HIGH SCHOOL SCIENCE TEACHERS' BELIEFS AND ATTITUDES TOWARDS THE USE OF INTERACTIVE WHITEBOARDS IN EDUCATION

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by

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To my family

BILKENT UNIVERSITY
GRADUATE SCHOOL OF EDUCATION

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Ceren Anatürk

June 2014

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

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ABSTRACT

HIGH SCHOOL SCIENCE TEACHERS' BELIEFS AND ATTITUDES TOWARDS THE USE OF INTERACTIVE WHITEBOARDS IN EDUCATION

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M.A., Program of Curriculum and Instruction
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June 2014

In recent years, the field of educational technology has rapidly developed and facilitated the integration of new generation technological tools into education. Interactive white boards (IWBs) are one of the popular technological tools which can be named as a product of this progression. In Turkey, with the scope of the FATİH (Movement of Enhancing Opportunities and Improving Technology) Project, the Ministry of National Education (MoNE) also distributed IWBs with internet connection for selected 17 pilot cities all around Turkey. This study explored high school science teachers' beliefs and attitudes towards the use of IWBs by considering six different FATİH Project pilot high schools in Ankara. Science teachers (biology, physics and chemistry) from six of the high schools were selected and 36 teachers participated to the questionnaire out of 46. Of these, three teachers from each school were chosen by considering their questionnaire results with purposeful sampling method. The study utilized mixed-methods approaches so quantitative data (questionnaire) were complemented by qualitative data (interviews and classroom observations).The results were analyzed with descriptive statistics and qualitative data analysis methods. According to the results, teachers agreed that IWBs are teaching tools which facilitate reaching different sources and displaying them to the whole class immediately. Although teachers have positive attitudes towards the use

of IWBs, it was seen that most of them do not feel comfortable while using IWBs in the classrooms. The reason for that was explained with insufficient in-service trainings by considering interview results. Moreover usage differences among science teachers (physics, chemistry and biology), common problems which are related to IWBs and contributions of IWBs to particular teaching process of the high school science teachers were indicated in following sections.

Key Words: Secondary education, interactive, interactive whiteboard, belief, attitude

ÖZET

LİSE FEN BRANŞI ÖĞRETMENLERİNİN EĞİTİMDE ETKİLEŞİMLİ TAHTA KULLANIMI İLE İLGİLİ GÖRÜŞ VE TUTUMLARI

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Son yıllarda eğitim teknolojisi alanı hızla gelişmekte ve yeni teknolojik araçların eğitim ile bütünleşmesini sağlamaktadır. Etkileşimli tahtalar bu ilerlemenin, en yaygın ürünlerinden birisi olarak adlandırılabilinir. Türkiye'de de Milli Eğitim Bakanlığı FATİH (Fırsatları Arttırma, Teknolojiyi İyileştirme Hareketi) Projesi pilot aşaması kapsamında, 17 şehirdeki okullara internet bağlantısı olan etkileşimli tahtalar sağlamıştır. Bu çalışma orta öğretim fen alanı öğretmenlerinin etkileşimli tahtalar ile ilgili tutum ve davranışlarını araştırmayı amaçlamış ve örneklem olarak, Ankara ilindeki altı pilot lise seçilmiştir. Araştırmada esas olarak, nicel (anket) ve nitel (mülakat ve ders gözlemi) araştırma yöntemlerinin birlikte uygulandığı karma yöntem kullanılmıştır. Toplam öğretmen sayısı 46 olup, 36 öğretmen ankete katılmayı kabul etmiştir. Anket sonuçlarının değerlendirilmesi sonucunda her okuldan farklı branşlardaki üç fen alanı öğretmeni (fizik, kimya, biyoloji) yönsemeli örnekleme metodu ile mülakat ve ders gözlemine katılmak üzere seçilmiştir. Veriler betimsel istatistik ve nitel veri analiz yöntemleri ile analiz edilmiştir. Sonuçlar göz önüne alındığında, öğretmenlere göre etkileşimli tahtalar ders sırasında farklı kaynakları araştırmaya ve onları sınıfla paylaşmaya olanak sağladığı için, iyi bir ders aracıdır. Öğretmenlerin çoğu etkileşimli tahtalar hakkında pozitif görüşlere sahip olmasına rağmen sınıf içi kullanımları sırasında kendilerini rahat hissetmedikleri

görülmüştür. Mülakat sonuçlarında bunun hizmet içi eğitimin yeterli olmamasından kaynaklandığını belirtmişlerdir. Buna ek olarak, farklı disiplinlerdeki fen alanı öğretmenlerinin, etkileşimli tahtayı kullanım farkları, etkileşimli tahtalar ile ilgili yaygın problemleri ve etkileşimli tahtaların fen alanı öğretmenlerinin eğitim süreçlerine katkıları ilerleyen bölümlerde açıklanmıştır.

Anahtar Kelimeler: Orta öğretim, etkileşim, etkileşimli tahta, görüş, tutum

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CHAPTER 1: INTRODUCTION

Introduction

Educational institutions combine education with the latest technologies and try to provide better opportunities to students. In recent years, one of the popular technological tools around the world is interactive whiteboards (IWBs) which are touch-sensitive new generation boards controlled by a computer. This technology is rapidly replacing to traditional teaching techniques. In Turkey, the Ministry of National Education (MoNE) has already started a project named FATİH (Movement of Enhancing Opportunities and Improving Technology) and as a part of piloting this project, they distribute IWBs with internet connections in 17 cities in Turkey. The current study explores high school science teachers' beliefs and attitudes towards IWBs by inspecting six different FATİH Project pilot schools in Ankara.

This chapter provides an overview of the research study. It starts with the background information of the study, the problem and purpose associated with research questions, and it concludes with the significance of the study and definition of the key terms.

Background

In the twenty-first century, technology has increasingly been used in education field and mostly has been used to teach students with different learning characteristics (Sözcü & İpek, 2012). In January 2002, the Welsh Assembly Government in the United Kingdom (UK) proclaimed that it would provide every primary school with

one IWB, one computer and one projector. After the pilot studies in England, this technology became the focus of interest among other countries in the world. The highest IWB penetration rate (73%) is in England (Liang, Huang & Tsai, 2012; McIntyre- Brown, 2011). Taiwan, Japan, Singapore, Malaysia, China and Russia are all actively advancing the integration of this technology in classroom teaching. The United States of America (USA), Canada and Mexico are also conscious of the importance of using the IWB in classrooms (Liang et al., 2012).

In addition to the other countries, in 2012, as part of a new project, Turkey started to pilot the use of IWBs and tablets in 52 schools across the country. The project is known as FATİH and is being carried out by the MoNE and is among the most significant educational investments of Turkey. The main goal of the project has been declared as to make Information and Communication Technologies (ICT) one of the main instruments of the education process. The project will also make the usage of these technologies effective for teachers and students in classrooms. Thus, it is expected of teachers to help students gain different points of view, create information of their own and be able to keep information through the years, and so, make preparations for the future generation from today (MoNE, 2012).

Since IWBs are already in use by teachers and students, the questions and studies focus on investigating their beliefs and attitudes towards the effectiveness and integration of the IWBs in classroom. A considerable amount of studies indicate positive findings about using IWB in classrooms and positive effects on learning. From a pedagogical perspective it is thought that IWBs facilitate collaborative group working among students (Kennewell & Morgan, 2003; Slay, Siebörger, &

Hodgkinson-Williams, 2008; Smith, Higgins, Wall, & Miller, 2005). As students have an interactive, activity based learning environment, they want to share their tasks and opinions with other students in the classroom. Another advantage of the IWB is that it is a teaching tool that has high interactivity. According to Murcia and Sheffield (2010), the wealth of the pictures, diagrams and photos, moving objects, annotating information and shown animations on the board enrich this interactivity. During lessons, students especially become volunteers to answer questions due to colorful images, shapes and games, so IWBs motivate students and increase teacher-student interaction (Glover, Miller, Averis, & Door, 2005; Murcia & Sheffield, 2010; Smith et al., 2005).

Although most of the studies report positive results for the integration of this technology, there are some conflicts about improving students' motivation and usage effectiveness. For example, it is thought that teachers' trainings are not adequate to use IWBs to their full potential. Also, some of the students find them difficult to manipulate (Smith et al., 2005). Other problems are stated by the teachers as related to the usage of the board and the long time needed for preparation before the lesson. On sunny days, the teacher's shadow falls on the screen during the writing process, so some of the students cannot see the board clearly and also the sound that comes from the board marker disrupts students' concentration during the lesson (Erduran & Tataroğlu, 2009).

Problem

Computer facilities such as wireless internet, IWBs and multimedia devices have started to enhance teaching and learning processes (Mathews-Aydınlı & Elaziz,

2010). Even if education with modern technological tools has started to replace the traditional classroom techniques, this evolution has raised a lot of questions and speculations together.

Like most of the countries around the world, IWBs became fashionable classroom tools in Turkey in the scope of the FATİH Project. Although a considerable amount of studies have emphasized positive attitudes towards the use of IWBs in classrooms, the differences in the education background of the country, pre-service trainings, and technological infrastructures of the schools may cause diverse conclusions. According to Abuhmaid (2014), several factors including teacher trainings, support of the school principals, adequate infrastructure, and mentoring are believed to be facilitating factors for the effective utilization of IWBs by teachers in the classrooms. Supporting the importance of the pre-service trainings, The European Commission (2013) states that, teachers' confidence in using ICT can be as important as their technical competence, because confidence levels have an influence on the frequency of utilisation of ICT based activities.

Thus by considering all of these issues, it is apparent that the utilization of IWBs can vary in different countries and according to educational technology background. Since this project is new in our country, the literature has some lacking points in terms of teachers' acceptance of the IWB in Turkey. In addition there are limited studies about science teachers' acceptance towards this technology.

This study will be a unique resource in terms of filling the gaps in the literature which are related to the beliefs and attitudes of the real users (teachers) towards IWB technology.

Purpose

The main aim of this study is to explore high school science teachers' beliefs and attitudes towards the use of IWBs in science classes. Another aim is to compare particular IWB usage differences among three disciplines of science teachers (physics, chemistry and biology) from each school.

The final aim is to find out the contributions of IWBs to particular teaching processes of the high school science teachers' teaching processes.

Research questions

The following research questions are designed in order to achieve the purpose of the study:

1. What are the attitudes of high school science teachers towards the use of IWBs?
2. How are the IWBs used in high school science classes?
3. What are the differences among high school science teachers' attitudes (physics, chemistry, biology) towards the use of IWBs?
4. How may IWBs contribute to particular teaching processes of high school science teachers?

Significance

Recently, technology in classrooms has been becoming much more widespread and its effect on teaching and learning has to be explored by researchers. Although the

pilot phase of the FATİH Project has already been launched all over Turkey and there are many claims towards the use of IWBs in classrooms, there is limited research which is related to high school teachers' views about integrating this technology in classrooms. It is hoped that this study's findings will make a contribution to the current literature by presenting science teachers' beliefs and attitudes towards the use of IWBs in classrooms, and that the findings will enlighten the similarities and differences in particular subject areas (physics, chemistry, biology) in terms of using IWBs.

Another significant aspect of the study is the selection of FATİH Project pilot schools as the study sample. By this means, the results of this study may be partially generalized to the overall success and progress of the project. Also the study directly aims to explain how much this technology may contribute to teachers' teaching process; hence, results will be beneficial for in-service trainings of the teachers that are organized by MoNE.

According to Liang et al. (2012), although IWB related studies focus on the interactive pedagogical practices in classroom, little attention has been paid to how teachers really use IWBs. Thus, since teachers utilize IWBs, it is very important to be aware of the opinions of those people that are using this technology.

Definition of key terms

Secondary education: Education which takes place after primary education and that corresponds with the students between the ages of fourteen to eighteen.

Interactive: Allowing a two-way flow of information between computer and its user, responding immediately to the latter's input (Oxford English Dictionary, 2014).

IWB: According to BECTA (2003),

> IWB is a large, touch-sensitive board which is connected to a digital projector and a computer. The projector displays the image from the computer screen on the board. The computer can then be controlled by touching the board, either directly or with a special pen. The potential applications are: using web-based resources in whole-class teaching, showing video clips to help explain concepts, presenting students' work to the rest of the classroom, creating digital flipcharts, manipulating text and practicing handwriting, and saving notes on the board for future use. (p. 1)

Belief: It is defined as the probability dimension of a concept (Fishbein & Raven, 1962).

Attitude: "It is a mindset or tendency to act in a particular way due to both individual's experience and nature" (Pickens, 2005, p.43).

CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

In recent years, technology has increasingly developed and started to be integrated in educational systems, as in other areas. IWBs are relatively new members of this technology that have started to be implemented in early twenty first century. Although the implementation of this technology started first in the UK, developing countries are striving to evolve their traditional classrooms to technologically equipped classrooms with IWBs. In Turkey, within the scope of the FATİH Project, more than one billion dollars have been invested in two basic and secondary national educational development programmes which are funded by national resources, the World Bank, and the European Union (Somyürek, Atasoy, & Özdemir, 2009). Although a considerable amount of studies report positive results for the integration of this technology into classroom teaching, especially in Turkey, the literature has some lacking points in terms of teachers' acceptance towards the IWB. Thus, this research aims to reveal high school science teachers' beliefs and attitudes towards the use of IWBs within the FATİH Project. The study is worth investigating because IWBs are becoming more widespread with the ongoing project in Turkey. As it is the teachers who use the IWBs, it is important to be aware of the opinions of those people who are using this technology.

This chapter firstly includes a definition of educational technology, the integration of IWBs into education, advantages with obstacles about IWBs and attitudes of science teachers towards the use of IWBs by considering other studies.

Educational technology

Technology has rapidly transformed society and the life of individuals in the last 20 years. This rapid integration has caused various applications in the education field and lead to studies which aim to integrate technology into the curriculum. According to AECT (2004), educational technology is the study of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources. The definitions and features of the educational technology include followings:

- Educational technology should not be restricted with only the use of computers. Implementation of videoconferencing, digital televisions, digital cameras, electronic whiteboards, mobile devices and apps, tablets and 3D printing can also be involved in this technology (Blazer, 2008; Education Week, 2007; Jackson, 2004; Johnson, Adams, & Cummins, 2012; Johnson et al., 2013; Marshal, 2002; McCampbell, 2002).
- Educators agree that educational technology should support the learning and specific teaching goals. Thus, the definitions of goals depend on the system capabilities and also the capacity of learners (National Council of Educational Research and Training, 2006; Sivin-Kachala & Bialo, 2000).
- Formative evaluation and summative evaluation are necessary parts of educational technology (National Council of Educational Research and Training, 2006).
- Educational technology also includes supporting teachers' trainings, creating systemic materials, and the training of students (National Council of Educational Research and Training, 2006).

Educational technology in the classrooms

This part aims to explain how technology is integrated into classrooms and its possible effects on students' active learning and teachers' teaching processes. According to National Council of Educational Research and Training (2006), adaptation of technology to the education should be based on identified educational goals, system capacities, teachers' capabilities and students' needs. In the literature there are resources which state the importance of integrating technology and education (Moyle, 2010; National Council of Educational Research and Training, 2006; Öztopçu, 2003). Moyle (2010) asserts that in Australia, integrating technology into teaching, and building students' creative potentials with technology is necessary for preparing students for the unknown futures they may face. According to Muir-Herzig (2004), technology in classroom provides knowledge-constructed classrooms; also, computers in classroom enhance student centered learning better than traditional methods.

Another view is that, online content provides several multimedia and interactive parts which make the learning process of students much more effective and make it easy to understand topics, rather than using black and white textbooks (Janitor, Fecilak, & Jakab, 2012). Moyle (2006) indicates that integrating technologies into teaching and learning, as seen by many educators, is affording opportunities to change teacher-centered education to student-centered learning.

As the result of scanning Horizon Reports which have been published between 2007-2014, novel technologies which were either used or projected to be used in education were listed below:

a) Mobile devices (Horizon, 2007)

Smart phones

Mobile devices' applications

b) Collaboration webs (Horizon, 2008)

c) Electronic books (Johnson, Adams, & Haywood, 2011)

d) IWBs (Johnson et al., 2011)

e) Gesture based computing like eye drawing, 3gear system (Johnson et al., 2011)

f) Tablets (Johnson et al., 2012; Johnson et al., 2013)

g) Augmented Reality (AR) (Johnson et al., 2012)

h) Game based learning (Johnson et al., 2011; Johnson et al., 2012)

i) Wearable technology (Johnson et al., 2013)

j) 3D Printings (Johnson et al., 2013; Johnson, Adams Becker, Estrada, &Freeman, 2014)

k) Virtual assistant (Johnson et al., 2014)

When the uses of technology in classrooms are taken into consideration in recent days, it was said that facilities have developed compared to past years. Nowadays, teachers can use digital storage equipments instead of huge files, attractive presentations, digital books or online lesson plans. Furthermore, modern classrooms that are equipped with IWBs and computers with Web 2.0 tools, improve students' effective learning environment.

Although technology brings advantages, according to some researchers, it can cause problems like inaccuracies of the information in the internet, plagiarism and lack of training about using technological tools. Also, Bransford, Brown and Cocking (2000)

caution that the positive impact of technology does not come automatically; much depends on how teachers use ICT in their classes (as cited in Kozma, 2003).

History of educational technology in Turkey

Like other countries, in Turkey, studies related to educational technologies were implemented with the aim of keeping up with technological innovations. According to Akkoyunlu and İmer (1998), educational technology in Turkey followed this chronological order:

- The materials about education were imported from foreign countries until 1960s (Alkan, 1977, p. 40).
- Educational technology studies started in 1970s.
- In 1970s, implementations of the technological tools in the schools started and it was dependent to the Ministry of National Education (MoNE).
- The integration of computers to the education field started in 1985. By the scope of a project, 225 teachers received training about using computers.
- In 1989 with the collaboration of MoNE and 24 universities, 750 teachers received training.
- Until 1990s, MoNE provided 170 computers for 55 primary schools, 1461 computers for 196 high schools, 1095 computers for 88 technical high schools and 432 computers for 43 vocational trade high schools.
- In 1990s, MoNE contracted an agreement with 9 computer firms to receive software and support. After three years, these software programs were started to be implemented in mathematics, chemistry and physics classes.
- In 1995 and1996 the attempts to produce CD-ROMs was started with the collaboration of TUBITAK. The first CDs were about Piri Reis, Independence War and science lessons.
- In 1997 and1998, with the start of 8 years of continuous education, MoNE decided to build computer laboratories for every high school and primary schools in cities and provinces in the scope of Çağı Yakalama 2000 project. (pp.160-162)

Although there were many attempts for implementing innovations in the area of educational technologies between 1983 and 2003, in reality, actions taken for implementing this integration were not successful (Akıncı, Kurtoğlu, & Seferoğlu, 2012).

In 2010, MoNE and Ministry of Transport, Maritime Affairs and Communication declared a project with the aim of enhancing opportunities and improving technology in classrooms which is named the FATİH Project. Within the scope this project, IWBs with capabilities of internet connection and tablets were distributed in 52 schools in17 cities in Turkey. It is stated that 42,000 schools and 570,000 classes will be equipped with the latest information technologies and will be transformed into computerized classes as Smart Classes (MoNE, 2012).

Since the aim of the project is to implement the technology all over Turkey and the cost is really high, the project brings arguments with it. Like most of the innovations, implementation of this project became a debate in the educational sciences area, but the final decision will be made by the real users in the classroom, who are teachers and students.

IWBs in classroom

IWBs were initially produced for presentations in offices and were called as electronic boards in 1990s (Higgins, Beauchamp, & Miller, 2007; Sözcü, & İpek, 2012). Although IWBs were initially produced for office workers, there is an increasing usage of IWBs in schools because of their ability to save and reuse materials as well as their influence in motivating the students (Higgins et al., 2007). In January 2002, the Welsh Assembly Government in the UK announced that it would provide every primary school one IWB, one computer, and one projector while every secondary school would receive three of each (Liang et al., 2011). After IWBs were first introduced in classroom, the interaction between students and teacher was improved hence, it gained reputation and initiated a reform in classroom

(Glover et al., 2005). While in a traditional classroom, only the teacher allows students to use blackboard, by means of IWBs, students can be integrated into the lecture. Consequently, IWB became an influential technological aid to help teachers transform the traditional classroom environment into a student-centered collaborative environment (Somyürek et al., 2009).

Definitions and types of IWBs

An IWB is a large touch sensitive display panel that can function as an ordinary whiteboard, a projector screen, an electronic copy board which has the specific software comes with it (Kennewell & Morgan, 2003).

Yang, Wang and Kao (2012) define IWBs as a large touch screen; both a whiteboard and computer screen. They also emphasise that the definition of an IWB is hidden in the word interactive. Also Cutchell (2005) stated that, the word interactive is comprised of four different key aspects; physical pointing and touching the screen with a finger, lucid elements, visualization and self-implementation.

BECTA (2004) provides working mechanism of IWBs by drawing a simple diagram. Figure 1 shows that computer has a connection with the IWB and projector. It sends messages to the projector and receives messages from the IWB. The messages that come from the computer are reflected to the IWB surface with the use of projector. Also, every movement on the board can be seen on the computer screen.

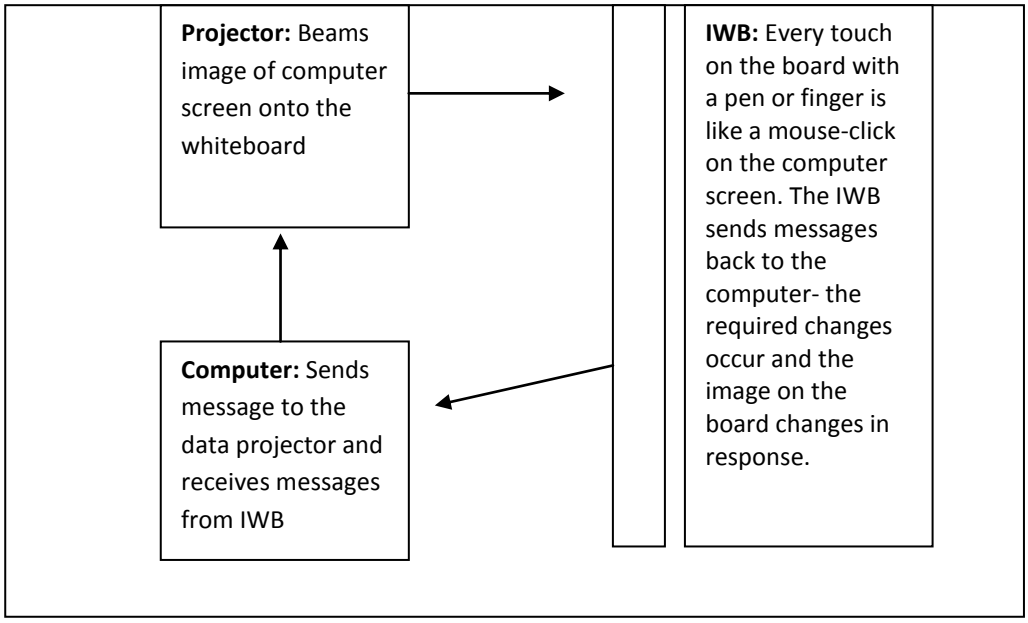

Figure 1. Working mechanism of IWBs (BECTA, 2004, p. 8)

Although all IWBs have similar working mechanisms, they can differ from each other in terms of specific features. BECTA (2004) claims that there are three types of IWBs. "The first type of IWB is infrared/ultrasound kits which can be fixed onto classical boards via clips or suckers" (p. 9). As this technology can be used without a projector, kits are less expensive than a dedicated whiteboard. The second type is known as passive whiteboard and it is sensitive to finger manipulations rather than infrared/ultrasound kits (Harris, 2005). The last type of the IWB is active whiteboards which can be manipulated by both human finger and a stylus pen (Harris, 2005).

IWBs in FATİH project

The IWBs in the FATİH Project are known as LCD (liquid crystal display) interactive boards and produced by VESTEL Company. The prominent feature of the board, is being touch-sensitive thus it is possible to manipulate the board by human finger and stylus pen. Other advantages of the board are, allowing the teleconference, connection with the printer for providing the materials during the lesson, and facility of web searching. These kinds of different features and functions are gained to IWB with a specific software programs. StarBoard software program is specific to the IWBs which are included in the FATİH Project (MoNE, 2012). This software program has a special menu and submenu in the screen and all the items and functions can be used immediately by touching the IWB screen (StarBoard Software User's Guide, 2007).

Advantages of using IWBs

Since this technology was rapidly integrated into the educational field, its advantages discussed between users and researchers. When the advantages of IWBs are taken into consideration, it is clear that they should be evaluated from different perspectives. Most of the studies report positive outcomes about the contributions of IWBs to pedagogical development of students, learning, motivation and information literacy of both teachers and students (Glover et al., 2005; Higgins et al., 2007; Lewin, Somekh, & Steadman, 2008; Smith et al., 2005; Thompson& Flecknoe, 2003).

In the literature, most of the studies state that IWBs increase interactions among teachers and students (Smith et al., 2005; Glover et al., 2005). Gerard, Widener and

Greene (1999) reported that, when IWBs were compared to other ICT devices, IWBs promoted the discussions in the classroom and thereby interaction more than other devices. Since the IWBs are included a specific software program, tools and functions in the board can show diversity. For example giving presentations with an IWB promotes much more interaction between students and effectiveness of learning compared to traditional proxy. Because using IWBs' functions and tools like drop and drag or snap line to object, may provide enriched learning environment for students (Yang et al., 2012). Furthermore, Kershner, Mercer, Warnick and Staarman (2010) stated that since IWBs provide collaborative activities between students, integration of IWB with other classroom learning systems and resources promote the collaborative learning skills of students.

The existence of the interaction in a classroom brings with it increased motivation (Glover et al., 2005; Higgins et al., 2007; Smith et al., 2005). Yang et al. (2012) emphasized that using the IWB can motivate students because students show more interest to join classroom conservations and investigations. According to Türel and Johnson's (2012) findings, most of the teachers agreed that using IWBs is motivating, engaging, and enjoyable for both teachers and students.

Manny-ikan, Dagan, Tikochinski and Zorman (2011) investigated the effects of the IWBs to the learning and teaching processes in schools in Israel. 838 students who were in grades 7 to12 participated in the study. The findings of the study show that the majority of students have positive attitudes towards the use of IWBs. Students also report that IWBs contribute to their learning process and promote a greater understanding of the lesson material. They also emphasize that IWBs promote greater interest and engagement in the learning process. In this study, the views of

the students supported the responses of the teachers. Similarly, teachers report that when they use IWBs in the classroom, they think that students' interest and motivation intensifies, and that they are much more focused.

Besides visual advantages, students who have special learning capabilities may have a greater effective learning opportunity with IWBs, since IWBs also address the kinaesthetic, visual, auditory, active, and verbal-social learners (Beeland, 2002; Glover et al., 2005; Schuck & Kearney, 2007). Also, some of the teachers say that because of the accessibility of every kind of presentation, picture and resource, teachers call it as a great time saver (Hodge & Anderson, 2007). Ateş (2010) states that with the possibility of internet connection, lectures can be enriched in terms of activity.

Lastly, BECTA (2004) indicates a different perspective by correlating the working mechanism of IWBs and its advantages as follows:

> In the simplest terms, a multimedia projector allows the user to display anything that is on their computer for an audience, and to control the computer from IWB screen, instead of having to return to the computer. This allows even a novice user to run applications such as CD-ROMs, word-processing documents, spreadsheets, presentations and the internet simply by 'clicking' in the right places on the board without losing engagement with a class. With a little bit of practice, teachers can then start to use 'floating tools' to add notes or comments and highlight sections of these pages.(p. 8)

Obstacles of IWBs

Although positive views about using IWBs were explained in earlier sections, there are some problems in the implementation process of this technology. One of the common problems related to IWBs is that, teacher trainings about the utilisation of IWBs are not suitable to the individual needs of teachers (Levy, 2002).

In their research, Kayaduman, Sırakaya and Seferoğlu (2011) report that the success of using IWBs in the classroom properly depends on the teachers' existing proficiency and the fulfilment of their needs with the trainings. Thus, if the teachers have sufficient training, they can disrupt the barriers in terms of using technology in class and can decrease anxiety during lectures (Kotrlik & Redmann, 2009).
The study of Hodge and Anderson (2007) is a kind of a journal that is written by a teacher. Although some of the studies state that IWBs are a time saver, this study has a different perspective about time issues, considering both the preparation of the lecture and the lecture itself. Teacher in the study thinks that she needs to spend extra energy for encouraging students to use the IWB, and also that training and preparation for the lecture needs excessively much more time. And also teachers in the other studies report similar results, as preparation for lectures take more time (Ball, 2003; Glover & Miller, 2001; Levy, 2002; Manny-ikan et al. 2011).

Erduran and Tataroğlu (2009) claim that using interactive white board in classroom affects teacher's authority poorly. According to Gray, Hagger-Vaughan, Pilkington and Tomkins (2005), when teacher uses IWBs in the class, he / she force the students to become more active on the contrary to teacher-centered education. Since the activities of the teacher diminish, this situation can cause the decline of the authority of the teacher in front of the students (as cited in Mathews- Aydınlı & Elaziz, 2010, p. 43).

According to Bell (2002), IWBs can provide materials for students with different learning styles such as tactile, auditory, and visual. And also by means of tactile activities, teachers' and students' interaction with the IWB in class is promoted

(Schuck & Kearney, 2007). The real problem which is the lack of software and activities, decreases use of IWBs as a tactile learning material. Thus, students hesitate interacting with the board during class (Smith et al., 2005).

In terms of technical problems, Smith (2000) states that IWB needs to be positioned in the classroom by considering the angle of sunlight and obstructions between the projector and the board. Teachers also report that while writing on the board, their shadow can obstruct the students' sight of the board and the voice that comes from the pen can disrupt the students' attention.

IWBs in science classroom

Use of IWBs in science classrooms

The research of Cox and Webb (2004) indicates that the most extensive uses of ICT in education have been in science classes at both primary and secondary schools. By considering this result, it may be generalized that the usages of IWBs in science classrooms are more common when compared to other subject groups. Also, a study conducted by Murcia (2008) found that active science learning connected to scientific concepts is becoming increasingly possible with the use of IWB technology.

Research by Murcia and Sheffield (2010) provide a list about effective interactive pedagogy that which is facilitated by teacher's use of IWB in science classes:

- using animations, films and diagrams promote students' interaction and interest towards the science lesson,
- accessing online information about science concepts or providing relevant examples about the subject promote learning,

- linking media files like videos enhance learning of the subject,
- interacting with online activities likes games or puzzles promote learning with fun,
- turning from one page to another quickly allows the contents of the lesson to be reviewed easily,
- saving of drawings and other written materials by means of record button.

According to the research done in Turkey, science teachers use IWB mostly for virtual experiments, zooming in and out of pictures and playing videos for students. This investigation was implemented in Izmir, between 35 science and mathematics teachers and was based on interview techniques. According to the results, science teachers use IWBs more than mathematics teachers (Erduran & Tataroğlu 2009).

Attitudes of science teachers towards the use of IWB

In the literature, researchers have explored the attitudes of teachers towards the use of IWBs in science classes. Jang (2010) claims that science teachers use the IWB as an instructional tool to share their knowledge in the subject matter. Teachers also think that IWB is the main tool for explaining scientific concepts which are hard to explain with using traditional teaching methods. Also, Murcia and Sheffield (2010) state that teachers' effective IWB pedagogy impact positively on the way the students talk about science.

Erduran and Tataroğlu (2009) establish that although the science teachers want to use the IWB in their classes, they believe that they need to have more training to use it efficiently. At this study teachers found it really constructive to use IWBs to address; multiple intelligences of students, draw students' attention easily and that it acts as a

means to reuse the material for the next lessons. Also, most of the teachers in this study believe that the usage of IWB facilitates the learning and raises the interest of students.

Summary

This literature review has shown the definitions of educational technology and its possible effects as the result of integrating technology into education. Resources in literature show that technology in classrooms provides advantages in terms of students' learning and teachers' teaching processes in many perspectives. Also, the development of educational technology was given in chronological order in this review.

IWBs which are the product of educational technology have become common in most of the educational institutions all around the world. This literature review provided a general opinion about the advantages and obstacles about using IWB technology. According to the researchers, IWB technology offers great advantages in terms of teaching and learning, however some lacking points like insufficient teacher trainings, inadequate amount of software which is proper for IWBs and incompetent technical support should be improved.

This literature review also showed the use of IWBs in science classrooms. It can be seen that there are different kinds of activities and uses in the science classroom like showing animations, films, diagrams and videos to promote students' interaction and interest towards the science classes. Also, the views of the science teachers were stated. Although there are a lot of studies which are based on the teachers' views

about using IWBs, it was seen that there are limited studies which focus on science teachers' attitudes towards the use of IWBs. The teachers in the literature review indicated that they use IWBs for explaining scientific concepts which are hard to explain with using traditional teaching methods.

The next chapter provides information about the research design for this study and how these analyses were applied to investigate science teachers' beliefs and attitudes towards the use of IWBs in high schools.

CHAPTER 3: METHOD

Introduction

This chapter starts with the justification of the research design. Then, it gives information about the context, participants and instrumentation. Finally, data collection and data analysis procedures are provided.

This study addresses the following research questions:

1. What are the attitudes of high school science teachers towards the use of IWBs?
2. How are the IWBs used in high school science classes?
3. What are the differences among high school science teachers' attitudes (physics, chemistry, biology) towards the use of IWBs?
4. How may IWBs contribute to particular teaching processes of the high school science teachers?

Research design

The purpose of this research is to investigate high school science teachers' beliefs and attitudes towards the use of IWBs in science classes. The study utilized a mixed-methods approach with an embedded design.

Mixed methods research

According to Johnson, Onwuegbuzie, and Turner (2007), mixed methods research combines elements of qualitative and quantitative research approaches to enhance the breadth and depth of understanding and corroboration. Basically, the aim of the

implementation of this method is to provide a better understanding of the research problems.

According to Creswell and Clark (2007), mixed methods research:

- Provides more detailed evidence for studying a research problem than either quantitative or qualitative research alone;
- Helps answer questions that cannot be answered by qualitative or quantitative approaches alone;
- Encourages the use of multiple worldviews or paradigms rather than the typical association of certain paradigms for quantitative researchers and others for qualitative researchers. (pp. 9-10)

About the study

At the beginning of the study, the attitudes of the high school science teachers towards the use of IWBs were measured quantitatively with a questionnaire. This quantitative data was supplemented by qualitative data which consisted of classroom observations and interviews with science teachers. Observations of each of the classes (physics, chemistry and biology) were used in order to explore IWB usage processes and differences among high school science teachers. Interviews with science teachers from each discipline (physics, chemistry and biology) were conducted to understand the contribution of IWBs to particular teaching processes and the main differences among subject area teachers towards the use of IWBs.

Context

In order to implement the study, the specific context was chosen in which individuals hold detailed views about the research questions. Hence, the study was implemented in the six FATİH Project pilot high schools (Hasan Ali Yücel Anadolu Öğretmen Lisesi, Ankara Lisesi, Mehmet Emin Resulzade Anadolu Lisesi, Mustafa Azmi Doğan Anadolu Lisesi, Sabahattin Zaim Anadolu Öğretmen Lisesi, Hacı Bayram

Anadolu İmam Hatip Lisesi) in Ankara (see Table 1). Since the aim of the study was to explore science teachers' beliefs and attitudes towards the use of IWBs in high schools, only six schools were chosen out of seven, since one of the schools was a primary school, it was not included in the study (see Table 1). The essential point about context is that, these six high schools constitute all of the pilot high schools that are members of this project in the city of Ankara.

Table 1
FATİH Project Pilot Schools in Ankara

No	City	Town	Name of the school
1	Ankara	Çankaya	Hasan Ali Yücel A.Ö.L.
2	Ankara	Altındağ	Ankara L.
3	Ankara	Yenimahalle	Mustafa Azmi Doğan A.L.
4	Ankara	Altındağ	Sabahattin Zaim A.Ö.L.
5	Ankara	Sincan	İl Genel Meclisi İ.Ö.O
6	Ankara	Çankaya	Mehmet Emin Resulzade A.L.
7	Ankara	Altındağ	Hacıbayram A.İ.L.

L: Lisesi (High School)
A.İ.L: Anadolu İmam Hatip Lisesi (Vocational Religious School)
A.L: Anadolu Lisesi (Anatolian High School)
A.Ö.L: Anadolu Öğretmen Lisesi (Anatolian Teacher High School)
İ.Ö.O: İlköğretim Okulu (Primary School)

Participants

In the mixed method study, qualitative analysis compensates for the small sample size in the quantitative study (Venkatesh, Brown, & Bala, 2013). Also the researcher uses a small, carefully chosen sample from a population with large number of individuals which holds certain characteristics (Creswell & Clark, 2007). In the literature this sampling method is named as purposeful sampling. Purposeful

sampling means that researchers intentionally select participants who have experience with the central phenomenon or the key concept being explored (Creswell & Clark, 2007).

Since this study was limited by the number of FATİH Project pilot high schools in Ankara, science teachers (biology, physics and chemistry) from each of the six high schools were selected. The total number of subjects in the sample was 46 but only 36 teachers filled in the questionnaire. This means 78.2% of the teachers joined the study. Of these, three teachers from each school were chosen by considering their questionnaire results with purposeful sampling method. Thus with two missing, 16 of the teachers were interviewed and their classrooms were observed. The distributions of the teachers who participated in the study according to schools are summarized in Table 2.

Table 2
The total number of participants in different schools

Name of the school	Q	I	O
Hasan Ali Yücel A.Ö.L.	6	3	3
Ankara L.	5	2	2
Mustafa Azmi Doğan A.L.	7	3	3
Sabahattin Zaim A.Ö.L.	4	2	2
Mehmet Emin Resulzade A.L.	8	3	3
Hacıbayram A.İ.L.	6	3	3
Total	36	16	16

Q: The number of teachers who completed the questionnaire.
I: The number of teachers who participated in the interview.
O: The number of teachers whose lessons were observed.
L: Lisesi (High School)
A.İ.L: Anadolu İmam Hatip Lisesi (Vocational Religious School)
A.L: Anadolu Lisesi (Anatolian High School)
A.Ö.L: Anadolu Öğretmen Lisesi (Anatolian Teacher High School)
İ.Ö.O: İlköğretim Okulu (Primary School)

Instrumentation

Thus the instruments of the research consist of;

- Questionnaire
- Interview
- Observation

Questionnaire

In this research in order to examine high school teachers' beliefs and attitudes towards the use of IWBs, a questionnaire was used. The original questionnaire was developed by Mathews- Aydınlı and Elaziz (2010) to investigate attitudes of teachers towards the use of IWBs in English as Foreign Language (EFL) classrooms. The researcher adapted the questionnaire for the science teachers by making the necessary pronoun changes.

The questionnaire includes five point Likert-scales, open-ended and multiple-choice items (see Appendix B). A reliability check with Cronbach Alpha resulted in the score of 0.78 (Mathews- Aydınlı & Elaziz, 2010). Since the questionnaire was adapted for current study with some changes, reliability again checked with Cronbach Alpha and resulted in the score of 0.84. In addition, to improve the questionnaire, a pilot study was conducted in the İhsan Doğramacı Vakfı Özel Bilkent Lisesi with nine science teachers in June 2013. Thus, the researcher had the chance to correct lacking points before starting the study.

Below, Table 3 shows the distribution of the questionnaire's items and their dimensions.

There are totally 22 items in the questionnaire which consists of the six subsections: attitudes related to IWBs as a teaching tool (9 items), positive attitudes towards the use of IWBs (5 items), negative attitudes towards the use of IWBs (5items), attitudes towards teacher training (2 items), the usage of IWBs in science classes (5 items) and the frequency of using IWB (1item).

Table 3
Questionnaire questions and dimensions

Dimensions	Questionnaire questions
Attitudes related to IWBs as a teaching tool	1,2,3,4,5,6,7,8,9
Positive attitudes towards the use of IWBs	10,12,17, 21, 22
Negative attitudes towards the use of IWBs	11,13,14,15,16,
Attitudes towards teacher training	18,19
The usage of IWBs in science classes	2,3,4,9,20
The frequency of using IWB	6

Interview

In order to explore the attitudes of science teachers towards the use of IWBs and for providing further insight, a semi-structured interview protocol was used (see Appendix C). Harrell and Bradley (2009) define the semi-structured interview method which is used open ended questions in a standardized order to understand the interviewees' views deeply.

The questions in the protocol were adapted from the interview questions of Mathews- Aydınlı and Elaziz (2010). There were 14 open-ended questions in total, exploring teachers' opinions about the benefits of IWBs, the most common problems

about using IWBs and general background information about the teachers. The researcher conducted these interviews with three of the science teachers from each school. Two of the teachers did not want to participate in the interviews and lesson observations. Therefore 16 of the teachers participated the interviews out of 18. The interviews were held in Turkish, and participants' responses were recorded on a voice recorder. In data analysis process all answers translated to the English by the researcher.

Observation

In addition to the interview questions, quantitative data was supplemented by observations of the three science classrooms (biology, physics and chemistry) from each school. An observation chart was developed as a result of the literature review and partially adapted from Altınçelik (2009), (see Appendix D). The questions in the chart basically focused on the teachers' common uses of the IWBs in science classes and their common problems which are related to IWBs. Besides that, there was an independent part which showed observed schema of the classroom that includes the location of the IWB.

Method of data collection

The data collection process occurred in three phases.

During phase one, preparation of the instruments took place in June and July of 2013. The questionnaire, observation charts and interview questions were organized at the end of an extensive literature review. Following the preparation of the instruments, the questionnaire was piloted with science teachers who were at Özel

Bilkent High School in June 2013. During the preparation process of the instruments, results from the pilot study were used to improve the questionnaire.

Phase two was obtaining permission from the MoNE which happened in October 2013. Both preparation of the MoNE permissions and the delivery of the document took more time than the researcher expected. In order to allow for the collection of data, an official letter from the MoNE was sent to the researcher and to the schools.

Phase three started in the middle of October 2013 with data collection. The process of data collection was discontinuous and lasted three months. The researcher visited all of the schools and collected the data through face to face interactions. The first instrument was a questionnaire which was used for getting information about the attitudes of high school science teachers towards the IWB use in the classroom. In total, 36 teachers joined the study and submitted the questionnaire.

Interviews and classroom observations were conducted with selected teachers after the evaluation of the questionnaire results. To determine the proper time for class observations and interviews with teachers, appointments were made with teachers for the following weeks. In total, the researcher interviewed 16 science teachers and joined these teachers' classes for observation. All of the interviews were dictated by the researcher. And also 11 of the teachers allowed their voice to be recorded during the interviews, five of the teachers preferred not to have their voices recorded.

Method of data analysis

Since the study used mixed methods, both quantitative and qualitative data analyses were used.

Quantitative data analysis

All of the items in the questionnaires were analyzed comparatively with descriptive statistics using the Statistical Package for Social Sciences (SPSS, v.15.0). All the Likert-scale items consisted of a 5-point scale: strongly agree (5), agree (4) no idea (3), disagree (2), and strongly disagree (1). While calculating means and standard deviations, the option "No idea" was excluded from the variables in order to investigate only the degree of actual agreement and disagreement among the participants. Since the descriptive analysis method was used for data analysis generally means, frequencies and percentages were used to represent the data.

Qualitative data analysis

Qualitative data gathered from the semi-structured interviews and observations. Grich (2013) indicates that two stages are needed for analysis of interview or observational data; first transcribing of them and second preliminary analysis of the data. Following that, gathered data was grouped according to conceptual frame work, research questions or key variables and replaced a proper display format. Miles and Huberman (1994) defined this procedure as coding for analysis.

In the current study, responses from the interview section were transcribed at the beginning of the data analysis. A structured coding system was created by considering the meanings of the responses and actions of the teachers. To keep

teachers' personal data confidential, numbers were given as a code to each interviewee. Interviews were analysed after categorizing the common responses with the help of colour codes, and under the sub-categories. For analysing classroom observations, a checklist which contained all the gathered data from observation charts was prepared. The data in the observation charts were grouped according to common features and categories. Lastly all data which were provided from interviews and observations were categorized by considering research questions. Thus, the researcher was able to analyse the qualitative data from two different perspectives.

CHAPTER 4: RESULTS

Introduction

This chapter presents the findings of the data analysis which were obtained from questionnaires, classroom observations and interviews.

Firstly, the demographic data are given in detail. Secondly, the findings of the research questions are presented by categorizing them into sub-sections.

Demographic data

The demographic data about the teachers were collected from the personal details part of the questionnaire. It was categorized for the following demographic features:

Age-gender-school-experience- subject area

The teachers' questionnaires were administered in six different high schools with 36 participants. Distributions of genders of the teachers were 61.1% (*N*=22) female and 38.9% (*N*=14) male (see Table 4). The ages of the teachers ranged between 26 to 46 and over. While 44.4% (*N*=16) of the teachers were 46 and over, 30.6% (*N*=11) were between 41-45, 22.2% (*N*=8) were between 36-40, and 2.8% (*N*=1) was between 26- 30. The highest number of participants, 22.2% (*N*=8) of the teachers, worked at Mehmet Emin Resulzade Anadolu Lisesi, for the reason that the number of science teachers in this school was higher than other schools in the study. Coming after this, 19.4% (*N*=7) of the teachers were from Mustafa Azmi Doğan Anadolu Lisesi, 16.7% (*N*=6) of them were from Hacı Bayram Anadolu İmam Hatip Lisesi, 16.7% (*N*=6) of the teachers were from Hasan Ali Yücel Anadolu Öğretmen Lisesi, 13.9% (*N*=5) of them were from Ankara Lisesi and 11.1% (*N*=4) of the teachers were from Sabahattin Zaim Anadolu Öğretmen Lisesi.

Table 4
Background information of teachers

Age			Gender			School			Experience			Area		
	f	%		F	%		f	%		f	%		f	%
26-30	1	2.8	Male	14	38.9	Sabahattin Zaim A. Ö. L.	4	11.1	6-10	2	5.6	B	15	41.7
36-40	8	22.2	Female	22	61.1	Hasan Ali Yücel. A.Ö.L.	6	16.7	11-15	5	13.9	C	11	30.6
41-45	11	30.6				Mehmet Emin Resulzade A.L.	8	22.2	16-20	11	30.6	P	8	22.2
46≥	16	44.4				Mustafa Azmi Doğan A.L.	7	19.4	21	18	50.0	Missing	2	5.6
						Ankara L.	5	13.9						
						Hacı Bayram A.İ.L.	6	16.7						

Note: f: Frequency, %: percentage
L: Lisesi
A.İ.L: Anadolu İmam Hatip Lisesi
A.L: Anadolu Lisesi
A.Ö.L: Anadolu Öğretmen Lisesi
B: Biology
P: Physic
C: Chemistry

The distributions of the science teachers due to their subject areas were as, 15 (41.7%) biology, 11 (30.6%) chemistry and 8 (22.2%) physics. Also they had varying years of experience in teaching science. While 50% (N=18) of the teachers had 21 years and over working experience, 30.6% (N=11) of them had 16-20, 13.9% (N=5) of them had 11-15 and 5.6% (N=2) of them had 6-10 years of working experience (see Table 4).

Findings of the study

The results were obtained from the analysis of four research questions, which were related to science teachers' attitudes towards using IWBs, usage in the science classrooms, differences among disciplines, and contributions of IWBs to particular teaching processes. At the beginning of the study, questionnaires were given to all of the participants. These quantitative data were complemented with the interviews in the second part of the study. For the third part, classroom observations became evidence for teachers' common usage of IWBs in science classrooms and their contributions to the particular teaching processes. In this chapter, the findings are given according to the main research questions and sub-sections.

Research question 1: Attitudes of high school science teachers towards the use of IWBs

Attitudes of high school science teachers towards the use of IWBs were categorized into four sub-sections:

- Teachers' attitudes towards IWBs as a teaching tool
- Teachers' positive attitudes towards the use of IWBs

- Teachers' negative attitudes towards the use of IWBs
- Teacher attitudes towards training programs about IWBs

Teachers' attitudes towards IWBs as a teaching tool

Teachers' attitudes towards the use of IWBs as teaching tools were investigated with nine of the questions (1, 2, 3, 4, 5, 6, 7, 8, and 9) of the questionnaire.

Table 5
Teachers' attitudes towards IWB as a teaching tool

		SD	D	NI	A	SA	Mean	SD
Q1	F	0	8	7	12	9	3.61	1.103
	%	0	22.2	19.4	33.3	25.0		
Q2	F	4	12	6	9	4	2.91	1.245
	%	11.4	34.3	17.1	25.7	11.4		
Q3	F	1	2	1	15	17	4.25	0.96
	%	2.8	5.6	2.8	41.7	47.2		
Q4	F	1	6	5	18	6	3.61	1.050
	%	2.8	16.7	13.9	50.0	16.7		
Q5	F	2	4	4	15	11	3.81	1.167
	%	5.6	11.1	11.1	41.7	30.6		
Q6	F	4	9	10	11	1	2.89	1.078
	%	11.4	25.7	28.6	31.4	2.9		
Q7	f	0	6	1	19	10	3.92	0.996
	%	0	16.7	2.8	52.8	27.8		
Q8	f	3	12	3	13	5	3.14	1.268
	%	8.3	33.3	8.3	36.1	13.9		
Q9	f	0	3	3	21	9	4.00	0.828
	%	0	8.3	8.3	58.3	25.0		

Note: f: Frequency SD: Strongly disagree (1) D: Disagree (2) NI: No idea(3) A: Agree (4) SA: Strongly agree(5)

SD: Standard Deviation
Q1: Using the IWB resources reduces the time I spend writing on the board.
Q2: When using IWBs in the classroom, I spend more time for the preparation of the lesson.
Q3: I think using IWBs makes it easier to reach different sources and display them to the whole class immediately.
Q4: IWBs are beneficial for saving and printing the materials generated during the lesson.
Q5: I can give explanations more effectively with the use of IWBs.
Q6: With the help of the IWB, I can easily control the whole class.
Q7: I think IWBs can be a good supplement to support teaching.
Q8: Using IWBs makes me a more efficient teacher.
Q9: Using IWBs makes it easier for a teacher to review, re-explain, and summarize a subject.

According to mean scores given in Table 5, teachers agree with most of the statements in the questionnaire. The highest mean score belongs to question three, approximately 89.9% (*N*=32) of the teachers think that IWBs make it easier to reach different sources and displays them to the whole class immediately. The second highest mean score belongs to question nine, 83.3% (*N*=30) of the teachers think that using IWBs make it easier for teachers to review, re-explain, and summarize. Regarding the first question, 58.3% (*N*=21) of the teachers think that using the IWB resources reduce the time they spend writing on the board. For the second question, 37.1% (*N*=13) of the teachers reveal that when they use IWBs in the classroom, they spend more time for the preparation of the lesson. Regarding the results of fourth question, 66.7% (*N*=24) of the teachers agree that IWBs are beneficial for saving and printing the materials generated during the lesson. Looking at the responses to the fifth question, 72.3% (*N*=26) of the teachers agree that they can give explanations more effectively with the use of IWBs.

The sixth question has the lowest mean score in this category (*M*=2.89). 37.1% (*N*=13) of the teachers disagree that with the help of using the IWB, they can easily control the whole class, while 28.6% (*N*=10) of the teachers indicate that they have no idea about this statement.

For the seventh question, 80.6% (*N*=29) of the teachers indicate that IWBs can be a good supplement to support teaching. Furthermore, looking at the responses to the eighth question, 50% (*N*= 18) of the teachers agree that using IWBs makes them more efficient teachers.

Teachers' positive attitudes towards the use of IWBs

Teachers' positive attitudes which were related to the use of IWBs were investigated with questions 10 and 12 in the questionnaire and implicitly investigated with interview questions 12 and 13.

Table 6
Teachers' positive attitudes towards the use of IWBs

		SD	D	NI	A	SA	Mean	SD
Q10	F	0	1	8	19	7	3.91	0.742
	%	0	2.8	22.2	52.8	25.0		
Q12	F	0	1	7	23	4	3.86	0.648
	%		2.9	20.0	65.7	11.4		

Note: f: Frequency SD: Strongly disagree (1) D: Disagree (2) NI: No idea (3) A: Agree (4) SA: Strongly agree (5)
SD: Standard Deviation
Q10: I like using IWB technology in my lessons.
Q12: I have positive attitudes towards the use of IWBs in science lessons.

The mean scores of the question 10 (*M*=3.91) and question 12 (*M*=3.86) indicate that teachers agree with questions 10 and 12. 77. 8% (*N*= 26) of the teachers agreed that they like using IWB technology in their lessons. The responses which are given for question 12 show that, 77.1% (*N*=27) of the teachers have positive attitudes towards the use of IWBs in science lessons. There is only one participant who disagreed with questions 10 and 12.

Interviews were carried out with 16 teachers out of 18. The researcher asked two questions (12 and 13) which were implicitly related with positive attitudes towards using IWBs in science classes (see Appendix C). Question 12 was about whether they would recommend this technology to their colleagues or not. 87.5% (N=14) of the teachers indicated that they recommend this technology to the other teachers. Two of the reflections which were recorded during interviews with Teacher 5 and Teacher 12 are given below:

Teacher 5 states that:

> I definitely recommend this technology to my colleagues because visual learning is really essential in science education (Teacher 5).

Teacher 12 states that:

> I recommend this technology to my colleagues who are in different schools. In this school, since the school is exam-oriented, IWBs have the secondary importance. But for other schools which are in rural areas, this technology is really essential (Teacher 12).

Question 13 was related to teachers' opinions about using IWB technology immediately in all of the schools in Turkey. 81.25% (N=13) of the teachers reflected that IWB technology in classrooms should become more common all around Turkey. The ideas of the teachers who gave the negative responses to these two interview questions (12 and 13) are given in the following section.

Teachers' negative attitudes towards the use of IWBs

Negative attitudes of teachers about the use of IWBs were investigated with questions 11, 13, 14 and16 in the questionnaire and from the interview questions 12 and 13.

Table 7
Teachers' negative attitudes towards the use of IWBs

		SD	D	NI	A	SA	Mean	SD
Q11	F	2	4	3	18	9	3.61	1.103
	%	5.6	11.1	8.3	50.0	25.0		
Q13	F	13	18	4	1	0	2.09	1,245
	%	36.1	50.0	11.1	2.8	0		
Q14	F	12	15	3	5	1	0.75	0.96
	%	33.3	41.7	8.3	13.9	2.8		
Q16	F	6	12	8	7	3	1.39	1.050
	%	16.7	33.3	22.2	19.4	8.3		

Note: f: Frequency SD: Strongly disagrees (1) D: Disagree (2) NI: No idea (3)
A: Agree (4) SA: Strongly agree (5)
SD: Standard Deviation
Q11: I feel uncomfortable in front of my students while using IWB.
Q13: I have negative attitudes towards the use of IWBs in science classes.
Q14: I do not think my students are ready for this technology.
Q16: I am not the type to do well with IWB-based applications.

The result of the eleventh question reveals that 75% (*N*=27) of the teachers feel uncomfortable in front of their students while using IWB. Considering the responses to the thirteenth question in this section, 2.8 % (*N*=1) of the teachers have negative attitudes towards the use of IWBs in science classes. According to the responses to the fourteenth question, 16.7 % (*N*=6) of the teachers think their students are not yet ready for this technology. Looking at the responses given for the sixteenth question, 27.7% (*N*=10) of the teachers think that they are not a good example for doing well with IWB-based applications.

The question 12 from interviews was whether they recommend this technology to their colleagues or not. 12.5% (*N*=2) of the teachers indicated that they did not

recommend this technology to their colleagues. Teacher 15 supported his idea with these expressions.

Teacher 15 states that:

> The priority could be for basic needs instead of such kind of costly technology (Teacher 15).

Interview question 12 was related to teachers' opinions about recommending this technology to their colleagues.12.5% (*N*=2) of them stated that they did not recommend (suggest using) this technology to their colleagues, because according to their beliefs projectors were sufficient. Question 13 was related to teachers' opinions about using IWB immediately around all schools in Turkey. 6.25% (*N*=1) of them stated that he/she did not support this technology to become widespread in schools.

Teacher 2 states that:

> There are some infrastructure problems related to internet connection. Also, teacher trainings are not sufficient. If IWB technology is to become more common, these problems should be solved (Teacher 2).

Teacher attitudes towards training programs about IWBs

Teachers' views related to teacher training about IWBs were directly investigated with questions18 and 19 in the questionnaire and with interview question 6.

Table 8
Teachers' views related to teacher training

		SD	D	NI	A	SA	Mean	SD
Q18	F	3	4	2	15	12	3.81	1.261
	%	8.3	11.1	5.6	41.7	33.3		
Q19	F	0	7	12	12	4	3.37	0.942
	%	0	20.0	34.3	34.3	11.4		

Note: f: Frequency SD: Strongly disagrees (1) D: Disagree (2) NI: No idea

(3) A: Agree (4) SA: Strongly agree (5)
SD: Standard Deviation
Q18: I believe that training is required to teach with IWB technology.

Q19: If I do not get sufficient training, I do not feel comfortable using IWBs in the classroom.

According to the scores in this table, the results of the eighteenth question reveals that 75% (*N*= 27) of the teachers think that training is required to teach with IWB technology. Looking at the responses to the nineteenth question, 45.7% (*N*=16) of the teachers stated that they do not feel comfortable using IWBs in classrooms for the reason that they think that they did not get sufficient training.

Interview question 6 was aimed to investigate how teachers learned to use IWBs. The responses for this question showed that, 93.75% (*N*= 15) of the teachers learned to use IWBs in the teacher training program which was implemented in the scope of FATİH Project. On the other hand, Teacher 3 states that:

> I learned to use IWBs while I was practicing in the classroom. I had taken the thirty-hour course program, but it was not satisfactory (Teacher 3).

Since the interview was semi-structured, the researcher asked other questions which were related to the hours and sufficiency of the training. Only three of the teachers out of fourteen stated that the teacher training was sufficient.

Teacher 5 states that:

> We learned in the course but it was not sufficient. We developed our skills about the IWBs as we were using it in the classroom, as we gained experience (Teacher 5).

Another view is stated by Teacher 9:

> I am not confident with using IWBs in the classroom. We learned what we can do with IWBs in in-service trainings but we did not learn how we can practice these (Teacher 9).

Research Question 2: Use of IWBs in high school science classes

This section is categorized into two sub-sections:

- Teachers' common uses of IWBs in science classes
- Teachers' common problems which are related to IWBs

Teachers' common uses of IWBs in science classes

In this section, data were provided by questionnaires, interviews and classroom observations to investigate teachers' common uses of IWBs in science classes. At the beginning, responses to the questions three, four and nine in the questionnaire were analyzed descriptively. The results obtained from the analysis of the questionnaires are presented in Table 9.

Table 9
The usage of the IWBs as a teaching tool in science classes

		SD	D	NI	A	SA	Mean	SD
Q3	F	1	2	1	15	17	4.25	0.96
	%	2.8	5.6	2.8	41.7	47.2		7
Q4	F	1	6	5	18	6	3.61	1.05
	%	2.8	16.7	13.9	50.0	16.7		0
Q9	F	0	3	3	21	9	4.00	0.82
	%	0	8.3	8.3	58.3	25.0		8

Note: f: Frequency SD: Strongly disagree (1) D: Disagree (2) NI: No idea (3)
A: Agree (4) SA: Strongly agree (5)
SD: Standard Deviation
Q3: I think using IWBs makes it easier to reach different sources and display them to the whole class immediately.
Q4: IWBs are beneficial for they allow saving and printing of the materials generated during the lesson.
Q9: Using IWBs make it easier for a teacher to review, re-explain, and summarize the subject.

Based on the results on Table 9, 88.9% (*N*= 32) of the teachers think that using IWBs make it easier to reach different sources and display them to the whole class

immediately. The results of the fourth question in the questionnaire reveals that 66.7% (*N*=24) of the teachers thought IWBs are beneficial in a way to allow the teacher to save and print the materials generated during the lesson. For question nine, 83.3% (*N*=30) of the teachers think that using IWBs makes it easier for a teacher to review, re-explain, and summarize the subject.

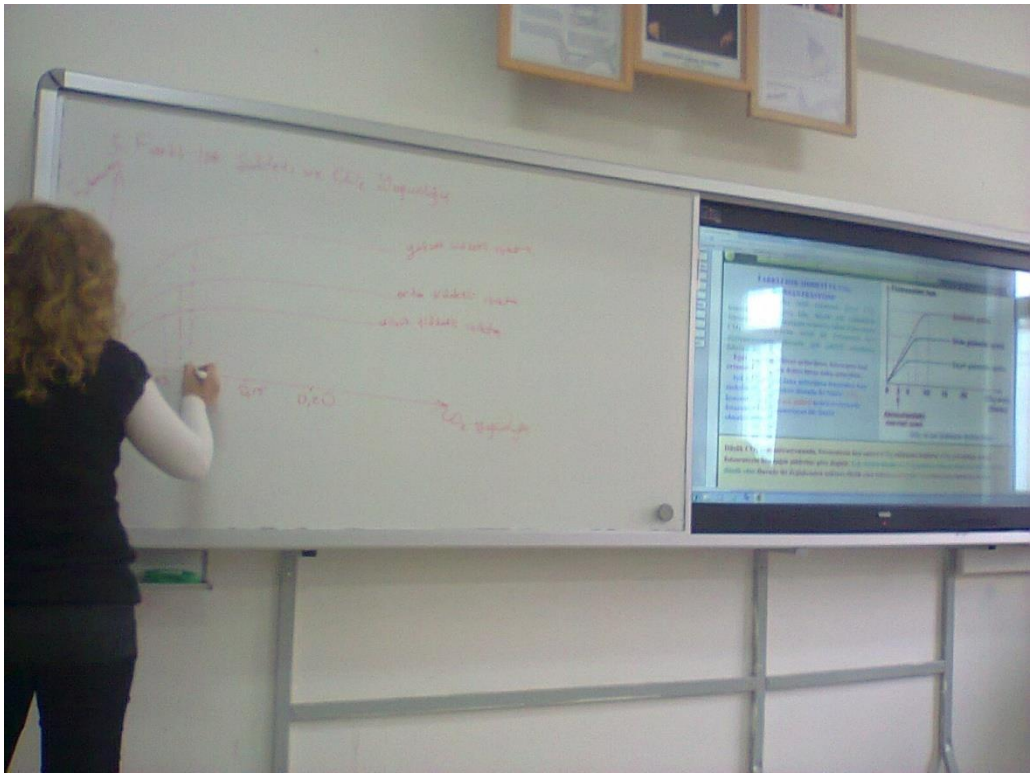

Figure 2. IWB in biology classroom

The responses to interview question nine provided detailed information in terms of understanding teachers' common uses of IWBs in science classes. The responses to the fifth question are presented in the Figure 3.

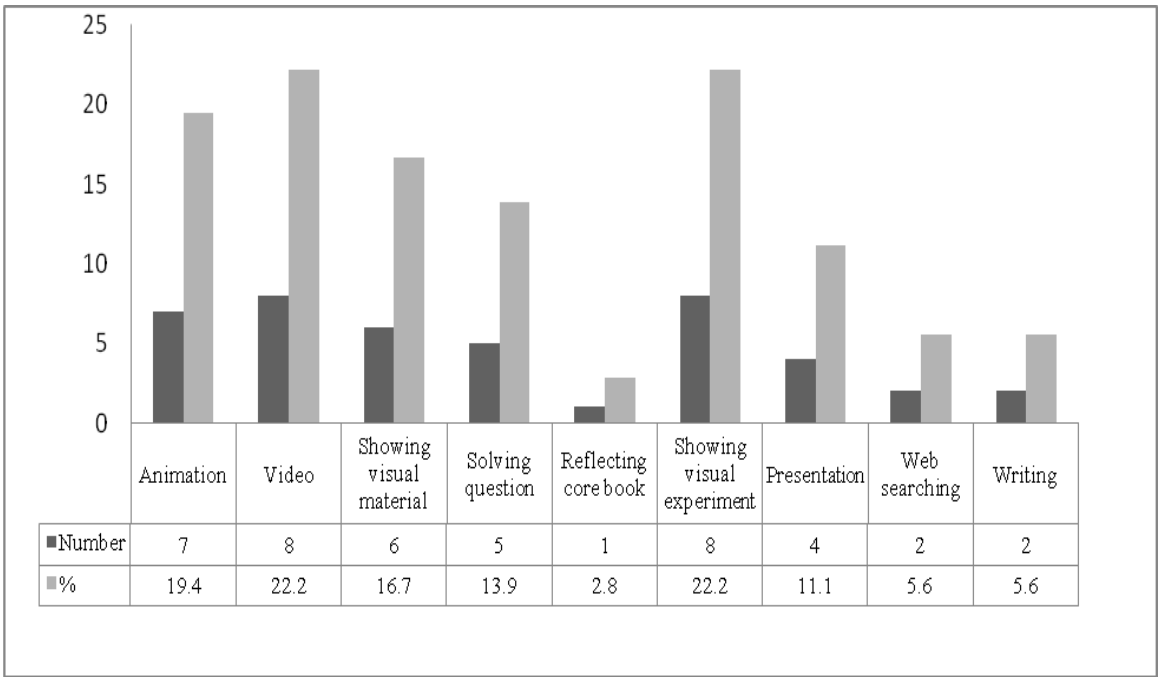

*Figure 3.*Teachers' common uses of IWBs in science classes

As seen in Figure 3, teachers state the common uses of IWBs as showing visual materials, videos and animations in science classes. 19.4% (*N*=7) of the teachers show animations by using IWBs during classes. 22.2% (*N*=8) of the teachers use IWBs for showing videos in the lessons. Also, teachers who use the IWBs for showing visual experiments account for 22.2% (*N*=8) of the total participants of interviews.

The usage of IWBs for writing, presentation and web searching is not as common as showing visual materials during classes. While 5.6% (*N*=2) of the teachers use IWBs for writing on the board, 5.6% (*N*=2) of them use IWBs for web searching during the classes. 11.1% (*N*=4) of the teachers use IWBs for presentations during classes. Also, there is only one teacher who prefers to use the IWB for reflecting the text books on the board.

In order to see the common uses of IWBs in science classrooms and to discover the problems related to this technology, the researcher also conducted observations of 16 different classes in which IWBs were used. The results of the observations are given in Table 10 according to teachers' subject areas.

Table 10
Basic functions of IWBs as a teaching tool in science classrooms

Basic functions of IWBs	Total	%
Teacher highlights a text or passage with different color.	1	6.25
Teacher uses her/his finger to draw or highlight something on the IWB screen.	8	50
Teacher searches for something on the Internet.	6	37.50
Teacher uses a specific software program during class.	10	62.50
Teacher uses the drag and drop function of IWB.	10	62.50
Teacher plays audio and video files.	3	18.75
Teacher writes on the board by using stylus pen.	2	12.50
Teacher navigates the texts and images from the board screen, not from the desktop or laptop computer.	11	68.75
Teacher uses the function of screen curtain.	11	68.75

As given in Table 10, 68.75% (N=11) of teachers navigate the texts and images from the board screen, not from the desktop or laptop computer. Also 68.75% (N=11) of them use the screen curtain features. Another common function which is used by 10 of the teachers (62.50%) is the drag and drop function of IWB. It is observed in the

classroom that 62.50% (*N*=10) of the teachers use a specific software program during classes. Also 50% (*N*=8) of them use their fingers for underlying or emphasising something on the board (see Figure 4). 37.50% (*N*=6) of the teachers use IWBs for web searching during classes.

Only18.75% (*N*=3) of the teachers play audio and/or video files. The number of teachers who highlight a text or passage with different color is just one (6.25%) and this function has the lowest percentage.

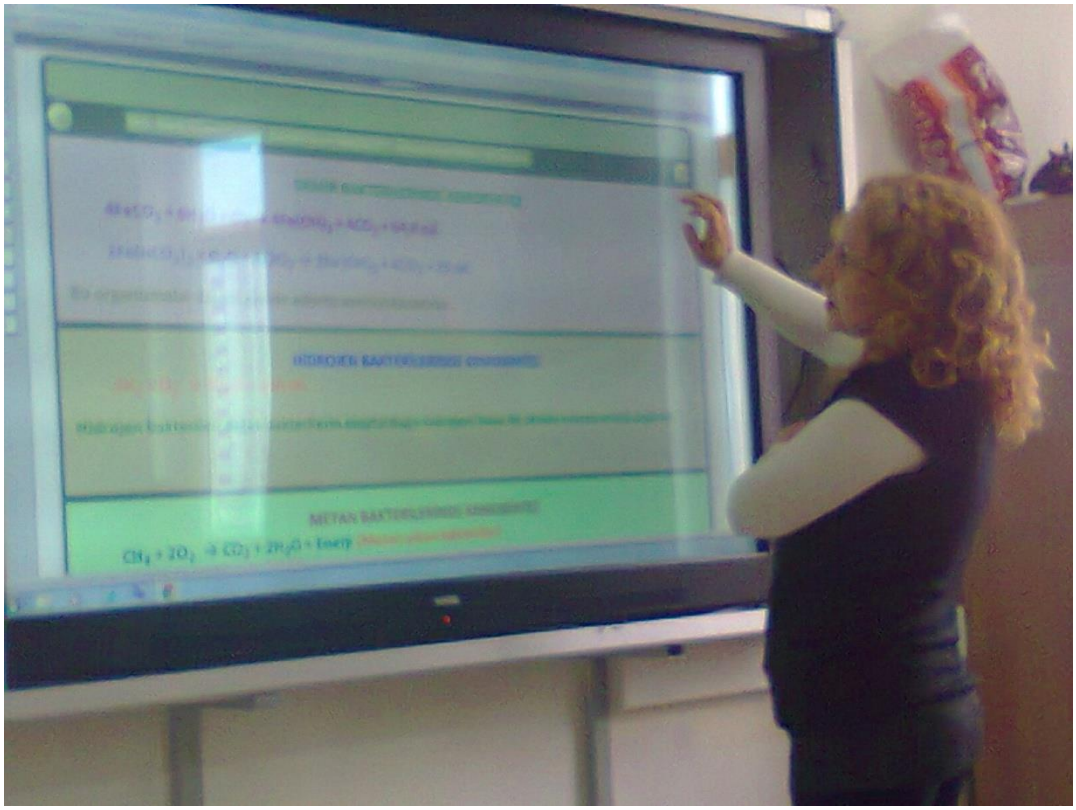

Figure 4.Teacher can use her finger to draw or highlight something on the IWB screen

Teachers' common problems which are related to IWBs

Teachers' commons problem while using IWBs during classes were investigated with interview question 14.

Table 11
The common problems which is related to IWBs

Common Problems which is related to IWBs	f	%
Not being able to see the things displayed on the IWB screen because of sunlight	1	6.2
Calibration settings and touch screen properties are damaged frequently	6	37.5
Students use the board out of intended purpose so IWBs are frequently damaged	6	37.5
Web connection is not sufficient	5	31.2
Eğitim Bilişim Ağı (EBA) does not update itself for new resources	5	31.2
Causing behaviour problems like the disruption of students' attention	3	18.7
Teacher needs a lot of time to prepare the materials	1	6.2
Discomfort in the eyes of teachers and students after extended interactions with the IWB and headaches	2	12.5
Teachers concern about the amount of radiation from IWBs	4	25
In-service training was unsatisfactory	10	62.5
Teachers need to become confident users but they think students are better about technology	5	31.2

Note: f: Frequency

Based on the scores in Table 11, 6.2% (N= 1) of the teachers state that sometimes, it is not possible to see the things displayed on the IWB screen because of sunlight (see

Figure 5). The teachers who think calibration settings and touch screen properties are damaged frequently make up 37.5% (*N*=6) of the total participants.

The reason for this was explained by Teacher 10:

> Since there are both chalk boards and IWBs in the classroom, the dust from the chalk boards damage the calibration property of the IWBs. The dust harms the touch-screen. Web connection is constantly slow so we cannot watch the videos. I use the teaching resources which I got used to while using old-fashioned projectors. Students use the board out of intended purpose, for listening to music at the break times. This issue also damages the calibration of IWBs. Lastly, in the service training, it was told that there would be tablet and IWB connection in the class. But it did not happen (Teacher 10).

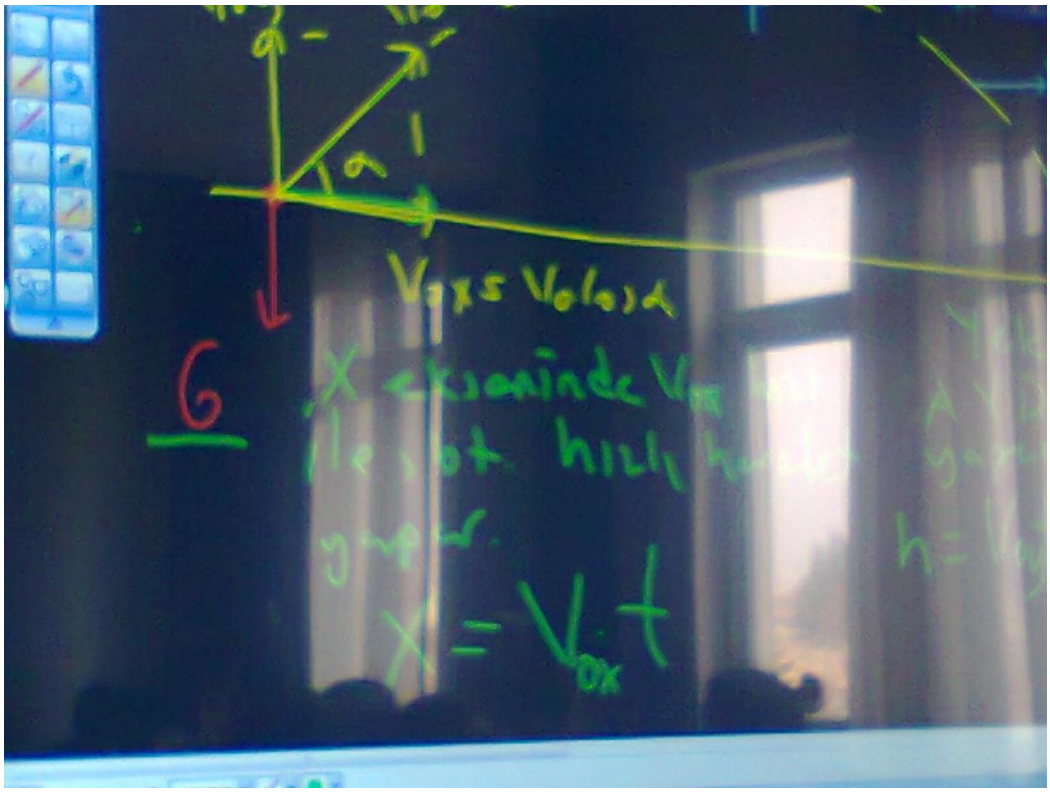

Figure 5. Not being able to see things displayed on the IWB screen because of sunlight

Just like Teacher 10, 37.5% (*N*=6) of the teachers state that since students use the board out of purpose, IWBs frequently break down. 31.2% (*N*=5) of the teachers think that web connection is not sufficient. Besides this, 31.2% (*N*=5) of the teachers

agree that EBA (Eğitim Bilişim Ağı) is not updated regularly with new resources. 18.7% (*N*=3) of the teachers agree that IWBs cause behavior problems like attention deficiency. Also some of the teachers indicated that this situation may be originated from teachers turn back to the classroom while writing on the IWB (see Figure 4). At the point of students' health, 12.25% (*N*=2) of the teachers think that students' eyes get tired when they continually look at the IWB screen and that the students suffer from headaches. In addition to these, 25% (*N*=4) of them were worried about the amount of radiation from IWBs.

Teacher 4 states that:

> IWBs damage the interaction between us and the students contrary to common belief. Students' attention is disrupted regularly. They suffer from headaches so I bought a radiation protector but it did not work. Our eyes get tired after we continually look at the screen. I tried to solve this problem by changing the color of the screen frequently. Using IWBs for every topic is meaningless, they are not proper for every topic. The preparation time for each lesson and searching for the materials take much more time than expected (Teacher 4).

Teachers who think in-service training was unsatisfactory make up 62.5% (*N*=10) of total interviewees. For the reason that 31.2% (*N*=5) of them think that students are better about using technology.

Teacher 13 states that,

> I am the guidance teacher of this school about IWB technology. According to my views, meeting with immense technology at young ages may cause problems in terms of children's health for the future. But at the same time, our students install programs and keep up with the technology very well. They are well-informed and are like the masters of the technology. Also, as another problem, tablets become a kind of play tool for students. The connection between the IWB and tablets of which we were told never became the reality (Teacher 13).

Research question 3: Differences among high school science teachers' attitudes (physics, chemistry, biology) towards the use of IWBs

In this section, differences among high school science teachers' attitudes (physics, chemistry, biology) towards the use of IWBs are categorized under two sub-sections:

- Keeping up with the educational technology
- The frequency of using IWBs

Keeping up with educational technology

Teachers' views which were related to keeping up with the educational technology were investigated with interview question five. The results were showed in the Figure 6 below.

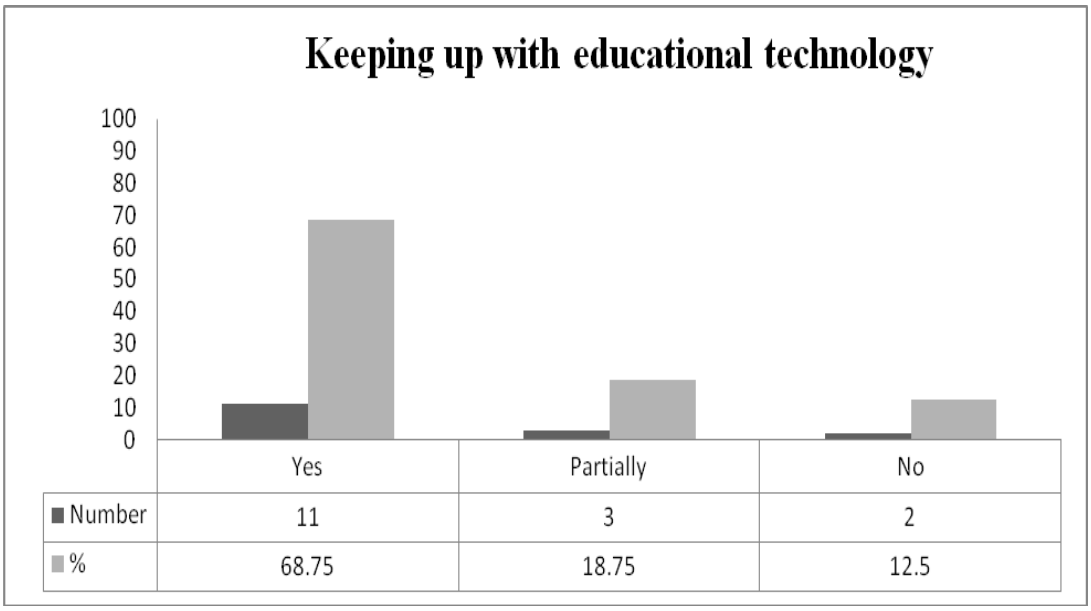

Figure 6. Distribution of teachers' responses towards the question of "Do you keep up with educational technology?"

As it is seen from the Figure 6, 68.75 % (*N*=11) of the teachers give the response of 'yes' to the question. It means that they keep up with the educational technology. 18.75% (*N*=3) of the teachers give the partially response which means they keep up with the technology to some extent. And %12.5 (*N*=2) of them stated that they do not keep up with educational technology.

Table 12
Distribution of different subject area teachers' responses to the question of "Do you keep up with educational technology?"

Responses	B	%	P	%	C	%	Total	%
Yes	4	25	3	18.75	4	25	11	68.75
Partially	1	6.25	1	6.25	1	6.25	3	18.75
No	1	6.25	1	6.25			2	12.5

B: Number of biology teachers
P: Number of physics teachers
C: Number of chemistry teachers

According to scores calculated in Table 12, it is clear that 25% (*N*=4) of all interviewees keep up with educational technology who are also in the discipline of biology. 6.25% (*N*=1) of them keep up with educational technology partially. And 6.25% (*N*=1) of them do not keep up with technology.

By considering the results of physics teachers, as it is seen in the Table 12, 18.75% (*N*=3) of all the interviewees who are also physics teachers keep up with the educational technology. 6.25% (*N*=1) of them keep up with educational technology partially. And 6.25% (*N*=1) of them do not keep up with the educational technology. Lastly, 25% (*N*=4) of all the interviewees who are also chemistry teachers stated that they keep up with the educational technology. Only 6.25% (*N*=1) of them stated that they keep up with the educational technology partially.

The frequency of using IWBs

The frequency of using IWBs in science classes was investigated in questionnaire with the question six. And it was investigated in the interview with 16 of the same teachers who participated in the questionnaire.

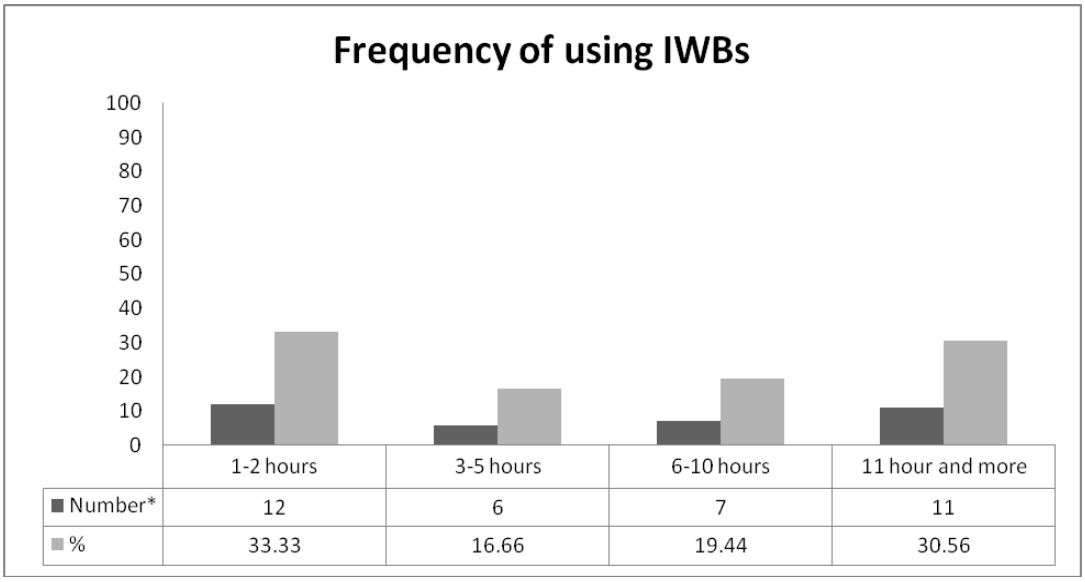

Figure 7. The frequency of using IWB in science classes (questionnaire results)

Number*: Number of teachers

Looking at the results at Figure 7, while 33.33% (*N*=12) of the teachers stated that they use IWBs 1-2 hours a week, 16.66% (*N*=6) of the teachers use IWBs for 3-5 hours in a week. And we see that 19.44% (*N*=7) of the teachers stated that they use IWBs 6-10 hours in a week. Lastly the second highest score belongs to 30.55% (*N*=11) of the teachers who stated that they use IWBs 11 hours or longer in a week. To check the consistency of the data, researcher asked the same question in the interview section. The results were shown in Table 13.

Table 13
The responses of different subject group teachers in terms of frequency of using IWBs

Responses	B	%	C	%	P	%	Total	%
Rarely	1	6.25	-	-	-	-	1	6.25
Sometimes	-	-	2	12.5	3	18.75	5	31.25
Often	4	25	4	25	2	12.5	10	62.5

B: Number of biology teachers
P: Number of physics teachers

C: Number of chemistry teachers

According to Table 13, 62.5% (*N*=10) of the teachers use IWBs in their lectures often. 25% (*N*=4) of all participants who are biology teachers, 25% (*N*=4) of all who are chemistry teachers and 12.50% (*N*=2) of all who are physics teachers stated that they use IWBs in their lectures often. 31.25% (*N*=5) of them stated that they sometimes use IWBs in their classes. Of these, 12.50% (*N*= 2) of all participants are chemistry teachers and 18.75% (*N*=3) of all are physics teachers. 6.25% (*N*=1) of all participants use IWBs in their classes rarely and this particular subject is a biology teacher.

Research Question 4: IWB's contribution to particular teaching processes of the high school science teachers

Two interview items (question 10 and 11) investigated teachers' views about IWBs' contributions to particular teaching processes. Question 10 aimed to learn teachers' views about the benefits of IWBs in science teaching settings. The question 11 was about when teachers use IWBs, whether they can attain the expected outcomes easily, or not.

Table 14
Teachers' views about IWBs' contributions to the science education

Teachers' views about IWBs'	P	%	C	%	B	%	Total	%
There is no benefit of IWBs to the science education	-		1	6.25	1	6.25	2	12.50
Showing the experiment in optimum conditions	3	18.75	3	18.75	1	6.25	7	43.75
Sharing the visual materials support the learning	2	12.50	2	12.50	3	18.75	7	43.75
Raising students' motivation and avoiding monotonous lesson	-		2	12.50	2	12.50	4	25.0
Saving of time	1	6.25	1	6.25	1	6.25	3	18.75

P: Number of physics teachers
C: Number of chemistry teachers
B: Number of biology teachers

As it is seen in Table 14, 6.25% (*N*=1) of all participants who are chemistry teachers and 6.25% (*N*=1) of all who are biology teachers stated that there is no benefit of IWBs to the science education. 18.75% (*N*=3) of all participants who are physics teachers and 18.75% (*N*=3) of all who are chemistry teachers and 6.25% (*N*=1) of all who are biology teachers gave responses as showing the experiment which is in optimum condition, contributes to science education.

Other contributions of the IWBs is stated by 12.50 % (*N*=2) of all participants who are physics teachers, 12.50% (*N*=2) of all who are chemistry teachers and 6.25 (*N*=1) of all who is a biology teacher stated that sharing the visual materials support the science learning. 12.50% (*N*=2) of all participants who are chemistry teachers and 12.50% (*N*=2) of all who are biology teachers claim that IWBs provide

motivation to students and help avoid monotonous classes. Lastly 6.25% (*N*=1) of all the teachers from each of the subject groups stated that IWBs help save time in science classes.

Table 15
Teachers' views which are related to the interview question 11

Views	P	%	C	%	B	%	Total	%
Yes	3	18.75	5	31.25	6	37.75	14	87.50
No	1	6.25	-	-	-	-	1	6.25
No idea	1	6.25	-	-	-	-	1	6.25

P: Number of physics teachers
C: Number of chemistry teachers
B: Number of biology teachers
Q11. If you use IWBs, do you think that you can attain the outcomes easily?

Table 15 indicates that 18.75% (*N*=3) of the physics teachers, 31.25% (*N*=5) of the chemistry teachers and 37.75% (*N*=6) of the biology teachers think that if they use IWBs in their lessons, they can attain the outcomes easily. Only one of the teachers stated that he/she has no idea about the question (6.25%). Lastly, one of the teachers thinks that if he/she uses IWBs, he/she will not attain the outcome easily (6.25%). Teachers' comments that are related to IWB's contributions to particular teaching processes can be exemplified as below.

Teacher 2 states that:

> IWBs are really beneficial to science education. Although teachers value the importance of conducting the experiment in the laboratory, it cannot be as effective as it is expected to be because of the huge number of students and other reasons. IWBs provide the opportunity to observe experiments in optimum conditions and discuss about problems and difficulties in crowded classrooms (Teacher 2).

Similar to Teacher 2, Teacher 5 states that:

> I use the IWBs especially for summarizing subjects to 12th grade students. Since they study for the university entrance exam, reviewing some topics is really easy with IWBs. Also, visual materials support learning and makes the knowledge last (Teacher 5).

Lastly, another different comment was provided by Teacher 10:

> If I use IWBs, I can attain the outcomes easier but IWB cannot work itself. Teacher is also important (Teacher 10).

CHAPTER 5: DISCUSSION

In this chapter, general findings of the research are discussed in detail. The chapter starts with the overview of the study which includes general explanation of the results. Secondly, the major findings of the research are introduced comprehensively in six categories. Thirdly, the implications for practice and further researches are explained. The final part of the chapter includes the limitations.

Overview of the study

This study investigated the beliefs and attitudes of high school teachers towards the use of IWBs in science classrooms (physics, chemistry and biology), actual uses of them in and possible contributions of IWBs to particular teaching processes of high school science teachers' teaching processes. Both qualitative and quantitative data were collected during the study.Findings of the data analysis were indicated in Chapter 4 in detail. The results showed that science teachers' attitudes towards the use of IWBs were mostly positive. According to the results of classroom observations and interviews, it was found that common uses of IWBs in science classes were: showing visual experiments, animations, videos and visual materials. Also, the possible contributions of IWBs to particular teaching processes of high school science teachers' teaching processes showed differences in different subject area teachers.

In the following section, the major findings and possible reasons for these findings are discussed under six sub-sections:

1. Distributions of ages, genders, experiences, schools and subject areas of teachers who participated in the study

2. Attitudes of high school science teachers towards the use of interactive white boards

3. Actual use of IWBs in high school science classes

4. Teachers' common problems which are related to IWBs

5. Differences among high school science teachers' (physics, chemistry, biology) attitudes towards the use of IWBs

6. Contribution to particular teaching processes of the high school science teachers

The major findings

Distributions of ages, genders, experiences, schools and subject areas of teachers who participated in the study

- The number of female teachers was higher than the number of male teachers in the study.
- The ages of the participants of the study were mostly 40 and over.
- The participants of the study were experienced teachers.
- There were 15 biology, 11 chemistry, 8 physics and 2 unspecified subject group teachers who participated in the study.

Attitudes of high school science teachers towards the use of interactive white boards

One of the aims of this research was to investigate science teachers' beliefs and attitudes towards the use of IWBs. Teachers' general views which were related to IWBs as a teaching tool were explored with questionnaire and interview questions.

According to teachers, using IWBs makes it easier for them to review, re-explain, and summarize a lecture. Most of the teachers agreed that they gave the explanations with utmost effectiveness with the help of IWBs.

In the literature, there are studies that found similar results (Glover & Miller, 2001; Mathews- Aydınlı & Elaziz, 2010). Another essential finding was the issue of time which was the time needed for the preparation of the lecture. A majority of teachers agreed that IWBs save time when they write on the board. According to Glover and Miller (2001), when teachers implement IWBs in their lectures, they need better preparations before the class. But, contrary to the findings of Glover and Miller (2001), the current research indicated that for the implementation of IWBs, teachers may not spend more time for the preparation of the lecture. In the literature there were two researches which found similar results with the current study (Mathews-Aydınlı & Elaziz, 2010; Türel &Johnson, 2012).

According to Gregory (2010), IWBs were significant for reducing behaviour problems in the classroom. Also, Türel and Johnson (2012) and Mathews- Aydınlı and Elaziz (2010) found similar results. Contrary to the findings in the literature, the current study indicated that IWBs may not facilitate classroom management, for the reason that some of the teachers claimed that students' attention can be distracted easily after long hours (see Table 11). Thus in the current study, it may be resulted from the teachers' common opinions that IWBs are not sufficient for classroom management alone, also teachers' performance is really important.

The majority of science teachers enjoy using the IWB technology and have positive feelings about it. Similar results were found in other studies in literature. Mathews-

Aydınlı and Elaziz (2010) and Altınçelik (2009) reported that teachers have positive attitudes towards the use of IWBs in their classes. Also, Türel and Johnson (2012) found that teachers were satisfied with using of IWB technology.

Demographic features of the participants bring another approach. Since the ages of the teachers who participated in the study were mostly 40 and over, the attitudes of teachers towards using IWBs were expected to be negative rather than positive. Waugh (2004) concluded that technology acceptance decreased as age increased (as cited in Kotrlik & Redmann, 2009, p. 46). According to Smerdon et al. (2000), experienced teachers were less capable of using computers and internet than less experienced teachers. But in the current study, although teachers' ages were 40 and over, their acceptance of IWB technology is extremely high.

Additionally, although teachers have positive beliefs and attitudes towards IWBs, it was found that they were not confident while they were using IWBs in classrooms. Smerdon et al. (2010) claimed that in-service teacher trainings and teachers' feelings of preparation are related. By looking at the responses to questions which were related to teacher training programs, most of the teachers stated that in-service trainings were unsatisfactory. These findings reveal that although teachers have the potential to use IWBs in their classrooms, they hesitate to use it because of needs to develop their technology skills.

Use of IWBs in high school science classes

Another finding of the current study was related to the actual use of IWBs in high school science classes. Regarding the teachers' responses which were collected with

the questionnaire and interviews, teachers admitted that IWBs are a good teaching supplement which makes it easier for a teacher to review, re-explain, and summarize the subject. While they strongly agreed that with IWBs it is easier to access different sources and display them to the whole class immediately, they also shared the same idea about IWBs that it makes it easier to save and print the materials generated during the lesson.

In addition to the questionnaire findings, results of the interview questions indicated that teachers mostly use IWBs to show visual experiments, materials, to show animations and to play videos in the science classes (Figure3). Thus it was found in the current study, the majority of the teachers prefer to use IWBs as a visual material for increasing the students' motivation and make learning permanent. Hodge and Anderson (2007) have reported similar findings, since IWBs integrate visual materials with active learning activities; it is a kind of facilitator of learning.

According to the views of Beeland (2002), IWBs address three modalities of learning: visual, auditory and tactile. In the current study, although teachers used a series of visual and auditory activities, no activity was observed for tactile learners. Thus some of the teachers indicate that EBA should provide specific activities which will incorporate the students into the lesson.

16 hours of observations in the science classes revealed that most of the teachers were able to use the basic functions of IWBs like: searching something on the internet, highlighting a text part, navigating the screen from the board itself and not

from the desktop computer, using functions of screen curtain and using specific software programs (Table 10).

During the classroom observations, one of the common uses of IWBs was searching for something on the internet spontaneously in the case of necessity. It was seen that freedom of accessing knowledge during classes reduces the pressure on teachers and promotes self-confidence. Hodge and Anderson (2007) also reported that; with the help of IWBs, teachers can bring the outside world like art galleries, scientists or the microscopic world into the classrooms.

Another important function which was used in observed classrooms was the drag and drop function of the IWBs. It was observed that teachers could make some changes on the lesson material immediately, could move figures and have implemented activities which are specific to IWBs. Bannister (2010) also reported in her study, by using the drag and drop function, many interactive activities can be arranged based on this simple idea.

Although the majority of teachers stated that they used IWBs for showing animations or playing videos in the interview, the findings in the observation phase were surprising in that only 18.75% (N=3) of the teachers played audio or video files. The reason for that may be originated the time limitation because of condensed curriculum in the lesson.

Teachers' common problems which are related to IWBs

In this section, the study focused on the common problems which were structured according to responses of science teachers who participated in the interview. The

results of the interview questions showed that 62.5% of teachers think that their in-service training was un-satisfactory. Therefore, teachers think that students are better at using IWBs rather than them. According to Smerdon et al. (2000), teachers' use of technology is related to their feelings of preparedness, and the feeling of preparedness can be strengthened with in-service trainings. Thus the results of both that study and the current one indicate that a majority of the teachers may become more motivated to use IWBs if they get proper in-service training.

Another problem is although teachers have StarBoard software program and tools which has included in IWB, most of them tend use the similar functions which are available in the proxy. Teachers do not use specific features of IWBs and most of them think that there is no basic difference between proxy and IWBs. Hence some of teachers think that there was no need such kind of costly innovation. From a different perspective, minority of teachers who use the specific features of the IWBs cannot describe the functions of IWBs which they use in the classroom. So according to result, it might be stated that most of the teachers' Technological Pedagogical Content Knowledge (TPACK) may be different from each other and need to be improved.

One of the common reported problems which were related to the use of IWBs was the frequency of damage to the boards or calibration settings. Teachers reflected that this problem may originate from the students' use of the board outside of intended purpose. According to teachers, students use IWBs as a play tool and they also listen to music and upload programs at the break times. During the classroom observations, the music sounds which came from the classes at the break times were commonly

observed. Thus, it can be stated that students' use of IWBs out of intended purpose may be the main reason for the frequent damage of the board.

Another common problem which was stated by the teachers is the insufficiency of the internet connection. In classroom observations, most of the teachers suffered from the lack of internet connection, and stated this problem in their interviews.

Another problem about the IWBs was the concerns about health, safety and the amount of resulting radiation. Teachers stated that students suffer from headaches after long hours of using of IWBs. In the literature there are some similar results (Bell 2001; Smith et al., 2005; Tameside MBC 2003). Also, the findings of other researchers, Koçak and Gülcü (2013), about teachers' concerns about resulting radiation, exhaustion of the eyes and headaches are similar to the current research.

As a final point, teachers wish to have relevant sources which can incorporate students to the lesson actively. They expect innovation from EBA for providing specific resources and activities which are available for IWBs. All of these findings reveal that if these problems can be solved, the expected results of the IWBs in education field may be as targeted.

Differences among high school science teachers' (physics, chemistry, biology) attitudes towards the use of IWBs

To evaluate the attitude differences among high school science teachers towards using IWBs, their acceptance towards keeping up with the educational technology was investigated. According to study, 68.75% of the teachers keep up with the educational technology regularly. Since the frequencies are approximately equal,

there was no significant difference between different subject areas of teachers in terms of keeping up with technology (see Table 12). This finding may be a reason for high acceptance ratios of IWB technology by high school science teachers.

Another important issue was frequency of using IWBs in the classrooms. Although most of the teachers had positive attitudes towards using IWBs, the number of hours which teachers use IWB technology was surprising. One third (33.33%) of the teachers stated that they use IWBs 1-2 hours in a week, and 30.55% of the teachers stated that they use IWBs 6-10 hours in a week. When it comes to differences among subject areas (physics, chemistry and biology), it can be stated that biology and chemistry teachers' use of IWB is more than physics teachers (Table 13). When the reasons for that were asked to physics teachers, most of them indicated that it might be originated from time limitation because of the needs of solving problem and practicing in especially physic lessons. Also they emphasize that since students find the physics lesson hard to understand, they prefer to solve problem and find IWBs activities are waste of time. This result can be related with the uses of IWBs in science classes. According to Table 13, it can be seen that physics teachers use basic functions of IWBs less than other teachers. This result may be correlated with teachers' opinion that using IWBs in every class is nearly impossible.

IWB's contributions to particular teaching processes of the high school science teachers

The final aim of this study was to investigate IWBs' contributions to particular teaching processes of the high school science teachers. 87.50% of the teachers stated that when they use IWBs in their lessons, they attain the outcomes easily. According to Smith (2000), IWBs provide the focal point and large images which motivate

students. Thus students remember lectures easily and objectives of teachers are fulfilled.

In the current study, 43.75% of the teachers stated that IWBs showing of the visual materials support learning. While, they think that IWBs improve students' motivation and help avoid monotonous lectures, they also indicate that IWBs have the possibility to show experiments in optimum conditions. Consequently, according their views, IWBs have important contributions to science classes.

Summary

The findings of this study are summarized as follows:

- High school science teachers have positive attitudes towards the use of IWBs in their classes.
- A majority of the teachers prefer to use IWBs as a visual material for improving the students' motivation and making learning permanent.
- Most of the teachers stated that IWB technology in classrooms should become more common all around Turkey.
- A majority of the teachers stated that when they use IWBs in their lectures, they attain the outcomes easily.
- The findings of the study reveal that biology and chemistry teachers tend to use IWBs more than physics teachers.
- On the contrary to the findings in the literature, the current study indicated that IWBs may not facilitate classroom management, some of the teachers claim that students' attention can be distracted easily after long hours.

- Although teachers have the potential to use of IWBs in their classrooms, they hesitate to use it because of their feelings of need to improve their technological skills.
- The results of the current study indicate that a majority of the teachers may become more motivated to use IWBs, if they get proper in-service training.
- Technical problems of IWBs may originate from using of the boards out of intended purpose.

Implications for practice

The FATİH Project has started to spread all around the country. To attain the maximum effectiveness in the scope of this project, the following actions are suggested:

- The in-service teacher training program which is about IWBs should be reorganized by considering the teachers' basic needs. Thus, the lack of confidence in using technology that is teachers' common problem can be dispelled.
- Since teachers prefer to use similar functions which they got use in the proxy, some of them found this innovation waste of money. The specific programs for IWBs, differences between proxy and IWBs may be explained in detail in in-service teacher training programs.
- The basic infrastructure problems (like internet connection problems) should be fixed by providing continuous technical service facilities.
- For further studies, infrastructure problems which were encountered in the pilot schools of FATİH project should be fixed at the beginning of the implementation step.

- EBA should create certain activities and games for IWBs which involve students' active participation in the lectures.
- The impacts of the IWBs to human health should be investigated by researchers.
- Students' access to the IWBs between classes should be regulated with some protective procedures.

Implications for further research

- In this research one of the aims was to explore high school teachers' beliefs and attitudes towards the use of IWBs in science classes, in addition to science teachers, research can be done with high school social science teachers.
- Other researchers can explore the compatibility of EBA's teaching resources designed for IWBs.
- This research explored attitude differences among high school science teachers (physics, chemistry, biology), the other researchers can investigate the usage differences between these three subject areas.
- The sufficiency of in-service teacher trainings which are provided by MoNE as a part of the FATİH Project can be investigated in further researches.
- This research explored high school teachers' beliefs and attitudes towards the use of IWBs in the pilot schools of the FATİH Project, tablet use can be investigated by other research.
- In this research, science teachers were a part of study as participants. The study can be conducted with school principals and students as participants for further researches.

- In this research, one-shot observation techniques were used as a part of data collection. For other research studies, a series of observations can be used for data collection.
- The research analyzed the beliefs and attitudes of the science teachers in high schools. Further researches can be implemented in primary or middle schools.
- This research was implemented in public schools. Other researches can be implemented with private schools.
- This research was implemented in the FATİH Project pilot schools in Ankara. Another one can be implemented all around Turkey for having judgment about general success of the project.
- In FATİH Project StarBoard Software program included with the IWBs. Other researches can investigate the other Software programs Open-Sankore, ActivInspire, Bi-Bright, etc.

Limitations

There are a number of limitations in this study;

- This study is limited to data gathered from the FATİH Project pilot schools in the city of Ankara. Although there are several more pilot schools currently using IWBs in Turkey, the number of participants was reduced due to financial reasons, the lack of time and travelling issues.
- In this research, since the number of participants was low (N=36), descriptive analysis was used as a statistical method. Thus, results and interpretation was inadequate for generalizing the study for all of Turkey.

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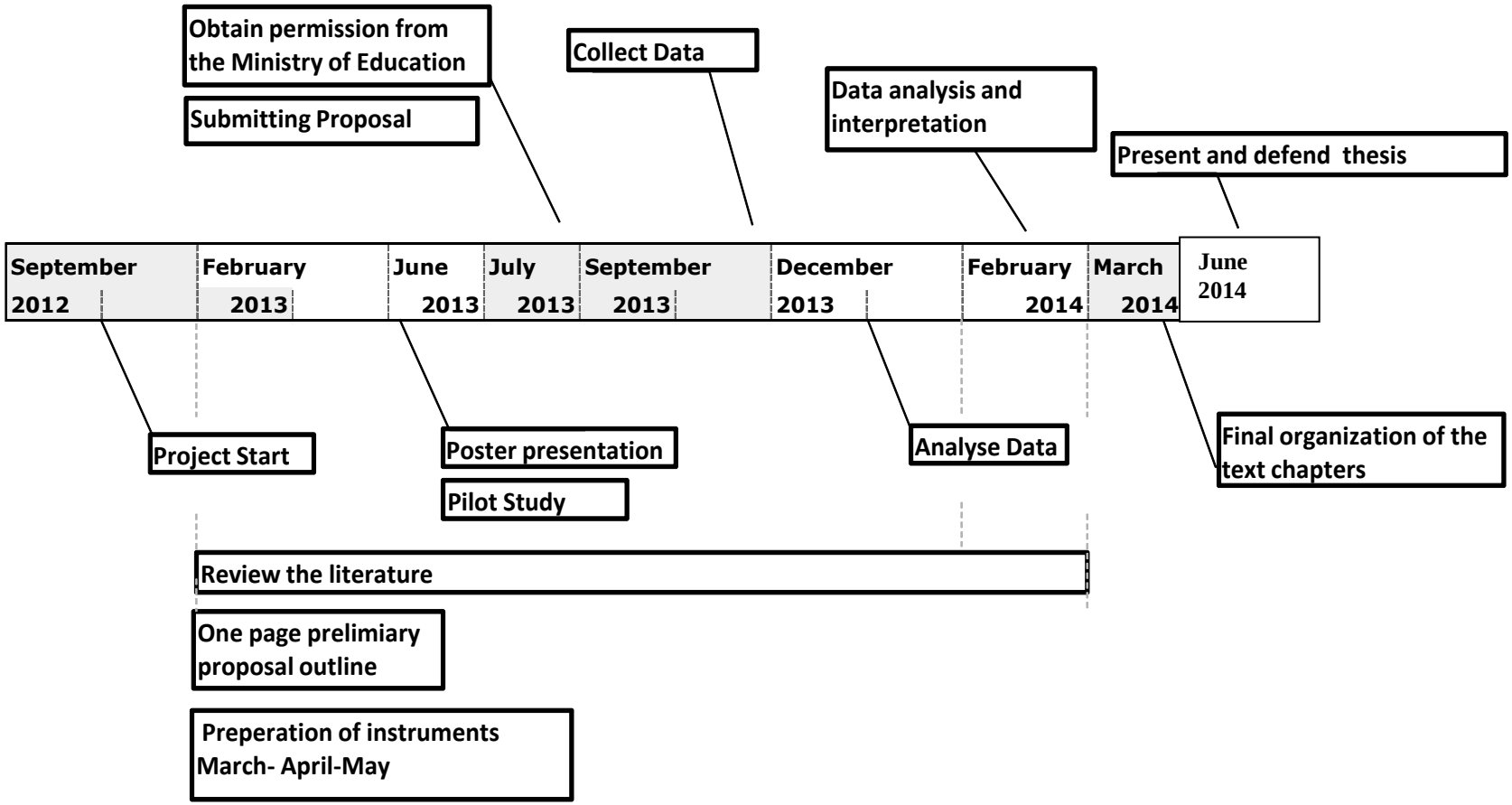
APPENDICES

Appendix A: Timeline



Appendix B: Teacher questionnaire

Dear participant,

This study is conducted in CITE Program in Bilkent University. It aims to investigate attitudes and perceptions of teachers towards the use of interactive whiteboards in science classrooms. This questionnaire for teachers is the first Phase of my study. All the personal data provided from questionnaires will be kept strictly confidential in my reports. Thank you in advance for your help and contribution.

Ceren Anatürk
ceren.anaturk@bilkent.edu.tr

Section I: General Information

1. Your age: 20-25 _ 26-30 _ 31-35 _ 36-40 _ 41-45 _ 46-Above _

2. Gender: Male _ Female _

3. Name of your institution/school you teach at
……

4. Subject
Area…….

5. Years of teaching experience:
1-5 years _ 6-10 years _ 11-15 years _ 16-20 years _ 21- above _

6. How many hours do you teach with an interactive whiteboard in science classes in a week?
1-2 hours a week _
3-5 hours a week _
6-10 hours a week _
11 or more hours _

7. For which skills do you use IWB technology most?

……

……...

Section II: General Attitudes

For the following items, please circle the answers that best resemble your opinion.

(O)

1= Strongly disagree

2= Disagree

3= No idea

4= Agree

5= Strongly agree

1. Using IWB-based resources reduce the time I spend in writing.	1 2 3 4 5
2. When using IWBs in the classroom, I spend more time for the preparation of the lecture.	1 2 3 4 5
3. I think using IWBs make it easier to reach different sources and display them to the whole class immediately.	1 2 3 4 5
4. IWBs are beneficial for they make it possible to save and print the materials generated during the class.	1 2 3 4 5
5. I can give more effective explanations with the use of IWBs.	1 2 3 4 5
6. With the help of an IWB I can easily control the whole class.	1 2 3 4 5
7. I think IWBs can be a good supplement to support teaching.	1 2 3 4 5
8. Using IWBs makes me a more efficient teacher.	1 2 3 4 5
9. Using IWBs make it easier for a teacher to review, re explain, and summarize the subject.	1 2 3 4 5
10. I like using IWB technology in my lessons.	1 2 3 4 5
11. I feel uncomfortable in front of my students while using IWB.	1 2 3 4 5
12. I have positive attitudes towards the use of IWBs in science classes.	1 2 3 4 5
13. I have negative attitudes towards the use of IWBs in science classes.	1 2 3 4 5
14. I do not think that my students are ready for this technology.	1 2 3 4 5
15. What I do in class with traditional methods is sufficient in teaching science.	1 2 3 4 5
16. I am not the type to do well with IWB-based applications.	1 2 3 4 5
17. I think IWBs make learning more enjoyable and more interesting.	1 2 3 4 5
18. I believe that training is required to teach with IWB technology.	1 2 3 4 5
19. If I do not get sufficient training, I do not feel comfortable with using IWBs in classrooms.	1 2 3 4 5

20. I can keep my students' attention longer with the help of IWB technology.	1 2 3 4 5
21. I think IWBs increase the interaction and participation of the students.	1 2 3 4 5
22. I think my students are more motivated when I use an IWB in my lessons.	1 2 3 4 5

Section III: Additional ideas and suggestions

1. Is there any other comment you would like to add about the use of IWBs:

……
2. Any problem or suggestion about the use of IWBs:

……
……

Thank you.

Appendix C: Teacher interview questions

1. Gender: Female ( ) Male ( )

2. Age: ( ) 20-30 **( )** 31- 40 **( )** 41- 50 **( )** 51-above

3. Years of teaching experience:

( ) 1-5 **( )** 6-10 **( )** 11-15 **( )** 16- 20 **( )** 25-above

4. Subject Area:

5. Do you keep up with educational technologies regularly?

6. How did you learn to use IWB?

7. How long have you been using IWB?

8. How frequently do you use IWB in your lectures?

9. When you consider your subject area, for what do you use IWB technology most (drawing, animation, photograph etc…)?

10. In your opinion, what could be the benefits of IWBs in science teaching settings?

11. When you use IWB in a class, do you think that you can attain the outcomes easier?

12. Do you recommend using the IWBs to other teachers?

13. Do you think that schools should start using IWB technology immediately?

14. What is the most common problems teachers face when using IWBs?

Appendix D: Lesson observation form

Name of the School:

Classroom:

Subject Area:

Number of Students:

Topic:

1.	Teacher highlights a text or parts of a text with different colors.	
2.	Teacher uses his/her finger to draw or highlight something on the IWB screen.	
3.	Teacher searches for something on the Internet.	
4.	Teacher uses a subject specific software program during the class.	
5.	Teacher hides and reveals a text or a part of a text or image.	
6.	Teacher uses drag and drop function of the IWB.	
7.	Teacher plays audio and video files.	
8.	Teacher writes on the board using a stylus pen.	
9.	Teacher saves written pages by clicking on the next icon.	
10.	Teacher prints out the students' work and distributes them to the whole class.	
11.	Teacher uses scanner to display the students' written product on the IWB.	
12.	Teacher uses a wireless keyboard	

	for writing on the board.	
13.	Teacher navigates the texts and images from the board screen, not from the desktop or laptop computer.	
14.	Teacher edits a student's written work on the board underlying, highlighting, or erasing.	
15.	Teacher uses the function of screen curtain.	
16.	Teacher prepares worksheets by using written materials in the class.	
17.	Connection is available between students' tablets and IWBs.	

18. Other uses**;**

19.
a) Board is difficult to see due to sunlight _
b) Computer breaks down or locks down _
c) Teacher is not confident with using the IWB _

Classroom Plan

Appendix E: Permission letter

From:	"Fatih Elaziz" <felaziz@gmail.com>
Subject:	Re: instrument permission
Date:	Thu, September 12, 2013 10:38 am
To:	ceren.anaturk@bilkent.edu.tr

Dear Anatürk,

No problem for using the questionnaire. Actually, it was modified by me and the original belongs to a foreign scholar.

Best regards.

M. Fatih ELAZİZ

2013/9/10 <ceren.anaturk@bilkent.edu.tr>

> Dear Mr. Elaziz,
>
> I am taking an MA course at Graduate School of Education at Bilkent
> Universty. One component of my course is to write a thesis. My research is
> about looking high school science teachers' beliefs and attitudes towards
> the use of IWB within the scope of FATIH Project.
>
> Having read your dissertation "ATTITUDES OF STUDENTS AND TEACHERS TOWARDS
> THE USE OF INTERACTIVE WHITEBOARDS IN EFL CLASSROOMS", I found parts of
> your instrument to be a good match for use in my research. Therefore, I am
> writing to ask permission to use a modified version of your questionnaire.
>
> I hope that you will be willing to share your hard work with me and look
> forward to hearing from you in the near future.
>
> Best regards,
> Ceren Anatürk

--
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