education*, Vol. 22, No. 1, pp.89–102.
- Korkmaz, O. and Cakil, I. (2013) 'Teachers' difficulties about using smart boards', *Procedia – Social and Behavioral Sciences*, Vol. 83, 595–599.
- Levin, T. and Wadmany, R. (2006) 'Teachers' beliefs and practices in technology-based classrooms: a developmental view', *Journal of Research on Technology in Education*, Vol. 39, No. 2, pp.157–181.
- Lopez, O. and Krockover, C. (2014) 'Contextual factors relevant to elementary teachers using interactive whiteboards in mathematics classroom discourse', *Journal of Interactive Learning Research*, Vol. 25, No. 3, pp.405–426. Available online at: <http://www.editlib.org/p/41970/>
- Maher, D. (2012) 'Teaching literacy in primary schools using an interactive whole-class technology: facilitating student-to-student whole-class dialogic interactions', *Technology, Pedagogy, and Education*, Vol. 21, No. 1, pp.137–152.
- Mariz, C., Carter, M. and Stephenson, J. (2017) 'Do screen presentations via interactive whiteboards increase engagement in whole-group lessons for students with autism spectrum disorder? A pilot study', *Journal of Special Education Technology*, Vol. 32, No. 3, pp.160–172.
- Mata, L., Lazar, G. and Lazar, I. (2016) 'Interactive whiteboards for teaching and learning science: ascertaining research', *Online Submission*, Vol. 20, No. 2, pp.135–148. Available online at: <https://search-proquest-com.ezproxy.hct.ac.ae/docview/2092492274?accountid=1215>
- McCrea, B. (2014) '8 great tools for classroom presentations: teachers are pairing hardware and software to create lessons that engage students and inspire collaboration', *THE Journal (Technological Horizons in Education)*, Vol. 41, No. 6, pp.1–20. Available online at: <https://www.questia.com/library/journal/1G1-381286421/8-great-tools-for-classroom-presentations-teachers>
- Mellingsaeter, M.S. and Bungum, B. (2015) 'Students' use of the interactive whiteboard during physics group work', *European Journal of Engineering Education*, Vol. 40, No. 2, pp.115–127.
- Murcia, K. (2014) 'Interactive and multimodal pedagogy: a case study of how teachers and students use interactive whiteboard technology in primary science', *Australian Journal of Education*, Vol. 58, No. 1, pp.74–88.
- Ozerbas, M.A. (2013) 'The effect of the use of interactive whiteboard on students' motivation', *Educational Research and Reviews*, Vol. 8, No. 7, pp.338–344.
- Peled, Y., Medvin, M. and Domanski, L. (2015) 'Integrating IWB use in Western PA K-12 schools districts: the professional development connection', *Journal of Interactive Learning Research*, Vol. 26, No. 3, pp.289–305. Available online at: <http://www.editlib.org/p/42001/>

- Rosetti, J. (2012) *Analyzing the perceptions and use of interactive whiteboards by prekindergarten teachers in the presentation of classroom lessons*, Doctoral dissertation, Walden University. Available online at: <http://www.editlib.org/p/116738>
- Şad, S.N. and Özhan, U. (2012) 'Honeymoon with IWBs: a qualitative insight in primary students' views on instruction with an interactive whiteboard', *Computers and Education*, Vol. 59, No. 4, pp.1184–1191.
- Samsonova, O. (2018) 'Elementary teachers' uses and perceptions of interactive whiteboards for instruction', *International Journal of Learning, Teaching, and Educational Research*, Vol. 17, No. 8, pp.17–35.
- Samsonova, O. (2019) 'Exploring elementary teachers' practices with response to IWBs'. *PUPIL: International Journal of Teaching, Education and Learning*, Vol. 3, No. 1, pp.130–145.
- Šumak, B., Pušnik, M., Heričko, M. and Šorgo, A. (2017) 'Differences between prospective, existing, and former users of interactive whiteboards on external factors affecting their adoption, usage and abandonment', *Computers in Human Behavior*, Vol. 72, pp.733–756.
- Tatli, C. and Kiliç, E. (2016) 'Interactive whiteboards: do teachers really use them interactively?' *Interactive Learning Environments*, Vol. 24, No. 7, pp.1439–1455.
- Tertemiz, N. (Isik), Sahin, D., Can, B. and Duzgun, S. (2015) 'Views of primary school teachers and students about the interactive whiteboard', *Procedia –Social and Behavioral Sciences*, Vol. 186, pp.1289–1297.
- Tosuntaş, Ş.B., Karadağ, E. and Orhan, S. (2015) 'The factors affecting acceptance and use of interactive whiteboard within the scope of FATİH project: a structural equation model based on the Unified Theory of acceptance and use of technology', *Computers and Education*, Vol. 81, pp.169–178.
- Tunaboğlu, C. and Demir, E. (2017) 'The effect of teaching supported by an interactive whiteboard on students' mathematical achievements in lower secondary education', *Journal of Education and Learning*, Vol. 6, No. 1, pp.81–94. Available online at: <https://eric.ed.gov/?id=EJ1120218>
- Türel, Y.K. and Johnson, T.E. (2012) 'Teachers' belief and use of interactive whiteboards for teaching and learning', *Educational Technology and Society*, Vol. 15, No. 1, pp.381–394. Available online at: http://www.jstor.org/stable/jeductechsoci.15.1.381?seq=1#page_scan_tab_contents
- Whyte, S., Schmid, E.C., van Hazebrouck Thompson, S. and Oberhofer, M. (2014) 'Open educational resources for CALL teacher education: the I TILT interactive whiteboard project', *Computer Assisted Language Learning*, Vol. 27, No. 2, pp.122–148.
- Yang, J.Y. and Teng, Y.W. (2014) 'Perceptions of elementary school teachers and students using interactive whiteboards in English teaching and learning', *Journal of Interactive Learning Research*, Vol. 25, No. 1, pp.125–154. Available online at: <http://www.editlib.org/p/36106/>