Interactive whiteboard use in elementary education

How to support teachers to improve their education, using the interactive whiteboard.

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Samenvatting

Het digibord wordt in het Nederlandse basisonderwijs veel gebruikt, en heeft veel mogelijkheden om waarde toe te voegen aan het onderwijs. Helaas worden op dit moment niet alle mogelijkheden ook daadwerkelijk gebruik, wat ervoor zorgt dat die toegevoegde waarde die het digibord heeft niet volledig wordt bereikt. In het verleden werden 'first-order barriers', redenen die extrinsiek zijn zoals techniek en tijd, altijd gezien als de grootste reden voor het niet volledige gebruik van de digiborden. Maar naar 'second-order barriers', redenen die intrinsiek zijn zoals kennis en houding, in combinatie met het digibord is nog weinig onderzoek gedaan. Daarnaast is er een behoefte aan de ondersteuning van leerkrachten bij het gebruik van het digibord, en de informatie over de 'second-order barriers' kan helpen bij het ontwerp van deze ondersteuning. Daarom was het doel van deze studie: (1) het signaleren van de invloed van 'second-order barriers' op het digibord gebruik van leerkrachten en (2) het signaleren van de voorkeuren voor ondersteuning van de leerkrachten om hun digibord gebruik te verhogen en daarmee de toegevoegde waarde van het digibord vergroten.

Dit is onderzocht door middel van een 'mixed methods' studie met twee verschillende onderdelen. Het eerste onderdeel was een kwantitatieve vragenlijst die het digibord gebruik van leerkrachten (N=393) en de invloed van de 'second-order barriers' op het digibord gebruik heeft gemeten. Het resultaat van deze vragenlijst was dat Nederlandse basisschool leerkrachten het digibord al regelmatig in hun onderwijs gebruiken, alleen zijn ze niet op de hoogte van alle mogelijkheden. De beste voorspeller voor het digibord gebruik van leerkrachten is kennis over het combineren van kennis over technologie, lesinhoud en didactiek, gemeten door het TPACK model van Koehler en Mishra (2009). Hoe deze kennis van leerkrachten het beste kan worden verbeterd is onderzocht in het tweede deel van deze studie, de focus groepen. De deelnemers (N=29) gaven aan dat alle geïntegreerde onderdelen van het TPACK model (Koehler & Mishra, 2009) belangrijk zijn om te leren tijdens een digibord training. Voor beginnende digibord gebruikers zou de nadruk hierbij moeten liggen op de integratie van de lesinhoud en technologie, terwijl de training voor ervaren digibord gebruikers zich zou moeten richten op de integratie van didactiek en technologie. Nederlandse basisschool leerkrachten willen dit graag leren aan de hand van praktische opdrachten, waarin zij een les maken die ze direct kunnen gebruiken in het onderwijs. Tijdens de training willen de leerkrachten ondersteuning van een expert, die een enthousiaste introductie geeft van alle basisvaardigheden en kan helpen bij het maken van de opdracht door vragen te beantwoorden.

Summary

The Interactive Whiteboard (IWB) is a widely used Information and communication technologies (ICT) device in the Dutch primary education which has a lot of possibilities to add value to education. Unfortunately not all the features of the IWB are being used by Dutch elementary teachers. This means that the potential added value of the IWB for education is not being achieved. First-order barriers, extrinsic reasons like using technology and time, are indicated in the past as the greatest reason for the above-mentioned. There is however, a lack of research on second-order barriers for example intrinsic reasons such as knowledge and attitude regarding the IWB. There is a need for IWB teacher support, and information on the second-order barriers can be valuable for the development of this support. Therefore, the goal of this study was: (1) to indicate the influence of second-order barriers on IWB use of teachers and, (2) to indicate the needs of support by teachers to improve their IWB use and gain added value from the IWB

This is done through a mixed methods study with two different parts; the first one was a quantitative survey which measured how teachers (N=393) use the IWB and how second-order barriers influence their IWB use. The results of the survey indicated that Dutch elementary teachers already use the IWB regularly in their education. However, they are not aware of all the features just yet. The best predictor for IWB use is the knowledge of how to integrate technology, and content in a pedagogically responsible way into a lesson as measured by the TPACK model of Koehler and Mishra (2009). How to improve the knowledge of teachers was measured in the second part of this study, the focus groups. Participants (N=29) indicated that all of the integrated parts of the TPACK model (Koehler & Mishra, 2009) are necessary to learn. However, the emphasis of the training for novice IWB users should be on integrating content and technology. The emphasis for experienced IWB users should be on integrating pedagogy with technology. Dutch elementary teachers like to learn this in training with a practical assignment in which they create a lesson that is ready to use. During the training they need support of an expert, who introduces the basics in an enthusiastic way, and is able to answer questions during the assignment.

1. About this study

This chapter provides an introduction of this study, including the ultimate goals. Literature states that the interactive whiteboard (IWB) can add value to education and is very popular. However, the added value of the IWB is often not achieved. Therefore, this study will explore how teachers make use of the IWB as they do, what factors influence IWB use, and explore how teachers can be supported to improve their use of the IWB.

1.1 Introduction

Information and communication technologies (ICT) have become an indispensable part of today's educational system. The rapid growth of ICT in education can be attributed to the perception of people that ICT enhances learning. A widely used ICT device is the interactive whiteboard (IWB). Nowadays, the IWB is located in about 75 percent of the Dutch classrooms (Kennisnet, 2013) and teachers are excited about it (Kennisnet, 2012). This popularity is due to the fact that the IWB fits with whole-class teaching, which suits traditional teaching methods (Hall & Higgins, 2005). The IWB can enrich classroom instruction, for example by supporting the instruction of the teacher with images, sounds, and videos and let the teacher save digital lessons (Kennisnet, 2011). The added value of the IWB for education is: (a) more vivid presentations, (b) clear organization of resources, (c) motivated pupils, (d) more interaction, (e) more insight in the learning process with voting machines, and (f) more collaborative learning (Kennisnet, 2010a).

However, the added value can only be achieved when teachers use the IWB the right way, and research states that this is often not the case (Beauchamp & Kennewell, 2013; Bidaki & Mobasheri, 2013). Previous research has shown that the main reasons for the limited use of all the features of the IWB are extrinsic for the teacher, like using technology, time and money (Bidaki & Mobasheri, 2013; Kennisnet, 2008). These are also called first-order barriers (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012). Prior research also found that these first-order barriers are most crucial for the integration of ICT in education. When there is no internet or an IWB that is not working properly the teacher cannot work with ICT. However, when the first-order barriers are resolved there are still some other barriers of importance for the right use of ICT, including the IWB. Those are reasons intrinsic to the teacher when it comes to the use of the IWB, like knowledge, attitude and beliefs (Bidaki & Mobasheri, 2013; Turel & Johnson, 2012; Kennisnet, 2010a; Bingimlas, 2009). These are called second-order barriers (Ertmer, et al., 2012).

According to the literature about second-order barriers and IWB use, teachers need to have a positive attitude towards the IWB, have the appropriate technical knowledge and skills, and need to combine them with the appropriate content and pedagogical knowledge to be able to use the IWB in a good manner (Beauchamp & Kennewell, 2013; Kennisnet, 2013; Sweeney, 2013; van Laer, Beauchamp & Colpaert, 2012; Kennisnet, 2010a). To achieve a positive influence on students' learning process and achievements with the help of the IWB, an interactive school culture is needed (Digregorio & Sobel-Lojeski, 2010). Teachers have to stop seeing the IWB as a set of tools which substitutes or supplements traditional teaching resources and start seeing the IWB as an aid to orchestration of the classroom. This means that the teacher has to arrange, organize or build features of the classroom (including the resources on the IWB) in such a way that they are appropriate for their pupils' characteristics, just like with other teaching materials. And the teacher continuously manipulate features of the classroom in response to students' actions (Beauchamp & Kennewell, 2013).

Current research states that because of the development of technology, first order barriers for the integration of ICT have decreased (Ertmer, et al., 2012). But the problems in using ICT are nowadays caused by second-order barriers like attitude and beliefs (Ertmer, et al., 2012). Most of the research of these second-order barriers concentrates on ICT in education and not specifically on the IWB. Therefore, this study will focus on the most frequently cited second-order barriers; *teachers' beliefs, attitudes* (Turel & Johnson, 2012; Westland, 2010), and *knowledge* (Beauchamp & Kennewell, 2013; Sweeney, 2013; Van Laer et al., 2012; Kennisnet, 2010a) in combination with the use of the IWB.

To let teachers use all the features of the IWB and gain the added value for education different studies indicate that support is essential (Beauchamp & Kennewell, 2013; Bidaki & Mobasheri, 2013; Sweeney, 2013; Turel & Johnson, 2012; Mathews-Aydinli & Elaziz, 2010; Kennisnet, 2008). However, how this support should be structured and how it can anticipate to second-order barriers is not fully explored. Therefore, the goal of this study is to: (1) indicate the influence of second-order barriers on IWB use of teachers and, (2) indicate the needs of support of teachers to improve their IWB use and gain added value from using the IWB. The outcomes of this study will indicate how Dutch elementary in-service teachers can be supported to make better use of all the features of the IWB. This support should be adapted to the prior knowledge of the teacher and to the teachers' view of the current practice for better learning (Timperley, 2008).

1.2 Scientific relevance

Besides the practical relevance of this study to the professional development of teachers, this study also has a contribution to science. The IWB is a trending topic in today's educational science, and according to Higgins, Beauchamp and Miller (2007) the most significant change in the classroom learning environment in the past decade. Different studies indicate a lot of promising possibilities for the IWB to improve the quality of education (Kennisnet, 2010a). However, there is a lack in specific research to second-order barriers in combination with the IWB in the Netherlands. This study creates more insight in the relation between second-order barriers and IWB use. Additionally, this study will also create more insight in the TPACK (Koehler and Mishra, 2009) of Dutch in-service teachers and their level of teaching with the IWB. Therefore, filling the gap in science and creating possibilities for practical research to professional development of teachers.

1.3 Overview of the following chapters

In the next chapter, Chapter 2, the theoretical framework including the added value of the IWB, the variables of this study and in-service teacher support will be further explained. Leading up to the research questions and hypotheses combined with the conceptual model of this study. Chapter 3 will describe the mixed method design used in this study. This includes a quantitative method for the first part of whereas the second part mainly consists of a qualitative method. The results of both parts of this study are described in Chapter 4, and discussed and conclude in Chapter 5, as well as some suggestions for future research.

2. Theoretical framework

In this chapter, the potential added value of an IWB will be explained, as well as the other variables of this study. This results in the research questions and hypotheses for this study. This study was performed in the context of the educational internet company Gynzy, some more background of this organization is described in the final part of this chapter.

2.1 The interactive whiteboard

2.1.1 Added value

According to Kennisnet (2010a) the added value of the IWB is: *more vivid presentations, clear organization of resources, motivated pupils, more interaction, more visible learning with voting machines, and more collaborative learning.* This corresponds to the four main characteristics of a powerful learning environment for optimizing learning in the classroom (Smeets, 2005). This powerful learning environment consists of (1) rich contexts and tasks that are as authentic as possible, and are provided to present connections to the world outside school, (2) active and independent learning that is stimulated, (3) co-operative learning that is stimulated, and (4) the curriculum that is adapted to the needs and capabilities of the individual pupils.

The IWB can support in achieving this powerful learning environment in the classroom. The connection to the internet brings the teacher in contact with a large amount of text, videos, pictures and digital learning materials which can bring the world outside the school into the classroom (1). Another advantage of the internet connection is that of all the materials support the teacher in creating interactive lessons (2) with content that is relevant for the pupils. Since the teacher has access to such a large amount of content, it is possible to adapt content to the needs and capabilities of an individual pupil (4) (Glover & Miller, 2001). The interactive lessons and digital features of the IWB, like the use of voting boxes, can change the interaction between pupils and teachers, and between pupils (Kennewell, Tanner, Jones & Beauchamp, 2008). The latter in particular can increase collaboration between pupils (3) (Levy, 2002; cited in Kennisnet, 2010a), but on the other side also independent learning can be stimulated by the IWB. This can be done by differentiate between the different learning levels of the pupils. When working and discussing together pupils will share different views with each other which will increase the learning effect (Kennisnet, 2010a).

2.1.2 IWB use

Although technology may hold a great advantage for education, it is the teacher who influences the integration process and therefore decides whether the potential of the technology gets achieved (Niederhauser & Stoddart, 2001). When teachers use the IWB they can progress from a novice user, who uses the IWB as a substitute of the blackboard, to an experienced user, who is confident in using the technology and has developed synergy between themselves, the technology and their pupils (Beauchamp, 2004).

In this study, this transition is described in a transitional framework (see Table 1) based on the transitional framework of Beauchamp (2004). In the framework, the progress of the skills of teachers when using the IWB is staged into five stages that are divided into three categories; Teaching content skills, ICT skills, and Pedagogical skills. This differs from the original framework. This alteration was made because the two original categories mechanical skills, and operating system use and file management are both about

the ICT skills of the teacher. Therefore, those two categories were combined into ICT skills. This created three new categories which were based on the three knowledge parts of TPACK (Koehler & Mishra, 2009) because these are the basic elements that a teachers needs to have to teach an IWB lesson. This model will be explained in the next Chapter.

In the transformational model the progression that a teacher makes when teaching with the IWB can be seen. During their progression through the model, teachers will use more of the IWB features, and become more interactive with their pupils. Every stage builds up on the prior stage. In the final stage; the synergistic user, the teacher uses all the features of the IWB and teaches interactive lessons teachers in this stage will achieve the full added value of the IWB.

2.2 Factors related to IWB use

Many different factors influence the instructional practice of the teacher. Wilkins (2008) studied a descriptive model with the factors: *knowledge, beliefs* and *attitude* that relate to the instructional practice of the teacher. Because the IWB in education is an instructional tool (Jang & Tsai, 2012) it is interesting to investigate the same factors only with the focus on the IWB use of the teachers instead of the instructional practice of the teacher.

2.2.1 Teachers knowledge

Teachers have to combine three basic elements to teach a lesson using the IWB, according to Koehler and Mishra (2009). This is described in a theoretical framework, which is called TPACK, see Figure 1. Technological, pedagogical and content knowledge form the basic elements of TPACK. This framework builds on the framework PCK of Schulman (1986) that describes the ability of teachers to integrate content knowledge with appropriate pedagogical approaches. Koehler and Mishra (2009) added technological knowledge to this framework as technology is nowadays an indispensable part of education.

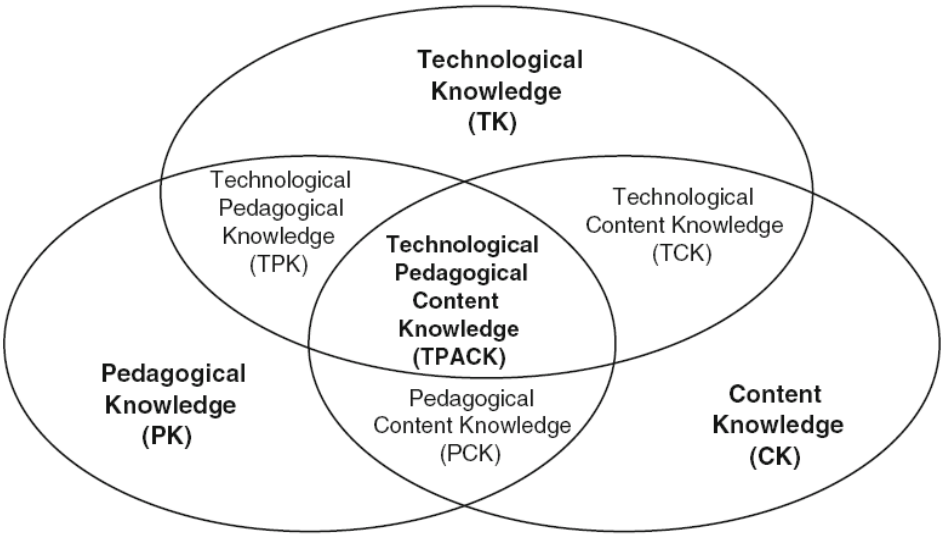

Figure 1: TPACK as depicted by Koh, Chai and Tsai (2013, p.795).

Table 1

The transitional framework of IWB use (based on Beauchamp, 2004)

Stage	Teaching content skills	ICT skills	Pedagogic skills
1. Black/whiteboard substitute	Teacher uses the IWB just like the old black/whiteboard. They write and draw on the IWB during the lesson.	Teacher uses the 'dig pen' and the computer to navigate the operating system. Teacher uses the IWB to show television programs. Teacher uses the 'board software', internet and word.	The interaction between teacher and pupils is limited to whole class instruction.
2. Apprentice user	Teacher uses the IWB to give linear presentations decorated with text and pictures. The IWB is used most in teaching core subjects, literacy and numeracy.	Teacher shows videos/audio from the internet. Teacher shows videos/audio from the internet. Teacher searches for IWB lessons from others, uses them and sometimes saves them.	Teacher lets the pupil use the IWB on planned moments to e.g. point to the correct figure or write down the answer.
3. Initiate user	Teacher uses the IWB regularly in the lessons and uses videos/audio from the internet to enrich the lessons. The IWB is used in growing range of subjects, e.g. history, geography and music.	Teacher uses a number of IWB programs and is able to switch between them. Teacher saves their self created lessons and the lessons of other teachers, and shares them with other teachers in an intranet environment. Teacher uses pictures and audio/video specifically for purpose, not just for decoration of the lessons.	Teacher invents and creates situations in where the pupils can work with the IWB.
4. Advanced user	The IWB has become an integrated part of education, with emphasis now on pupil learning rather than technical facility. The teacher can give interactive lessons (e.g. Mindmap).	The teacher uses scanned material (e.g. worksheets, textbook pages) to be showed on the IWB. The teacher is able to use external hardware in combination with the IWB (e.g. voting boxes or a tablet to navigate on the IWB). Teacher uses revised/improved versions of previous used lessons to enhance pupil learning. Teacher uses more and more external resources, e.g. links to websites. Teacher is able to integrate audio/video in the preparation of lessons.	The teacher lets the pupils frequently use the IWB as part of the lesson 'come and show me what you mean'.
5. Synergistic user	Teacher knows all the possibilities of the IWB and uses the IWB as an integrated part of education which results in fluid interactive lessons that motivate pupils to learn.	Teacher uses a lot of resources like, educational programs, audio, and video organizes and stores them as taken for granted. Teacher is able to share their lessons with other teachers outside their own environment (for example in communities or forums).	There is much interaction and collaboration between the teacher and the pupils, as well as between pupils. Teachers and pupils use the IWB in planned and unplanned situations, and are both able to construct meaning and dictate the direction, momentum and scale of the next step in the lesson.

TPACK describes seven categories of teacher knowledge which are needed for good education with ICT. Three of them are the main constructs: Technological knowledge, Pedagogical knowledge, and Content knowledge. Teachers need to integrate these three categories to be able to implement technology with relevant content and pedagogy styles. This integration forms four other categories with in the middle technological, pedagogical and content knowledge (Koehler & Mishra, 2009). Research to the coherence of the different categories of the TPACK model, concluded that the different parts are indistinguishable from each other (Chai, Ng, Li, Hang & Koh, 2013; Sahin, 2011; Archenbault & Barnett, 2010). There is an indirect relation between TK, CK, PK and TPCK, and there is a direct relation between TCK, TPK, PCK and TPCK (Chai, Ng, Li, Hang & Koh, 2013). It is more useful to focus on those intermediary parts than focus on only the basic parts; TK, PK, or CK (Chai, Ng, Li, Hang & Koh, 2013). Therefore when developing teacher training to increase teachers' TPACK, all the intermediary sources of knowledge need to be in the training.

2.2.2 Beliefs about teaching and learning

Teacher beliefs can be about anything that has to do with teaching. In this study we focus on the teacher beliefs about models of teaching and learning. Because the way in which a teacher teaches does not have to change because of the implementation of an IWB in the classroom, therefore teachers do want to use ICT when this fits to their beliefs about education (Van Gennip, 2008; cited in Kennisnet, 2010a). Which is in agreement with the conclusions of Kim, Kim, Lee, Spector and DeMeester (2013) and Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur and Sendurur (2012) that teachers enact their technology integration closely aligned with their beliefs, which means that beliefs will influence their IWB use.

There are two commonly used prototypic ideologies: (1) traditional beliefs, and (2) constructivist beliefs. These two beliefs are sometimes referred to as learner-centered beliefs, and teacher-centered beliefs (Ertmer, et al., 2012). Teachers with traditional beliefs, find themselves responsible for the regulation of the individual student learning. Teachers believe in whole class teaching, follow a textbook and teach subjects separately. In contrast, teachers with constructivist beliefs stimulate their students to take responsibility for their own learning processes and the regulation of these. They build the curriculum on student ideas, create thematic units based on students' interest, and prioritize student collaboration (Ertmer, et al., 2012; Meirink, Meijer, Verloop & Bergen, 2009).

When comparing these two beliefs with the transitional framework in Table 1, the first three stages of the model match with the traditional beliefs. The teacher is the one who uses the IWB and gives whole class linear presentations of which pupils cannot change the content. The constructivist teacher beliefs match the fourth and fifth stage of the framework, because pupils and teachers both use the IWB, and the lessons have a more interactive character in which the pupils and teachers both construct meaning and dictate the direction, momentum and scale of the next step in the lesson. This means that teachers with a high constructivist teacher belief are in a higher stage of the IWB use. On the other hand, teachers with a traditional teacher belief are in a lower stage of the IWB use. Because the focus of this study is on improving the IWB use, the focus will be on the constructivist teacher belief.

2.2.3 Attitude towards the IWB

Besides the influence that beliefs have on IWB use, attitude also influences the IWB use. The main difference between the variables teacher beliefs and attitude is that the belief is about how to teach, and the attitude is about how much a teacher likes the IWB. That attitude influences the IWB can be assumed by several studies indicate that there is a relation between attitude and ICT use, or ICT integration. For example, Sang, Valcke, van Braak and Tondeur (2010) concluded that attitude toward computer use in education is the strongest predictor of prospective computer use.

The attitude of teachers towards ICT in education has a strong effect on the actual use of ICT by teachers (Inan & Lowther, 2010).Teachers with a positive attitude towards computer use in education are more likely to favor the features of computers to enhance education (van Braak, 2001). Although the drawback is that a negative attitude means a significant barrier for the ICT use in education (Bingimlas, 2009). Because the IWB is an ICT device, it can be assumed that when teachers have a positive attitude towards the IWB this will influence their IWB use accordingly. There is not much research about attitude and the IWB, but the studies that do exist indicate a reversed effect; that teachers like the IWB more when they increase the hours of using the IWB (Mathews-Aydinli & Elaziz, 2009).

2.2.4 Teacher background variables

For the purpose of this study it is interesting to take some background characteristics of the teachers into account. These are; *Teaching experience*, the number of years that a teacher teaches, and *IWB experience*, the number of years a teacher works with the IWB. These two variables have some already pre-defined relationships with the other variables. For example; the relation between the teaching experience and the TPACK of teachers is found in a study of Jang and Tsai (2012). They found that when a teacher has more years of teaching experience they have a significantly higher TPACK than teachers who had fewer years of teaching experience. Other relations stated in the literature are between the IWB experience and TPACK, and between the attitudes of teachers towards the IWB. This first relation is found by Jang (2010), he states that the IWB technology can help to develop teachers' TPACK. The second relation is indicated by Mathews-Aydinli and Elaziz (2010). The hours of using the IWB increase the teachers' rating of how much they like using technology, in this case the attitude towards the IWB.

2.3 Professional development

As stated before, teacher support is essential when increasing teachers' use of all the IWB features and gain the added value for education (Beauchamp & Kennewell, 2013; Bidaki & Mobasheri, 2013; Hockly, 2013; Sweeney, 2013; Turel & Johnson, 2012; Mathews-Aydinli & Elaziz, 2010; Wood & Ashfield, 2010; Kennisnet, 2008). However, the already existing teacher training is often found inadequate, because it's focused on pre-service teachers, and lacking an in-depth follow-up as well as support that teachers need (Mathews-Aydinli & Elaziz, 2010).

Studies show some directions for a good and efficient IWB teacher training focused on improving teachers TPACK (Jimoyiannis, 2010; Kennisnet, 2012). Teachers and professionals have to work together, by asking critical questions, to learn from each other. During the teacher training there needs to be some practical assignments to design technology enhanced curriculum materials, those assignments can lead to an automatic integration of ICT in education. And when teachers' experiences will be combined with expert information this creates a sophisticated way of learning (Ng, Nicholas & Williams, 2010).

2.4 The current study

To summarize, the IWB is a widely used ICT device in the Dutch elementary education which has a lot of possibilities to add value to education. Unfortunately not all the features of the IWB are being used by Dutch elementary teachers, which means that the potential added value of the IWB in education, in most cases, will not be achieved. Prior research indicates that educational practices will be influenced by first-, and second order barriers. The first-order barriers are indicated in the past as the most important reason for the above-mentioned, but with improving technology, the contribution of second-order barriers becomes more and more important. There is some research on the influences of second-order barriers on ICT integration in educational practices. However, this research is insufficient to describe the influence of second-order barriers on the actual use of the IWB.

On the other hand there is an increasing demand for professional development of teachers for working with the IWB. Prior research states different directions for this professional development, and there are some studies that indicate some main topics. However, in which way this professional development of teachers for IWB use should be structured is not fully explored.

Therefore, this study investigates which factors influence the IWB use, and use these results for the second part of this study the exploration of the professional development of teachers for using the IWB. This leads to the following research question:

How can Dutch elementary in-service teachers be supported to make use of all the features of the IWB and create a powerful learning environment?

The answer to this question can be found by answering the following sub questions and their corresponding hypotheses:

1. *How do Dutch elementary in-service teachers use the IWB in their lessons?*
2. *Do the second-order barriers knowledge, attitude towards ICT in education and constructivist teacher beliefs influence the IWB use of teachers?*
   - *H1: A high knowledge score increases the IWB use.*
   - *H2: A high constructivist teacher beliefs score increases the IWB use.*
   - *H3: A positive attitude towards IWB increases the IWB use.*
3. *Do the teacher variables, teaching experience and IWB experience influence the IWB use of teachers?*
   - *H4: A high teaching experience leads to a higher knowledge which increases the IWB use.*
   - *H5: A high IWB experience leads to a higher knowledge which increases the IWB use.*
   - *H6: A high IWB experience leads to a higher positive attitude towards the IWB which increases the IWB use.*

To be able to support teachers with the use of the IWB it is interesting to know what type of support teachers need, therefore the last explorative sub question is:

4. *What needs for support do teachers have to improve their IWB use?*

The above mentioned factors that are related to the IWB use can be depicted in six hypotheses that lead to a conceptual model (see Figure 2) which guides this study.

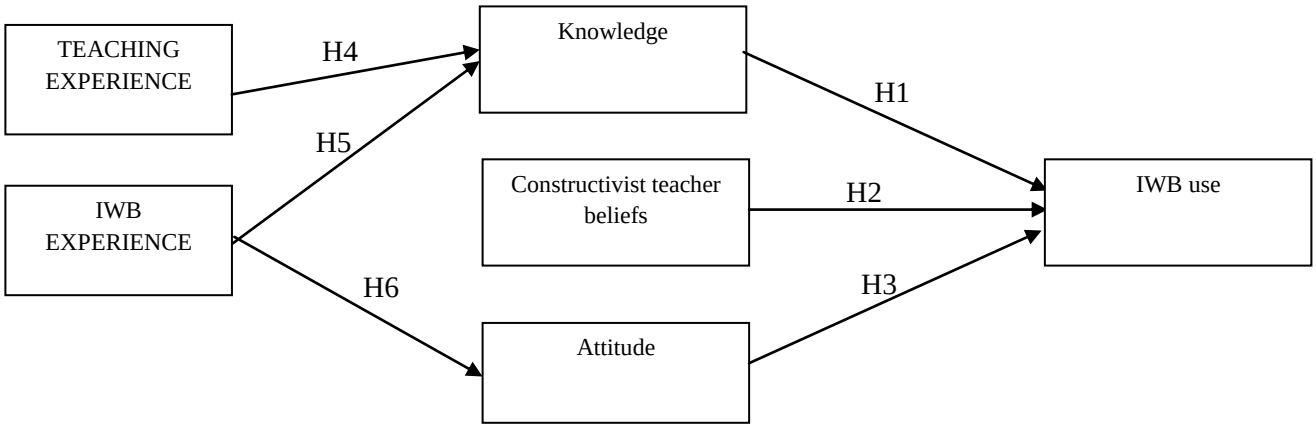

***Figure 2**:* Conceptual model of the hypotheses of this study.

2.5 Context

This study is performed in the context of Gynzy. Gynzy is an educational internet company, located in Eindhoven. Gynzy develops IWB software to help teachers get the most out of their IWB according to their mission:

"Helping elementary school teachers and pupils to an enjoyable and easy to use digital learning experience every day."

The software provides teachers with a total package including a board function, tools and lessons. It is independent of any method and independent of any brand IWB. Gynzy is used by approximately 50.000 teachers in the Netherlands. The feedback that teachers give is almost always positive; however, the usage numbers that Gynzy collect show that teachers just use about 25 tools per month of the 250 tools of Gynzy and about four tools per login. This is in agreement with the findings in the literature. Teachers are motivated to use the IWB, although they don't use all the features in order to achieve the earlier described added value of the IWB.

3. Method

The performed study consists of two parts. First a quantitative part with an online survey was performed with the goal to understand which factors influence teachers' use of the IWB. After the first part a second mainly qualitative part was carried out with the goal to find out what needs of support in-service teachers have. This was done by focus groups.

3.1 Research design

A mixed methods study was performed to examine the use of the IWB of Dutch elementary teachers. This study is divided into two parts, a quantitative and a mainly qualitative part, see Table 2. The parts followed each other sequentially; which is called a fully mixed sequential design (Leech & Onwuegbuzie, 2009).

Table 2

Overview of the sub questions and the two separate parts of this study.

	PART 1 Survey	**PART 2 Focus group**
(1) How do Dutch elementary in-service teachers use the IWB in their lessons?	X	
(2) Do the second-order barriers TPACK, attitude towards ICT in education and constructivist teacher beliefs influence the IWB use of teachers?	X	
(3)Do the teacher variables, teaching experience and IWB experience influence the IWB use of teachers?	X	
(4) What needs for support do teachers have according to improve their IWB use?		X

3.2 PART 1 – Online Survey

3.2.1 Respondents

The online survey was sent to 50.000 teachers using Gynzy, they received a link to the survey in the weekly newsletter of Gynzy. The teachers were approached by criterion and convenience sampling; the criterion is that the teacher should use the IWB, and teachers have the choice to participate or not (Onwuegbuzie & Leech, 2007). The pre-set goal was to reach the minimum of 385 respondents that completely filled in the survey. This number is calculated by the following formula (Moore & McCabe, 2007); $n=(z^*:2m)^2$. $z^*=1.96$ (according to a confidence interval of 95%) and the error rate (m) is 5%. This makes $n= (1.96:2x0.05)^2$, n= 384,16. Thus at least 385 respondents had to participate in this study to apply the findings to the entire population of Dutch teachers with a reliability of 95%.

The total number of teachers that responded to the survey was 480 (response rate of 0.96%), of who 393 filled in the complete survey. This is more than the minimum stated, therefore only the results of the 393 respondents that filled in the complete survey were used in this study. This means that the results of this study are representative for all the Dutch Gynzy teachers with a confidence interval of 95% and an error rate of 5%. 66 of the respondents were male (16.8%) and 327 of the respondents were female (83.2%), this is similar to the distribution of male (18%) and female (82%) teachers in the Dutch

elementary education (Stamos, 2012). The age of the respondents ranged from 20 to 63 (*M*=41.9; *SD*=11.7).

3.2.2 Instrumentation

An online survey was used to assess the knowledge, attitude towards the IWB, constructivist teacher beliefs and IWB use of the teachers, see Appendix 7.1. This survey consisted of 31 items divided over the four constructs; *IWB use (15 items), constructivist teacher beliefs (7 items), knowledge (4 items)* and *attitude (5 items)*. Five additional items were used to collect demographic information (age, gender, teaching experience, IWB experience and type of education).

All items were formulated as statements, and respondents were asked to indicate to what extent they agreed or disagreed with the statement on a five-point Likert scale: *(1) totally disagree, (2) disagree, (3) neutral, (4) agree,* and *(5) totally agree*. The only deviating construct is the IWB use, respondents were asked to what extent they use the IWB as stated using a five-point Likert scale: *(1) never, (2) sometimes, (3) regularly, (4) often,* and *(5) (almost) always*.

IWB use

The IWB use was measured using a construct based on the transformational framework of this study. The construct measured to what extent a feature of the IWB is being used by the respondent. This construct consists of 15, five-point Likert scale items, and the reliability of this scale was high, α=.84. An example of an item is: "I use the IWB to search for IWB lessons of others that I save to use in a later moment".

Constructivist teacher beliefs

The constructivist teacher beliefs variable was measured with one already existing construct of the Teacher Beliefs Survey (Woolley, Benjamin & Woolley, 2004). The constructivist teacher beliefs were measured with seven, five-point Likert scale items with an acceptable reliability, α=.64. An example of an item is: "Learners get a lot of time to work together".

Knowledge

Knowledge was measured with a TPACK construct consisting of four, five-point Likert scale items (Koh, Chai & Tsai, 2013), The reliability of this construct was high, α=.75. An example of an item was: "I can teach lessons that appropriately combine the teaching content, technologies and teaching approaches".

Attitude towards the IWB

And the last variable attitude towards the IWB was measured with five, five-point Likert scale items, from an existing construct of Turel and Johnson (2012). An example of an item was: "I notice my IWB skills are improving day by day". The Cronbach's alpha of this variable was low, α=.53. To improve the reliability of this scale, the first item is deleted. The reason for this low reliability is probably the fact that the first item was negatively formulated in the survey. With the item being deleted the reliability increases, the Cronbach's alpha raises to .66, which is acceptable.

3.2.3 Procedure

The invitation for the online survey was sent using the weekly newsletter of Gynzy, which was sent twice to all 50.000 Dutch Gynzy teachers. At the start of the survey participants were informed about the content and the goal of the study. Respondents were free to fill in the survey anonymously or not

anonymously by giving their e-mail address. At the end of the survey the respondents were asked if they were interested in participating in a second study. The incentive that 10 respondents could win for filling in the complete survey was a Gynzy workshop or a one-year subscription to the music tool from Benny Vreden.

3.2.4 Data analysis

The collected data was analyzed with SPSS 20.0. The data file was checked for errors and unusable responses were eliminated from analysis. Respondents with no IWB experience (*n*=2) were removed, which means that 393 responses were used for further analysis.

Before analyzing the data to answer the research questions, some other analyses were performed. First the two negative formulated items were reversed and the reliability of each variable was calculated. Subsequently total scale scores were calculated for the variables; IWB use, knowledge, attitude, and constructivist teacher beliefs to be able to perform the correlation and regression analysis.

To find out how Dutch elementary teachers use their IWB, the descriptive statistics of the variable IWB use were analyzed. In every stage of the transitional framework, three items were created. A respondent who is in stage three will allocate a lot of points to the first nine items and little points to the last six items. Respondents who scored between 5-15 points on the total scale score of knowledge were indicated in the first stage; *Black/whiteboard substitute*, respondents who scored 16-30 points were indicated in the second stage; *Apprentice user*, 31-45 points were respondents in the third stage; *Initiate user*, 46-60 points were respondents in the fourth stage; *Advanced user*, and last respondents who scored between 61-75 points were indicated in the fifth stage; *Synergistic user*. The percentage of the number of teachers in a specific stage of the transformational model is calculated

To indicate any relations between the variables, a correlation matrix was made using the Pearson product-moment correlation coefficient. Thereafter some preliminary analyses were performed to check the assumptions normality, linearity and homoscedasticity. Subsequently the impact of the predicting variables on the IWB use was measured using a four block multiple regression analysis. The first three blocks contained the three variables of this study; first knowledge, second constructivist teacher beliefs and third attitude. In the fourth block the teacher background variables and age were added to the analysis. This order was based on the conceptual model. In order to test the mediating effect that was stated in the conceptual model a mediation analysis was conducted. This analysis was done in four steps, (1) indicate a significant relationship between the independent variable of interest and the mediator (another independent variable), (2) indicate a significant relationship between the mediator and the dependent variable, (3) indicate a significant relationship between the independent variable and the dependent variable, and at last (4) indicate a relationship between the independent variable, and no significant relationship between the mediator and the dependent variable when performing multiple regression analysis. There is perfect mediation when all the steps have a positive significant result.

3.3 PART 2 – Focus Group

3.3.1 Participants

The 29 participants of this qualitative part of the study were approached by snowball sampling (Onwuegbuzie & Leech, 2007), respondents of the first part indicated that they wanted to participate in the second part and recruited other teachers to participate in one of the five focus groups of this study. This

number of focus groups was chosen because three to five focus groups are typically enough to reach saturation (Morgan, 1997; cited in Onwuegbuzie & Leech, 2007).

The number of participants to the five focus groups ranged between the three and nine. The best number of participants for a focus group to create a discussion is six to ten (Morgan, 1997; cited in Onwuegbuzie & Leech, 2007). Three of the five focus groups reached this limit, although one focus group consisted of five participants and one of only three participants because of illness.

The participants consisted of two men (6.9%) and 27 (93.1%) women, and the age of the participants ranged from 23 to 59 (*M*=40.9; *SD*=10.96). The participants had an average of 14.17 years of teaching experience (*SD*=10.01) and used the IWB for approximately 2.43 years (*SD*=2.40). The knowledge level of the participants is quite high, the average knowledge score of the participants is 13.17 (*SD*=2.67).

There weren't any major differences between the five focus groups, see Appendix 7.2. All groups had the same mean scores on the variables of Table 8. Although the differences were small, Focus group 4 was quite young (*M*=35.2), and Focus group 1 was quite old (*M*=49.2). In the other variables there were also only some small differences, the participants of Focus group 1 had quite low IWB experience (*M*=0.95), same as Focus group 3 (*M*=0.74). Focus group 1 scored low on knowledge (*M*=10.7). The Focus group with the highest knowledge score compared to the others was Focus group 3 (*M*=15.7), they were also the most experienced Focus group (*M*=6.7).

3.3.2 Instrumentation

A qualitative focus group was used for this part of the study to examine what needs teachers have for support in using the IWB. Focus groups have the advantage that they are fast and efficient in obtaining multiple participants; the informal environment makes the respondents feel safe enough to share information; and the interaction between the participants can yield important data (Onwuegbuzie, Dickinson, Leech, & Zoran, 2009). These advantages make a focus group the perfect method for this part of the study. Furthermore, the data from a lot of in-service teachers could be obtained in a short amount of time. Because teachers are always busy, the focus group was held in half an hour. To be able to gain as much information in that little time, the focus group had to be made highly structured.

The focus group consisted of three parts. In the first quantitative part the participants were asked to fill in their age, gender, teaching experience, IWB experience and answer the four knowledge questions from the survey of part 1 (α=.73). The second part of the focus group focused on what teachers want to learn. The third part focused on how teachers want to learn.

Materials

The first and second part of the focus group were highly structured. At the start of the focus group the participants had to fill in an individual form. On this form they had to answer the questions regarding their background and respond to the second question. The answer for the second question was structured with 20 cue cards with propositions based on the intermediary parts of the TPACK model of Mishra and Koehler (2009), see Appendix 7.3. Every intermediary part; TCK, PCK, TPK, and TPCK formed the base for five propositions, because it is more important to focus on these intermediary parts (Chai, Ng, Li, Hang & Koh, 2013). An example of a proposition is: *'Anticipate to the different levels of pupils with appropriate content on the IWB'*. This proposition is linked to TPCK. The propositions were based on propositions of different surveys (Chai, Ng, Li, Hong & Koh, 2013; Archembault & Barnett, 2010).

3.3.3 Procedure

All participants received an informed consent brochure by e-mail, one day before the focus group. The goal, the length and the confidentiality of the focus group was explained in this brochure. The focus groups were all held in the school of the participants, in order to make the participants feel comfortable. At the start of the focus group the researcher introduced herself and explained the goal of the study, the different parts of the study and she also emphasized that all information would be treated confidentially and anonymously. The participants had to read the informed consent form, and when they filled in the form they gave permission to have the conversation recorded. The focus groups took approximately half an hour each, and were recorded on video and audio.

The participants individually had to choose five of the 20 propositions of which they have difficulties with during an IWB lesson. Afterwards they had to divide 10 points to these five answers. The most points had to go to the proposition of which the participant wanted to learn most, and the least amount of points to the proposition of which the participant wanted to learn the least. After this the participants got a few minutes to discuss which propositions a novice IWB-user needs to learn, which propositions a intermediate IWB-user needs to learn, which propositions a experienced IWB-user needs to learn, and which propositions do not need to be learned. These four categories are based on the transitional framework of this study, but the five categories of the framework are limited to novice, intermediate and experienced IWB user, or don't need to be learned, because these are more obvious for the participant.

After this question the participants had to discuss the second main question; "How do teachers want to learn?" This second question was much less structured. The researcher asked the question, how do you want to learn? And indicated some optional answers; 'do you want to learn from a book, a website, a presentation, exercises, or something totally different?' During the discussion that followed, the researcher motivated the participants to focus on the different types of IWB-users and some questions were asked about the advantages and disadvantages of the proposed methods.

After the focus groups the participants where thanked for their participation and the member check was explained to them. The member checks were formed by a small introduction about the used method and a summary of the conversation was sent to the participants two days after the focus group, in order to strengthen the construct validity (Dooley, 2001). Participants had one week to respond with adjustments and additions. There were no responses on this member check.

3.3.4 Data analysis

The data of the focus groups were analyzed in two different parts. First the negatively formulated item of the knowledge variable was reversed and the reliability was calculated as well as the total scale score. Descriptive analyses were done on the five separate focus groups as well as of all the participants together. How frequent a participant chose a specific cue card, and the scores attached to them were calculated and put into a table. The percentage of focus groups that attributed a cue card to one of the four categories was added to the same table. These results were compared with the descriptive information of every focus group.

The results on video of the second part of the focus group were transcribed and encoded. The answers of the focus groups on the question how teachers want to learn were compared using a cross case analysis.

This is a methodology that makes sense of masses of qualitative data from multiple sources and ensures that these findings are objective, reliable and valid (Miles & Huberman, 1994; Yin, 1994). The results were classified into three main subjects, based on data; *Cooperative learning*, *Curriculum development*, and *Support*. Everything else mentioned by the participants was classified as; *Other findings*.

Table 7

Results of the cross case analysis of the second part of the first question.

		FG 1	FG 2	FG 3	FG 4	FG 5
Cooperative Learning	Working together on the IWB, in small groups (max 2-3 teachers) to exchange experiences and knowledge.	√			√	√
	Work in small groups with the same level of IWB experience and skills.	√				√
	Working alone on assignments, but afterwards exchange tips, tricks and experiences. To learn from each other.		√	√	√	√
	Give your colleagues assignments, so that you get information about topics you need to know.		√			
	Get practical examples of how to use the IWB in your lessons.	√			√	
	Exchange tips, tricks and experiences on regular basis, for example during the monthly meeting.	√	√	√	√	√
Curriculum Development	Learning by doing; doing practical assignments that are close to real practice.	√	√	√	√	√
	Relate assignments to teaching methods, so you can use the lesson that you create, while practicing.	√	√	√	√	√
	A follow-up course to repeat all the learned and ask new questions, for better learning.			√	√	√
Support	An enthusiastic introduction before the practical assignments.	√	√	√	√	√
	During the practical assignment there needs to be support, for example an expert, to ask questions.	√	√	√	√	√
	An expert that observes you while working with the IWB and gives feedback afterwards.			√		
	E-mails with tips and tricks about how to use your IWB, updates, and give interactive lessons is convenient.				√	
Other findings	Watch out with overcharging too much time.			√		√
	It stays important that the equipment, for example, the computer, the IWB, and the internet should work.				√	
	Set aside some time to learn to work with the IWB. They prefer a study day but it's also good to plan time during the monthly meeting. This can be very short.	√	√	√	√	√
	The method of teach like a champion can be great for this topic.	√	√			
	The design of the HEMA-academy is great for this topic.					√

4. Results

In this chapter the results of the online survey and the focus groups are depicted. First is described how teachers use the IWB. Second the results of the correlation and regression analysis are depicted, which results in the new predicting model. The results of the second part of this study are separated into two parts. What teachers want to learn regarding to the IWB is described first, and second the results of the second part of the focus group; how teachers want to learn more about the IWB are described.

4.1 Results part 1 – Online survey

4.1.1 Descriptive statistics

The mean scores of the variables of this study were calculated to explore the results on the different variables, as well as the predicting variables and the dependent variable. An overview of the minimum scores, maximum scores, the mean scores (*M*), and the standard deviation (*SD*) is given in Table 3.

Dutch elementary teachers have a relatively high IWB use, knowledge, constructivist teacher beliefs, and attitude. The maximum score is achieved in all of the variables. Interesting is that knowledge is the only variable of which one or more respondents indicated themselves very poor and reached the minimum points.

Table 3

Descriptive statistics of all the variables of this study.

Variable	*Range*	*Min.*	*Max.*	*M*	*SD*
IWB use	15-75	24	75	45.87	8.21
Constructivist teacher beliefs	7-35	15	35	25.42	3.19
Knowledge	4-20	4	20	14.70	2.81
Attitude	4-20	7	20	16.15	2.42
Teaching experience	-	1	50	16.96	11.34
IWB experience	-	1	12	4.42	2.00

4.1.2 IWB use

The use of the IWB of the Dutch elementary teachers is mainly centered into the third and fourth stage of the model. Most of the respondents scored between the 31 and 45 points [*M*=45.87, *SD*=8.21], see Table 4, which means that more than 90% of the Dutch elementary teachers are initiate users and after that are some advanced users.

Table 4

Frequencies of the variable IWB use.

	Range of Points	*N*	Percentage
Stage 1; Black/whiteboard substitute	5 – 15	0	0.0%
Stage 2; Apprentice user	16 – 30	10	2.5%
Stage 3; Initiate user	31 – 45	192	48.9%
Stage 4; Advanced user	46 – 60	176	44.8%
Stage 5; Synergistic user	61 – 75	15	3.8%
Total		393	100%

4.1.3 Predicting IWB use

The results of the Pearson product-moment correlation coefficient can be seen in Table 5. There are two strong positive relationships, between age and teaching experience and between knowledge and IWB use. Age helps to explain 72% of the variance in respondents' teaching experience score. And knowledge helps to explain nearly 25% of the variance in respondents' IWB use score, which are quite large relations. Somewhat lower, but still quite respectable relations were found between the variables Attitude and IWB use, and Constructivist teacher beliefs and IWB use. Both the variables explain nearly 11% of the variance in respondents' IWB use score. This means that there is a positive relation between IWB use, knowledge, constructivist teacher beliefs and attitude towards the IWB. A higher score on one of these three independent variables means a high score on the dependent variable IWB use. Other significant positive correlations were found between knowledge and constructivist teacher beliefs and IWB experience and knowledge, only these were very small.

Table 5

Correlation matrix with all the variables of this study (N=393).

Measures	**1**	**2**	**3**	**4**	**5**	**6**
(1) Total IWB use						
(2) Total knowledge	0.497**					
(3) Total constructivist teacher beliefs	0.329**	0.227**				
(4) Total attitude	0.328**	0.239**	0.218**			
(5) Age	-0.087	-0.149**	0.063	0.161**		
(6) Teaching experience	-0.071	-0.144**	0.040	0.151**	0.849**	
(7) IWB experience	0.127*	0.141**	-0.003	0.056	0.223**	0.252**

** = p<0.01; *= p<0.05

All variables were entered in the multiple block regression. Consistent with the conceptual model in Figure 2, the variable knowledge was entered in the first block. The second block contained the variable constructivist teacher beliefs, the third block the variable attitude, and the final block the variable IWB experience, teaching experience and age.

The model as a whole explained 33% of the variance in IWB use F (6.386) = 33.18; p < .001. As can be seen in Table 6, the best predictor for IWB use is knowledge, followed by constructivist teacher beliefs and attitude. The other predicting variables IWB experience, teaching experience and age do not make a unique significant contribution to the dependent variable IWB use (p > .05).

Table 6

Results of the 4-block multiple regression analysis.

	Block 1 (ΔR^2 = .247)			*Block 2 (ΔR^2 = .049)*			*Block 3 (ΔR^2 = .032)*			*Block 4 (ΔR^2 = .012)*		
	Adj. R^2	***B***	***β***	***Adj. R^2***	***B***	***β***	***Adj. R^2***	***B***	***β***	***Adj. R^2***	***B***	***β***
Knowledge	.245	1.452*	.497	.293	1.301*	.446	.323	1.192*	.408	.330	1.099*	.399
Constructivist teacher beliefs					.584*	.227		.501*	.195		.528*	.198
Attitude								.638*	.188		.692*	.186
IWB experience											.342	.083
Teaching experience											.011	.016
Age											-.076	-.108

** p < 0.001*

Because the conceptual model includes two mediators: knowledge and attitude, a mediator analysis was performed according to the steps outlined in section 3.2.4. The analysis revealed a mediating effect of knowledge on IWB experience. This means that when a teacher gains more IWB experience the knowledge will increase which increases the IWB use of the teacher. The results of the 4-block multiple regression and mediator analysis can be found in the final model of this study, see Figure 3. The β-values in Figure 3 indicate that when the predicting variable, for example knowledge, increases by one standard deviation (*SD*=2.81) the score of the dependent variable, in this case IWB use (*SD*=8.21), will increase by 0.399 standard deviation units. In this case; 0.399*8.21=3.28.

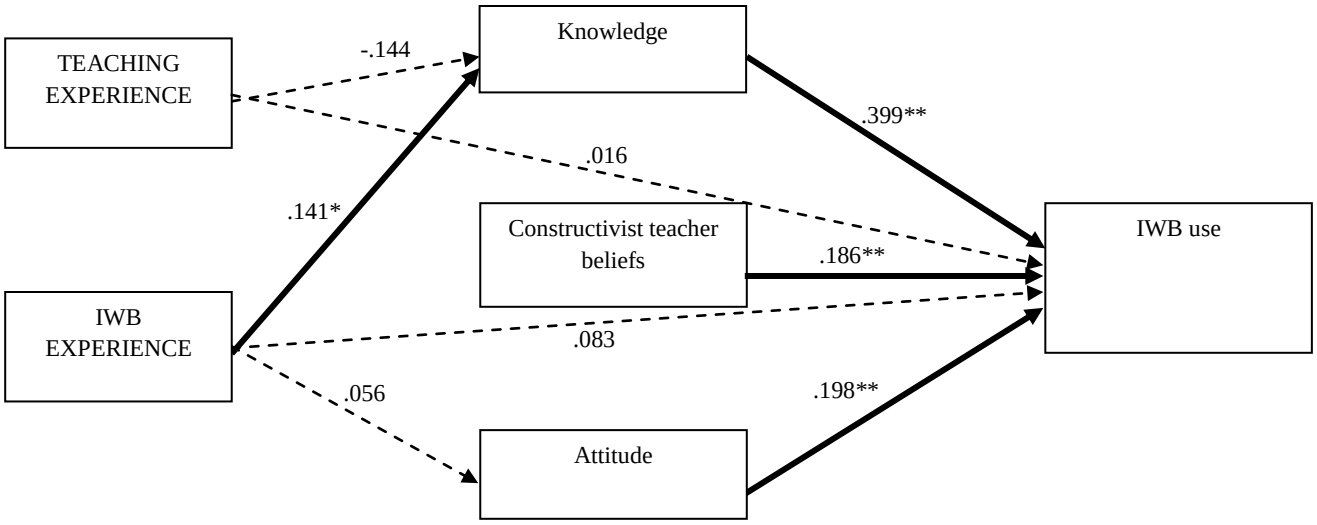

***Figure 3**:* Final model of this study.
** p < .001, * p < .01

The best predictor for IWB use is knowledge. When the knowledge of teachers increases, the teachers will use more of the features of an IWB, and transfer to a higher stage in the transformational framework of this study. To develop teachers' knowledge, teachers need to develop themselves, in the second part of this study the need for support of the teachers is examined in mainly qualitative focus groups.

4.2 Results part 2 – Focus groups

4.2.1 What to learn?

The results of the first part of the focus group study are schematically depicted in Table 6 (see Appendix 7.3 for the propositions). The left side of the table answers the question; 'where do teachers experience difficulties with during a lesson'. The first two columns indicate the number of participants that choose a particular cue card. The four other columns indicate how many points the participants gave to the cue card when asked how much they would like to learn about the proposition on this cue card.

The right part of the table indicates how many of the focus groups assigned a particular cue card to a teacher training for one of the experience levels of IWB users; novice, intermediate and experienced IWB users. Also the option to exclude the cue card from a teacher training was given; this is depicted in the last column. The results will be discussed in the next paragraphs of this chapter.

Table 6

Overview of the results of the quantitative questions of the focus group.

	N	***%***	***Min***	***Max***	***M***	***SD***	***Novice***	***Intermediate***	***Exp.***	***Excl.***
TPK1	3	2.4%	1	2	1	1	60%	-	-	40%
TPK2	1	0.8%	2	2	2	-	40%	-	20%	40%
TPK3	13	10.2%	1	5	3	1	-	20%	80%	-
TPK4	13	10.2%	1	5	3	1	-	20%	80%	-
TPK5	7	5.5%	1	2	1	1	60%	40%	-	-
TCK1	5	3.9%	1	3	2	1	60%	40%	-	-
TCK2	10	7.9%	1	3	2	1	20%	80%	-	-
TCK3	2	1.6%	1	3	2	1	100%	-	-	-
TCK4	8	6.3%	1	3	2	1	60%	20%	20%	-
TCK5	2	1.6%	1	2	2	1	60%	-	-	40%
PCK1	4	3.1%	2	6	3	2	-	40%	-	60%
PCK2	8	6.3%	1	4	3	1	-	20%	20%	60%
PCK3	1	0.8%	1	1	1	-	80%	-	-	20%
PCK4	8	6.3%	1	2	1	1	-	20%	-	80%
PCK5	7	5.5%	1	5	2	1	-	20%	-	80%
TPCK1	1	0.8%	3	3	3	-	60%	-	-	40%
TPCK2	3	2.4%	2	3	2	1	20%	80%	-	-
TPCK3	13	10.2%	1	4	3	1	20%	-	80%	-
TPCK4	13	10.2%	1	3	2	1	-	40%	60%	-
TPCK5	5	3.9%	1	4	3	1	40%	60%	-	-

4.2.2 Difficulties during the lesson

Dutch elementary teachers do experience the most difficulties with TPCK and TPK, see Table 6. The propositions that scored high were:

- *Apply strategies to combine content, ICT and pedagogical skills (TPCK3).*
- *Anticipate the different levels of pupils with appropriate content on the IWB (TPCK4).*
- *Anticipate the different levels of pupils during the lesson by using the IWB (TPK3).*
- *Choose appropriate computer programs/tools for the different learning strategies of the pupils (TPK4).*

These four propositions were all chosen by 10,2% of the participants. There was some discussion in focus group 3 about what exactly the anticipation to different levels of pupils is;

"I wonder if that's possible, to use the IWB to anticipate on all the different levels of the pupils." *(Participant #3.4)*

"When working with a 'praatplaat', the one child will only be able to point at a specific object, the other child will be able to recognize the sound, and another child will know the word with the animal. Then you do apply to all different levels, right?" *(Participant #3.1)*

The proposition that followed this and was chosen by 7.9% of the participants, was this one of TCK:

- *Combining the content of the method with IWB programs/tools (TCK2).*

Next were three propositions of PCK and TCK which were chosen by 6.3% of the participants. A remark regarding to the PCK propositions is that the participants were confusing these with TPCK. One of the reasons for this was that during the investigation they held the IWB in mind when answering.

- *Presenting the content of the lesson by using the computer by, for example, a mind map of graph (TCK4).*
- *Adjusting the content of the lesson to the different learning strategies of the pupils (PCK2).*
- *Think of pedagogical strategies when seeing the learning content (PCK4).*

About PCK2 the participants of focus group 4 were unanimous.

Teachers do not experience a lot of difficulties with the following five propositions of all the four categories;

- *Involve students with the lesson by using the IWB (TPK2).*
- *Search for media (sounds, movies, etc.) matching to the learning content (TCK3).*
- *Creating interactive lessons with learning content for the pupils, by using the IWB (TCK5).*
- *Excite pupils to learn by using interesting learning content (PCK3).*

- *Recognize that a good lesson consists of the combination of ICT, learning content and pedagogical skills (TPCK1).*

The participants indicated that pupils are already enthusiastic when you only turn on the IWB. About the last proposition (TPCK1) some critics were given by one of the participants. To put this quote in context; she has been a teacher for almost 39 years:

"So you suppose that a good lesson always consists of the IWB? It's also possible without an IWB. Otherwise you suppose that the past 30 years all our lessons were wrong." (Participant #4.3)

4.2.3 Learning needs

The participants assigned an average of three points, which is the most compared to the others, to three of the four propositions where teachers indicated to have the most difficulties with; TPK and TPCK;

- *Apply strategies to combine content, ICT and pedagogical skills (TPCK3).*
- *Anticipate the different levels of pupils during the lesson by using the IWB (TPK3).*
- *Choose appropriate computer programs/tools for the different learning strategies of the pupils (TPK4).*

These are the same propositions that were mentioned the most in the previous question, this means that teachers want to learn the most about the propositions where they also seem to have the most difficulties with.

Other propositions which participants want to learn about were from the categories PCK and TPCK, the same remark that was made before, can be made to this result. The participants did answer the questions though while keeping the IWB in mind. Therefore, it is possible that they don't mean the actual PCK proposition but see this with combination of the IWB, which makes it a TPCK proposition.

- *Adjusting the learning content to the different levels of the pupils (PCK1).*
- *Adjusting the content of the lesson to the different learning strategies of the pupils (PCK2).*
- *Creating an interactive lesson with the IWB and learning content that challenges the pupils to learn (TPCK5).*

Overall the participants do want to learn about how to anticipate the different levels of learning strategies of the pupils, when using the IWB for instruction. During the focus groups, the participants indicated that they find it very hard to be interactive during the lesson:

"I find it hard to be interactive" (Participant #4.6)
[Everyone nodded in assent]
"That is when you are not the only one to work with the IWB, right?" (Participant #4.7)
"And the pupils like it so much to work with the IWB, he" (Participant #4.3)
"But I find it hard, because we can sit and watch to the IWB with all of us 31 together, and that I let one pupil give the answer on the IWB, but I don't like that, it's so.." (Participant #4.4)
"But you do have some games in where you make two groups compete, but I don't know a lot of that." (Participant #4.3)

The participants want to learn the least about the following propositions from TPK and PCK:

- *Recognize the pedagogical qualities of a computer program/tool (TPK5).*
- *Excite pupils to learn by using interesting learning content (PCK3).*
- *Think of pedagogical strategies when seeing the learning content (PCK4).*

About the first proposition (TPK5) one participant indicated that she is not aware of what the pupils are doing when working with a specific learning method, for example, 'de wereld in getallen'. The other participants responded that because it's from a specific learning method it can be assumed that the computer program matches the instruction. Although they think it's too much for a teacher to know the specific pedagogical qualities:

"Yes, and the pedagogical qualities, I think it is way too much asked from the teacher. From classical programs you usually get it somewhat faster… But with, for example 'Ambrasoft' which is unrelated from any method, I don't know what the pupils are learning, it can be anything. (Participant #5.1)

4.2.4 Different levels compared to learning needs

The last four columns of Table 9 show the percentages of how many focus groups assigned the cue card to one of the four categories.

Novice IWB user

The most propositions were assigned to this category, which means that the participants think that novice IWB users have to learn more than the teachers in the other two categories. The novice IWB users do want to learn mainly about integrating the learning content with ICT.

The proposition that was assigned to this category unanimous was from TCK;

- *Search for media (sounds, movies, etc.) matching to the learning content (TCK3).*

Another proposition that was assigned to this category by 80% of the focus groups was one from PCK;

- *Excite pupils to learn by using interesting learning content (PCK3).*

And six other propositions were assigned by 60% of the focus groups to this category;

- *Making learning attractive by using the IWB (TPK1).*
- *Recognize the pedagogical qualities of a computer program/ tool (TPK5).*
- *Search for appropriate computer programs/tools with the learning content (TCK1).*
- *Presenting the content of the lesson by using the computer by, for example, a mind map of graph (TCK4).*
- *Creating interactive lessons with learning content for the pupils, by using the IWB (TCK5).*
- *Recognize that a good lesson consists of the combination of ICT, learning content and pedagogical skills (TPCK1)*

The participants indicated during the focus groups that integrating learning content using the IWB is important;

"The fact that you have an IWB, makes things very convenient. Recently I found a movie about how to make an apple pie, which was very clear for the most pupils." (Participant #1.6)

"… Or inside Gynzy. That you can build blocks, to find a tool inside Gynzy isn't so hard, but outside to find a real computer program. I think that a novice teacher really likes to be able to find something good." (Participant #5.1)

Intermediate IWB user

According to the participants (80%) the intermediate IWB user wants to learn the most about the following propositions:

- *Combining the content of the method with IWB programs/tools (TCK2).*
- *Choose appropriate computer programs/tools that match with the learning content and the way of teaching (TPCK2).*

These are followed by a proposition of TPCK that is assigned by 60% of the focus groups:

- *Creating an interactive lesson with the IWB and learning content that challenges the pupils to learn (TPCK5).*

The IWB training for intermediate IWB users should be just like the training for novice IWB users. Which focuses on integrating learning content with ICT, although some pedagogical tips and tricks can be added to that. So intermediate IWB users start to learn how to match their IWB use with their pedagogic skills.

Experienced IWB user

The experienced IWB user should learn a lot about integrating their pedagogic skills with ICT. This includes anticipating on different levels and learning strategies of the pupils by using the IWB. The propositions that were assigned to this category by 80% of the focus groups are:

- *Anticipate the different levels of pupils during the lesson by using the IWB (TPK3).*
- *Choose appropriate computer programs/tools for the different learning strategies of the pupils (TPK4).*
- *Apply strategies to combine content, ICT and pedagogical skills (TPCK3).*

60 % of the focus groups also assigned the following proposition to the experienced IWB users:

- *Anticipate the different levels of pupils with appropriate content on the IWB (TPCK4).*

Which is interesting, because these are the same propositions where the participants indicated to have most difficulties with, and were the participants want to learn most about. About the last proposition (TPCK4) one participant said:

"I think that's pretty hard, during the lesson. Because you have to know so much, when you want to anticipate on the pupils during the lesson." *(Participant #5.2)*
"Yes, that has to be put to the experienced training." *(Participant #5.3)*

Exclude of the teacher training

The propositions that were excluded from the IWB training were mainly from PCK. This is probably because teachers already have these skills when they come from teacher training. 80% of the focus groups assigned the following propositions to be excluded:

- *Think of pedagogical strategies when seeing the learning content (PCK 4).*
- *Help the pupils understand complex concepts by combining learning content and pedagogical knowledge (PCK5).*

The other propositions that were assigned by 60% of the focus groups to be excluded are:

- *Adjusting the teaching content to the different levels of the pupils (PCK1).*
- *Adjusting the content of the lesson to the different learning strategies of the pupils (PCK2).*

4.2.5 How to learn?

The results of the third part of the focus group are depicted in Table 7. The results of the focus groups are divided into four categories, based on the three main topics mentioned in literature about teacher support (Beauchamp & Kennewell, 2013; Hockly, 2013; Koh & Divaharan, 2013; Voogt, Fisser, Pareja Roblin, Tondeur & van Braak, 2012; Inan & Lowther, 2010; Jimoyiannis, 2010; Kennisnet, 2010a; Ng, Nicholas, Williams, 2010; Sang, et al., 2010; Bingimlas, 2009).

4.2.6 Cooperative learning

The participants indicate that they wanted to do the practical assignments to a large extent just by themselves. Although two focus groups indicated that they wanted to do the practical assignments in small groups, with a maximum of two/three persons. They prefer to do the assignment with their colleague, to make it more useful. Two groups also indicated that they like to have a training specific for the experienced IWB users. The experienced users want to ask other questions, and don't need the basics.

"Working with two or three colleagues I like the most, because you can learn from each other; 'this thing I always do that like this, and that thing I create that over here. When you are working with a big group, than you have, at least that's at our school, that it takes very long." ***(Participant #4.6)***
"… yes, more and more people are going to talk then." ***(Participant #4.2)***
"Yes [nods]" ***(Participant #4.6)***
*"I prefer to work with your duo colleague, if you have one, that's the most useful."****(Participant #4.3)***

They indicated that is it very useful to exchange experiences after the assignment with colleagues and also exchange tips and tricks. This process of exchanging experiences should be regulated, because otherwise teachers will lose their attention. The exchange can be during meetings with the whole team, and they don't have to take long, five minutes is enough.

"Well you could do a training and then let it come back later, for example, we have 'bouw-' meetings. During those meetings I can show what I just discovered. That has to take only 5 minutes. That everyone stays sharp on this topic, and that everyone is enthusiastic to continue." ***(Participant #5.2)***

4.2.7 Curriculum development

The focus groups were unanimous about this part. A presentation only during an IWB training isn't enough. Teachers want to do a practical assignment which is really close to their practice. They even want to create a lesson during the training that they can directly use in their class.

"…not only listening, because than you forget 80%." ***(Participant #4.6)***
"I agree, you have to do it. Because when you do a useful assignment in which you really create something that you can use, that feels as if it not only costs time, but it also yields time." ***(Participant #4.7)***

All focus groups indicated that it is important to do something after the training; they came up with ideas of exchanging experiences during monthly meetings. But three focus groups indicated that they even want to have a follow-up course;

"Well I think that, knowing my colleagues, that the first day everyone is super enthusiastic and if it don't includes a follow-up it becomes diluted." *(Participant #4.2)*
"Yes, there has to be something that forces you to do it. Because otherwise you think, well now I'm going to work on my 'handelingsplannen' because that has priority. There has to be something that…" *(Participant #4.6)*
"Yes, that's why I came with the second day…" *(Participant #4.3)*
"Yes, such a follow-up day when you look back, is very clever." *(Participant #4.2)*

One of the focus groups that indicated to do a follow-up course also came up with the idea that this follow-up course can be only for experienced IWB users, a kind of extra training with more experienced learning content. These experienced teachers can then spread this information to their colleagues when they are ready.

Support

All the focus groups were unanimous about the support during the teacher training. Before teachers are going to do the practical assignment they need an introduction. They prefer a short enthusiastic presentation with small chunks of information. During the practical assignment they need an expert to answer questions. Some focus groups even indicated that they need an expert to observe them when they are doing the practical assignment and get feedback from the expert.

"Yes, by doing, you straightforwardly find things out. I liked the fact that during the training there was a short demonstration of everything, which could have been more, and afterwards you experience the program for yourself." *(Participant #2.?)*
"Yes, that we got the opportunity to work for ourselves today, and that the expert walked by and answered questions was really nice." *(Participant #2.?)*

Also during the follow-up course the support is important. After the training when teachers are starting to work with the IWB, they run into things. An expert can answer questions and maybe repeat a part of the training, for better learning.

"So that repetition is important, and when you don't have a study day, an one-hour training in which you work with the IWB, and do a practical assignment such as; 'make a lesson' and afterwards you give feedback. Write difficulties down, but there has to be only a short period to the moment when the expert is coming back and you can ask your questions." *(Participant #3.2)*

One focus group agreed that they want to receive an email with tips and tricks after the training, although in the other focus groups there were just two participants that mentioned that they like getting emails. Some participants indicated to click those emails away. So the need for getting emails depends per teacher.

Other findings

Other things that came up during the focus group were time and two related learning projects that are suitable for this topic. First time, the focus groups indicated that when developing a teacher training you have to be careful with taking too much time from the teachers. Therefore the school has to set aside some time to learn how to work with the IWB. The focus groups were unanimous about using a study day for the IWB training. After the training the teachers want to exchange experiences with each other, although this has to be regulated. This can be done during monthly meetings and doesn't have to take long.

"Yes, that is so much fun. Indeed you don't have to overcharge in time. And with this method [the Gynzy training they received consisted of a small presentation, practical assignment, and feedback], if I compare it with 'Activ', that consumes so much time, which make it inconvenient. Although, the program 'Activ' has a lot more features, almost no limitations. But I prefer the little time with limitations… Time is very important!" *(Participant #3.4)*

"The added value of a study day is that you are with all your colleagues, and you can talk about it, and give feedback…" *(Participant #1.1)*

Two focus groups indicated that 'Teach like a champion' could be a good method for exchanging experiences with colleagues. During this project teachers had a few minutes to show, during the monthly theme meeting of the team, what they do when activating the pupils. This can be done also with the experiences teachers have when working with the IWB. Another project that was indicated by another focus group was the 'HEMA-academy'. This is an online learning environment where online courses can be followed. The school can obligate to do some courses about for example the IWB, and afterwards in a meeting of the team they can discuss their experiences.

"Yes, the 'Hema' offers courses for schools but also for consumers… The IWB could be a topic of such a course." *(Participant #5.3)*
"And what are the advantages of this 'Hema' course? *(Researcher)*
"That you look back the courses every moment." *(Participant #5.3)*
"And that you can do the course any moment if you like." *(Participant #5.1)*

This last remark about the 'HEMA-academy' is interesting because it is contrasting with the need for an expert that gives real life training.

5. Discussion and conclusion

In this chapter the results will be discussed, as well as the method. The results are discussed by following the research and sub questions of this study. This will lead to some concluding remarks and suggestions for future research.

In this study, the IWB use of Dutch elementary teachers was investigated as well as how this IWB use can be improved in order to make use of all the features of the IWB and create a powerful learning environment. This study was guided by the research question; 'How can Dutch elementary in-service teachers be supported to make use of all the features of the IWB, achieve the added value and create a powerful learning environment?' The study consisted of two parts. The first part was a quantitative survey that indicated which factors influence the IWB use of teachers and which factor is the best predictor for the IWB use of teachers. The second part of the study was a mainly qualitative focus group, in which the needs for support were examined. What do teachers want to learn, and how do they want to learn?

To answer the research question four sub questions were posed. The first sub question examined how Dutch elementary in-service teachers do use their IWB in their lessons presently. The results from the first part of this study stated that Dutch elementary in-service teachers are mainly in the third; initiate user, and fourth; advanced user, stage of the transformational framework of this study. This means that they use the IWB regularly (third stage) up to always (fourth stage) in their lessons. The teachers in the third stage already create situations in which pupils can work with the IWB, and teachers in the fourth stage let the pupils frequently use the IWB. So the average Dutch elementary teacher is not a novice IWB user any more, although they do not know enough features of the IWB to use the IWB fluently during the lessons. And they don't have as much interaction and collaboration as the Synergistic user (stage five), which is needed for a powerful learning environment. This result corresponds to the expectation that teachers do not use all of the features of the IWB. Teachers do work with the IWB for a couple of years, so they know the basics and are able to teach with the IWB. But they do not see themselves as experts when it comes to using the IWB.

To be able to improve this IWB use, the second and third sub questions about factors influencing the IWB use, were examined. Results of the quantitative survey show that knowledge (TPACK) is the most influencing factor, and so, the best predictor for the IWB use of Dutch elementary in-service teachers. Attitude towards the IWB and constructivist teacher beliefs also had a direct influence on IWB use, though this influence is only half as much as that of knowledge. An indirect influence was found between IWB experience and knowledge which will lead to better IWB use. This corresponds to the hypotheses H1, H2, H3 and H5 which were all confirmed in this study. The finding that teachers with higher knowledge scores are better in using the IWB is probably due to the fact that teachers who know how to integrate ICT with content and pedagogy they can more easily use all the features of the IWB as described in the higher stages of the transitional framework of this study. The results of the survey correspond to the formulated hypotheses, with exception of two hypotheses; H4 and H6. That IWB experience leads to a higher knowledge and teacher experience not can be explained by that teaching only, influences only the PCK which should be high already when a teacher starts to be a teacher. Working with the IWB influences all parts of the TPACK model and how more experience how more knowledge a teacher gets. The last interesting result of the survey was that the attitude of teachers is not improving by using the IWB (IWB experience). This is probably due to the fact that teachers at the start of using the IWB are already enthusiastic about the IWB; while continuing to work with the IWB they seem to keep this enthusiasm.

The first part of the study indicated that when knowledge increases, the IWB use will increase. Therefore, knowledge was the main topic of the second part of this study, the focus groups. Dutch elementary in-service teachers were asked what they want to learn to improve their IWB use and how they want to learn. The integrated parts of the TPACK model of Mishra & Koehler (2009) can't be seen separately (Chai, Ng, Li, Hang & Koh, 2013) and results of the focus group state that teachers did find it hard to separate PCK from using the IWB. Therefore, the training should integrate all the parts of the TPACK model and focus on how to integrate them into an IWB lesson. Even though all categories are important during the training; the emphasis of the training can change. The training for novice IWB users should emphasize on the integration of content and ICT, while the training for experienced IWB users should emphasize on the integration of pedagogical skills and ICT. This is consistent with the fact that teachers that don't know all the features of the IWB, first want to know how the IWB works. The search and implementation of content can be seen as a part of this basic knowledge of the IWB. The second step, as can be seen in the later stages of the transformational framework of this study, is the focus on pupils and the IWB. For that purpose teachers need to have a lot of pedagogical knowledge. Although, all the parts of TPACK are necessary in IWB training, the participants indicated that not too much focus has to be put on PCK. Most of the propositions linked to this category are attributed to the category; 'don't need to be learned' which can be explained by the fact that teachers already have the PCK knowledge when they became teachers. Although one proposition of PCK was attributed to the training for novice IWB users, this was probably due to the fact that teachers had difficulties with seeing the propositions separate from the IWB.

The results on the question 'how teachers want to learn' show that teachers indicated three main topics necessary when learning knowledge about integrating the IWB in education; "Cooperative learning, Curriculum development and Support". Teachers do have little time, which makes that the teacher training should be closely related to practice. Teachers do want to develop their own lessons which are based on teaching methods when doing course design assignments (Voogt, Fisser, Pareja Roblin, Tondeur & van Braak, 2012). Interesting is that while literature states that group based design experiences to have a positive influence on the TPACK of teachers (Jimoyiannis, 2010), the majority of the participants indicated to do course design assignments by themselves. Although, teachers are not completely against collaboration, they indicated that after practical assignment they want to exchange experiences and tips and tricks with their colleagues. Two of the focus groups indicated that they want to do course design assignments in small teams but they prefer to do the assignments with their 'duo-colleague' because then they can utilize the assignment for creating a ready to use lesson.

That teachers need to learn some theory about ICT in education (Jimoyiannis, 2010) was also mentioned by the participants. Teachers want this theory given to them in enthusiastic short presentations, in which they learn the basics and see some good practices. The theory needs to be linked to issues of the teachers according to the participants this corresponds to the statements of Kennisnet, (2010b). The results of the focus group also show that the participants want to have a follow-up course after the training. In this training they can ask new questions that came up after the training. They indicated that by repetition the learning is better, just as how the pupils learn. Besides a follow-up course they want a regulated moment to exchange experiences. This can be done during meetings of the whole team, but has to be regulated otherwise the enthusiasm of the teachers will move to the background. Concluding; time is the most important argument for the results of the focus groups. The participants are willing to learn about working with the IWB, only they want to learn as efficient as possible. The training has to be scheduled by the

school the participants prefer a study day or a monthly team meeting. And during the training the participants want to do a practical assignment which makes them create a lesson that can be used right away. Everything has to be as practical and relevant as possible.

Because there are no major differences between the descriptives of the focus group, and between the needs for support, no judgments can be made about the needs for support for one particular group of teachers.

By training teachers' knowledge (TPACK) their IWB use will increase and teachers use more and more features of the IWB, and find themselves in higher stages of the transitional framework of this study. When teachers grow to a higher stage of the transitional framework of this study the IWB use will improve, the powerful learning environment of Smeets (2005) will be reached, and learning in the classroom will be optimized.

Because these are only the outlines for an IWB training for professional development of teachers, future design research is needed to develop the real training, one for novice IWB users and one for experienced IWB users, and tested in schools. Also, it might be interesting to research the predictors for IWB use in other types of education. This research was focused on Dutch elementary education. Future research focusing on the influence of knowledge, attitude towards the IWB in education and constructive teacher beliefs on IWB use in other types of education creates insight and the opportunity to train teachers in other types of education also.

During this study the existing training for Gynzy has been transformed, from a presentation about the basic functions of Gynzy, to an interactive training including a practical assignment. This training is not tested, but the outlines of the training follow the findings of this study. Therefore, an advisory report for Gynzy, including tips for testing was added in the Appendix (Appendix 7.4).

6. References

Archenbault, L. M., & Barnett, J. H. (2010) Revisiting technological pedagogical content knowledge: Exploring the TPACK framework. *Computer & Education, 55*, p. 1656-1662. doi: 10.1016/j.compedu.2010.07.009

Beauchamp, G. (2004). Teacher Use of the Interactive Whiteboard in Primary Schools: towards an effective transition framework. *Technology, Pedagogy and Education, 13*(3), p. 327-348. doi: 10.1080/14759390400200186

Beauchamp, G., & Kennewell, S. (2013). Transition in pedagogical orchestration using the interactive whiteboard. *Education and Information Technologies, 18*(2), p. 179-191. doi: 10.1007/s10639-012-9230-z

Bidaki, M. Z., & Mobasheri, N. (2013). Teachers' Views of the Effects of the Interactive White Board (IWB) on teaching. *Social and Behavioral Sciences, 83*, p. 140-144. doi: 10.1016/j.sbspro.2013.06.027

Bingimlas, K. A. (2009). Barriers to the successful integration of ICT in Teaching and Learning Environments: A Review of the Literature. *Eurasia Journal of Mathematics, Science & Technology, 5*(3), p. 235-245. Retrieved from http://ejmste.com/v5n3/EURASIA_v5n3_Bingimlas.pdf

Braak, van, J. (2001). Individual characteristics influencing teachers' class of use of computers. *Educational computing research, 25*(2). p. 141-157. doi: 10.2190/81YV-CGMU-5HPM-04EG

Chai, C. S., Ng, E. M. W., Li, W., Hong, H-Y, & Koh, J. H. L. (2013). Validating and modelling technological pedagogical content knowledge framework among Asian preservice teachers. *Australasian Journal of Educational Technology, 29*(1), p. 41-53. Retrieved from http://ascilite.org.au/ajet/submission/index.php/AJET/article/viewFile/174/24

Dooley, D. (2001). *Social research methods* (4e). Englewood Cliffs, New Jersey: Prentice-Hall.

Digregorio, P., & Sobel-Lojeski, K. (2010). The effects of interactive whiteboards (IWBs) on student performance and learning: a literature review. *Educational Technology Systems, 38*(3). p. 255-312. doi: 10.2190/ET.38.3.b

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: a critical relationship. *Computers & Education 59.* p. 423-435. doi: 10.1016/j.compedu.2012.02.001

Glover, D., & Miller, D. (2001). Running with technology: the pedagogic impact of the large-scale introduction of interactive whiteboards in one secondary school. *Journal of Information Technology for Teacher Education, 10*(3). p. 257-278. doi: 10.1080/14759390100200115

Hall, I., & Higgins, S., (2005). Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted learning, 21*, p. 102-117. doi: 10.1111/j.1365-2729.2005.00118.x

Heitink, M. (2013). *Designing for scale; Linking actors for successful curriculum development.* [Thesis] Retrieved from: http://essay.utwente.nl/62320/1/MSc_Heitink_M._-_S0096059.pdf

Higgins, S., Beauchamp, G., & Miller, D. (2007). Reviewing the literature on interactive whiteboards. *Learning, Media and Technology, 32*(3), p. 213-225. doi: 10.1080/17439880701511040

Hockly, N. (2013). Interactive whiteboards. *ELT Journal, 67*(3), p. 354-358. doi: 10.1093/elt/cct021

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: a path model. *Educational Technology Research and Development 58*, p. 137-154. doi: 10.1007/s11423-009-9132-y

Jang, S-J. (2010). Integrating the interactive whiteboard and peer coaching to develop the TPACK of secondary science teachers. *Computers and Education, 55*. p. 1744-1751. doi: 10.1016/j.compedu.2010.07.020

Jang, S-J., & Tsai, M-F. (2012). Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect to use of interactive whiteboards. *Computers and Education, 59*. p. 327-338. doi: 10.1016/j.compedu.2012.02.003

Jimoyiannis, A. (2010). Designing and implementing an integrated technological pedagogical science knowledge framework for science teachers professional development. *Computers & Education 55*. p. 1259-1269. doi: 10.1016/j.compedu.2010.05.022

Kennewell, S., Tanner, H., Jones, S., & Beauchamp, G. (2008). Analysing the use of interactive technology to implement interactive teaching. *Journal of Computer Assisted Learning, 24*, p. 61-73. doi: 10.1111/j.1365- 2729.2007.00244.x

Kennisnet (2013). *Vier in Balans Monitor 2012*. Kennisnet: Zoetermeer. Retrieved from http://www. kennisnet.nl/fileadmin/contentelementen/ kennisnet/Over.kennisnet/Vier_in_balans/Vier_in_balans _monitor_2013.pdf

Kennisnet (2012). *Vier in Balans Monitor 2012*. Kennisnet: Zoetermeer. Retrieved from http://www. kennisnet.nl/fileadmin/contentelementen /kennisnet/Bestanden_Hans/vierinbalans2012_01.pdf

Kennisnet (2011). *Vier in Balans Monitor 2011*. Kennisnet Zoetermeer. Retrieved from http://www.kennisnet.nl/fileadmin/contentelementen /kennisnet/Over.kennisnet/Vier_in_balans/Vier_in_Balans _Monitor_2011.pdf

Kennisnet (2010a). *Meerwaarde van het digitale schoolbord*. Kennisnet: Zoetermeer. Retrieved from www.ehdo.nl/pdf/meerwaarde_digitale_schoolbord.pdf

Kennisnet (2010b). *Maak kennis met TPACK*. Kennisnet: Zoetermeer. Retrieved from http://www.kennisnet.nl/ fileadmin/contentelementen /kennisnet/Flipping_the_classroom/Nr._26_Maak_kennis_met_TPACK.pdf

Kennisnet (2008). *Digitale schoolborden in het PO. Onderzoek naar de implementatie, gebruik en meerwaarde van digiborden in het primair onderwijs*. Kennisnet: Zoetermeer. Retrieved from http://www.kennisnet.nl/fileadmin/ contentelementen/kennisnet/ Onderzoek/Documenten/onderzoeksreeks/Nr._6_Digitale_ schoolborden_ in_het_po.pdf

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education 29.* p. 76-85. doi: 10.1016/j.tate.2012.08.005

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), p. 60-70. Retrieved from http://www.tcrecord.org/Content.asp? ContentID=12516

Koh, J. H. L., Chai, C.S., & Tsai, C-C. (2013). Examining practicing teachers' perceptions of technological pedagogical content knowledge (TPACK) pathways: a structural equation modeling approach. *Instructional Science, 41*, p. 793-809. doi: 10.1007/s11251-012-9249-y

Koh, J. H. L., & Divaharan, S. (2013) Towards a TPACK-fostering ICT instructional process for teachers: Lessons from the implementation of interactive whiteboard instruction. *Australasian Journal of Educational Technology, 2013, 29*(2). p. 233-247. Retrieved from http://ascilite.org.au/ajet/submission/index.php/AJET/article/view/97

Laer, van, S., Beauchamp, G., & Colpaert, J. (2012). Teacher use of the interactive whiteboards in Flemish secondary education—mapping against a transition framework. *Education and Information Technologies*. doi: 10.1007/s10639-012-9228-6

Leech, N. L., & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. *Quality & Quantity, 43.* p. 265-275. doi: 10.1007/s11135-007-9105-3

Mathews-Aydinli, J., & Elaziz, F. (2010). Turkish students' and teachers' attitudes towards the use of interactive whiteboards in EFL classrooms. *Computer Assisted Learning, 23*(3). p. 235-252. doi: 10.1080/09588221003776781

Meirink, J. A., Meijer, P. C., Verloop, N., & Bergen, T. C. M. (2009). Understanding teacher learning in secondary education: The relations of teacher activities to changed beliefs about teaching and learning. *Teaching and Teacher Education 25.* p. 89-100. doi: 10.1016/j.tate.2008.07.003

Miles, B., & Huberman, A.M. (1994). *Qualitive Data Analysis*. Thousands Oaks, CA: Sage publications Inc

Moore, D. S., & McCabe, G. P. (2007). *Statistiek in de praktijk.* Sdu Uitgevers bv.: Den Haag.

Ng, W., Nicholas, H., & Williams, A. (2010). School experience influences on pre-service teachers' evolving beliefs about effective teaching. *Teaching and Teacher education, 26*, p. 278-289. doi: 10.1016/j.tate.2009.03.010

Niederhauser, D. S., & Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education, 17*, p. 15-31. doi: 10.1016/S0742-051X(00)00036-6

Onwuegbuzie, A. J., Dickinson, W. B., Leech, N. L., & Zoran, A. G. (2009). A Qualitative Framework for Collecting and Analyzing Data in Focus Group Research. *International Journal of Qualitative Methods, 8*(3), p. 1-21. Retrieved from http://research.apc.org/images/2/2f/A_Qualitative_Framework_for_Collecting_and_ Analyzing_Data_in_Focus_Group_Research.pdf

Onwuegbuzie, A. J., & Leech, N. L. (2007). A Call for Qualitative Power Analyses. *Quality & Quantity, 41*(1), p.105- 121. doi: 10.1007/s11135-005-1098-1

Onwuegbuzie, A. J., & Leech, N. L. (2004) Enhancing the Interpretation of "Significant" Findings: The Role of Mixed Methods Research. *The Qualitative Report 9*(4), p. 770-792. Retrieved from http://www.nova.edu/ssss/QR/QR9-4/onwuegbuzie.pdf

Pallant, J. (2005). *SPSS Surival Manual: A step by step guide to data analysis using SPSS for Windows (Version 12).* Crows Nest NSW – Allen & Unwin.

Petursdottir, S. (2012). The effectiveness of integrating existing digital learning resources into classroom teaching – an evaluation of the learning achievement. *Nordic Studies in Science Education, 8*(2). p. 150-161. Retrieved from https://www.journals.uio.no/index.php/nordina/article/view/524

Sahin, I. (2011). Development of Survey of Technological Pedagogical and Content Knowledge (TPACK). *Turkish Online Journal of Educational Technology, 10*(1). Retrieved from http://files.eric.ed.gov/fulltext/EJ926558.pdf

Sang, G., Valcke, M., Braak, van, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education, 54.* p. 103-112. doi: 10.1016/j.compedu.2009.07.010

Schulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher, 15*(2), 4-14. Retrieved from http://www.jstor.org/stable/1175860?origin=JSTOR-pdf

Smeets, E., (2005). Does ICT contribute to powerful learning environments in primary education? *Computers and education, 44*. p.343-355. doi: 10.1016/j.compedu.2004.04.003

Stamos (2012). Werkgelegenheid in fte. Retrieved from http://stamos.nl/index.rfx?verb=showitem&item=2.1.11&view=table

Sweeney, T. (2013). Understanding the use of interactive whiteboards in primary science. *Australasian Journal of Educational Technology, 29*(2), 217-232. Retrieved from http://ascilite.org.au/ajet/ submission/index.php/AJET/article/view/26

Timperley, H. (2008). "Teacher professional learning and development". In *The Educational Practices Series – 18*. Ed. Jere Brophy. International Academy of Education & International Bureau of Education: Brussels.

Turel, Y. K., & Johnson, T. E. (2012). Teachers' Belief and Use of Interactive Whiteboards for Teaching and Learning. *Educational Technology & Society, 15*(1). p. 381–394. doi: 10.1080/17439880701511040

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2012). Technological pedagogical content knowledge – a review of the literature. *Journal of Computer Assisted Learning, 29*, p. 109–121. doi: 10.1111/j.1365-2729.2012.00487.x

Westland, L. (2010). *Gebruik en invoering van de digitale schoolborden bij stichting Voila*. [Thesis] Retrieved from http://igitur-archive.library.uu.nl/student-theses/2010-1022-200242/Scriptie_Lonneke_Westland_MA.pdf

Wilkins, J. L. M. (2008). The relationship among elementary teachers' content knowledge, attitudes, beliefs, and practices. *Journal of Mathematics Teacher Education, 11*, p.139-164. doi: 10.1007/s10857-007-9068-2

Wood, R., & Ashfield, J. (2008). The use of the interactive whiteboard for creative teaching and learning in literacy and mathematics: a case study. *British Journal of Educational Technology, 39*(1), p. 84-96. doi: 10.1111/j.1467-8535.2007.00703.x

Woolley, S. L., Benjamin, W-J. J., & Woolley, A. W. (2004). Construct validity of a self-report measure of teacher beliefs related to constructivist and traditional approaches to teaching and learning. *Educational and Psychological Measurement, 64*(2). p. 319-331. doi: 10.1177/0013164403261189

Yin, R. K. (1994). *Case study research, design and methods* (2nd edition). Thousand Oaks, CA.: SAGE Publications Inc.

7. Appendix

7.1 The online survey of part 1

Descriptive information	Gender Age Years of teaching Years of working with the IWB Type of education
IWB use	I use the IWB to write and draw. I use 'board software', internet and word on the IWB. I use the IWB only during whole class instruction. I use the IWB to give linear presentations decorated with text and pictures I search IWB-lessons made by others and save them to use them later. I allow pupils on planned moments to work with the IWB, to e.g. point to the correct figure or write down the answer. I use the IWB regularly in lessons and use videos/audio from the internet to enrich those lessons. I create lessons and the lessons of other teachers, and share them with other teachers. I create situations in where the pupils can work with the IWB. I use the IWB to give interactive lessons that support pupils' learning. I know how to use external hardware (e.g. voting boxes or a tablet). I let the pupils often work on the IWB, for example they may show me what they mean. I use the IWB to give interactive lessons that motivate pupils to learn. I save the IWB lessons that I create, and share them with teachers also outside my own school. The pupils decide what to learn and the next step of the lesson.
Constructivist teacher beliefs	I believe that expanding on students' ideas is an effective way to build my curriculum. I prefer to cluster students' desks or use tables so they can work together. I invite students to create many of my bulletin boards. I involve students in evaluating their own work and setting their own goals. I make it a priority in my classroom to give students time to work together when I am not directing them. I prefer to assess students informally through observations and conferences. I often create thematic units based on the students' interests and ideas.
Knowledge (TPACK)	I can teach lessons that appropriately combine my CS1, technologies and teaching approaches I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district
Attitude towards the IWB	I enjoy teaching with an IWB. Because of using an IWB, I feel myself more prepared for instructors. I notice my IWB skills are improving day by day. Learning how to use an IWB is essential to me. IWB makes my courses more enjoyable.

7.2 Descriptives of the different Focus Groups

Focus Group 1	***Range***	***Min.***	***Max.***	***M***	***SD***
Age		36	58	49,17	7,52
Teaching experience		6	30	22,50	9,83
IWB experience		0,2	1,5	0,95	7,52
Knowledge	4-20	6	16	10,67	3,98
Gynzy experience		0,1	1,5	0,60	0,47

Focus Group 2	***Range***	***Min.***	***Max.***	***M***	***SD***
Age		23	59	39,67	12,86
Teaching experience		1,5	17	8,17	4,97
IWB experience		0,2	3	1,24	0,76
Knowledge	4-20	11	16	13,22	1,79
Gynzy experience		0,2	1	0,59	0,40

Focus Group 3	***Range***	***Min.***	***Max.***	***M***	***SD***
Age		33	50	39,80	6,42
Teaching experience		6	24	16,20	6,61
IWB experience		0,2	1	0,74	0,37
Knowledge	4-20	11	16	13,60	2,074
Gynzy experience		0,2	0,5	0,32	0,164

Focus Group 4	***Range***	***Min.***	***Max.***	***M***	***SD***
Age		23	57	35,17	13,54
Teaching experience		1	39	12,58	14,34
IWB experience		3	7	5,00	1,41
Knowledge	4-20	12	17	14,00	1,79
Gynzy experience		1	4	2,17	1,17

Focus Group 5	***Range***	***Min.***	***Max.***	***M***	***SD***
Age		36	46	41,33	5,03
Teaching experience		10	25	15,33	8,39
IWB experience		4	8	6,67	2,31
Knowledge	4-20	15	16	15,67	0,58
Gynzy experience		3	3	3	0,00

7.3 Propositions of part 2

Factor	Proposition	
TPK	Making learning attractive by using the IWB	TPK1
	Involve student with the lesson by using the IWB	TPK2
	Anticipate to the different levels of pupils during the lesson by using the IWB	TPK3
	Choose appropriate computer programs/tools for the different learning strategies of the pupils	TPK4
	Recognize the pedagogical qualities of a computer program/ tool	TPK5
TCK	Search for appropriate computer programs/tools with the learning content	TCK1
	Combining the content of the method with IWB programs/tools.	TCK2
	Search for media (sounds, movies, etc.) matching to the learning content	TCK3
	Presenting the content of the lesson by using the computer by, for example, a mind map of graph	TCK4
	Creating interactive lessons with learning content for the pupils, by using the IWB	TCK5
PCK	Adjusting the teaching content to the different levels of the pupils	PCK1
	Adjusting the content of the lesson on the different learning strategies of the pupils	PCK2
	Excite pupils to learn by using interesting teaching content	PCK3
	Think of pedagogical strategies when seeing the learning content	PCK4
	Help the pupils understand complex concepts by combining learning content and pedagogical knowledge.	PCK5
TPCK	Recognize that a good lesson consists of the combination of ICT, teaching content and pedagogical skills	TPCK1
	Choose appropriate computer programs/tools that match with the learning content and the way of teaching.	TPCK2
	Apply strategies to combine content, ICT and pedagogical skills	TPCK3
	Anticipate to the different levels of pupils by appropriate content on the IWB	TPCK4
	Creating an interactive lesson with the IWB and learning content that challenges the pupils to learn.	TPCK5

7.4 Advisory report for Gynzy

During this study the existing training for the IWB software of Gynzy was transformed from a presentation with information about the basic functions of Gynzy into an interactive presentation with practical assignments. This training fits with the findings of this study, but can be improved and tested. In this advisory report the outline for an optimal Gynzy training according to the findings of the study is described. Because the training was not tested and only carried out a few times, there are also some recommendations for testing the training.

7.4.1 Training and providing information

Training teachers is very important, teachers learn the best and prefer to learn by doing, although these type of trainings are not always possible. Gynzy is offering their services to the Netherlands, Belgium and, to the United States of America. When real-life training is not possible Gynzy can also provide examples of good practices, e.g.: how can you use Gynzy when integrating technology, teaching content and pedagogy. This is important because when teachers own experiences will be combined with expert information a sophisticated way of learning is created (Ng, Nicholas & Wiliams, 2010).

7.4.2 Three types of training

To learn teachers how to use Gynzy, there are three types of training needed. One training for novice-intermediate IWB users, one for experienced IWB users, and for both of them a refresher training. The target group of the first training consists of teachers who are in the first three stages of the transformational framework. Those teachers use the IWB just like their old blackboard, or use the IWB to give linear presentations decorated with text and pictures. They use a number of IWB programs, are able to switch between them, and create situations in where the pupils can work with the IWB. But they do not know all of the features of the IWB and find it hard to create a fully interactive lessons on the IWB.

The target group of the experienced teachers consists of teachers from the fourth and fifth stage of the transitional framework. Those teachers use the IWB as an integrated part of their education, use a number of IWB programs, scanned material, and a lot of external resources. The experienced teacher can give interactive lessons in which pupils use the IWB frequently, and inspire other teachers how to work with the IWB.

7.4.3 Novice IWB users training

The Gynzy training for novice IWB users needs to start with a short enthusiastic presentation containing some good practices of using the IWB during a lesson. By showing these good practices you indirectly explain the basic functions of Gynzy. The focus of the presentation has to be on how you find a good tool that fits to your lesson, or how can you make use of other software when using Gynzy. This presentation has to be short, between 15-30 minutes. After this presentation the teachers get the assignment to create a lesson which they can use the day after the training. During the 30-60 minutes that teachers work individual or in pairs (preferable with their ‘duo-colleague’) on the assignment, the trainer answers questions and provides the teachers with feedback. After the assignment the teachers assemble back together and are allowed to ask questions to the trainer. Also this is a great moment to share the lessons that were made during the practical assignment. The teachers have to tell about what they created and how, this will inspire other teachers. This last feedback moment should take about 15-30 minutes. To be able to answer all the questions of the teachers it is preferable to be with two or more trainers, this depends on the size of the group. The training can be held in one hour, however, preferable is to take the

time and take the full two hours for the training. Especially when the training is for a large group of participants.

To ensure a smooth training, the school where the training takes place has to prepare some things. First of they have to make sure that there are enough computers for all the teachers that participate in the training. Second the teachers that participate have to think of a lesson that they are going to teach in the near future. And let them take some learning materials (for example: books) with them to the training. When the school works with teachers they just need one computer per pair of teachers, and they can think of a lesson together. The last thing needed for the training is a working IWB with a stable internet connection, for the presentation and feedback session.

Important before the training, is that input from the school should be taken into account. Every training is different because every school is different. Some schools already have some questions about Gynzy. Sometimes the level of the participants is very low or relatively high, the first short presentation should be altered to the school. After the training (if the school is interested) it is possible to provide the school some assignments. These can be special challenging assignments which should always be applied to practice. For example: 'Create a lesson including a quiz made by yourself'. By keeping in touch with the participants, for example by giving these assignments you stay in contact with the school, which makes it easier for teachers to ask questions and provide feedback.

7.4.4 Experienced IWB users training

The training for experienced IWB users should place emphasis on TPK; integrating pedagogical knowledge with technological knowledge. While Gynzy is a program that attempts to help teachers use the IWB this is a very important part, although this might be a bit out of reach for a Gynzy training. In the first part of this study we saw that the majority of the respondents 48,9% indicates themselves as Initiate user, 44,8% (stage 3) indicates themselves as advanced users (stage 4), and only 3% of the respondents indicates themselves as a synergistic user (stage 5). Although this number can be different because the possibility for social desirable answers from the respondents, and that people who participate to a study like this, are mainly positive about the subject and good at it (Swanborn, 2007; cited in Heitink, 2013). This means that the majority of the Dutch elementary teachers are in the third stage and will need the novice IWB users training. For a specific training designed for experienced IWB users some further research is necessary. The consideration can be made whether this is the responsibility of Gynzy, or that Gynzy only wants to focus on novice IWB users.

Another possibility is that Gynzy could try to train the experienced teachers in such a way that they are capable of training the novice IWB users at their school.

7.4.5 Refresher training

The participants of the focus groups indicated that teachers need refresher training after the novice IWB users training. This refresher training has to take place one or two months after the training. During the refresher training teachers are able to ask questions to the trainer and exchange experiences. The participants indicated that they would like to get some refresher training to keep everybody sharp when working with the IWB and learn to use the IWB even more.

7.4.6 Testing the training

The effect of the suggested training is not known, because this type of training isn't tested. By testing the training you can do a cost-benefit analysis and consider if the suggested training is worth the effort. This testing can be done as follows;

1. Do a qualitative study and asks teachers how they experienced the training. Ask what parts they liked and disliked about the training. Furthermore, after a while you can ask what the participants remembered of the training or even more specific: what they have learned.

2. Implement the training and compare the usage statistics of the participating teachers after the suggested training, with the usage statistics after the prior training. Which training leaded to more usage of Gynzy?