Interactive Technology. Traditional Practice?
Two Case Studies of Teachers' Commencing with Interactive Whiteboards and Tablets

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ABSTRACT
In this paper, we examine findings on the pedagogical use of interactive whiteboards and tablets in schools, gathered over the last five years. The findings reveal how challenging it can be to utilise the opportunities provided by interactive technology. The paper then introduces two case studies focusing on how teachers prepare when beginning to use interactive technologies. Both cases show how teachers develop new ways of using the technology in a pedagogical setting, but also how they face challenges in terms of continuous professional development and implementation of technology in practice.

Keywords:
Interactivity, Interactive whiteboards, Tablets, Teachers' professional development

INTRODUCTION
The emergence of information and communication technologies (ICTs) is influencing our school system. In extension, the aim of this paper is to take a closer look at how technologies such as interactive whiteboards (IWBs) and tablets are integrated into teaching and learning processes. Since the beginning of this century, schools have invested heavily in computers, recently also in tablets (i.e. iPads and Android-based slates), and interactive whiteboards.
Approximately 70% of classrooms in Norway include an IWB and approximately 10% of teachers have tried out tablets in their teaching (European Commission, 2013).

From a European perspective, Norway is one of the top five countries in terms of student access to computers, tablets, and interactive whiteboards at school (European Commission, 2013). However, according to the European Commission (2013), Norwegian schools are quite mediocre in terms of pedagogical usage concerning such technology, but also when it comes to self-reported digital competence among teachers. There is therefore a need for more in-depth studies, in order to examine how Norwegian teachers use interactive technologies in their educational practice. Additionally, existing literature can provide valuable knowledge in terms of both research findings and methodology.

In this paper, we therefore present a literature review before addressing the following research questions: 1) which pedagogical strategies do Norwegian teachers utilise in our two cases when starting to use IWBs and tablets in their teaching? 2) How is the concept interactivity evident in the teachers’ use of IWBs and tablets? We answer the research questions in two steps. First, we present and discuss findings from a literature review, which explores research on pedagogical use of IWBs and tablets. The review was conducted in order to clarify and explore whether there are any common factors that influence the integration and use of interactive technology in teaching and learning. Secondly, we present and analyse findings from interviews with teachers and students about their experience using IWBs and tablets as part of their classroom engagement in Norway.

**CONTEXTUAL BACKGROUND**

**Interactive Technology, Teaching and Learning**

The concept of interactivity touches upon interplay, cooperation, or some kind of exchange between two or more actors, which allows for at least two possible interpretations: 1) either as interaction between a human and a machine (from a technological point of view); or 2) as a communication and exchange between people (from a pedagogical point of view) (Severin & Tankard, 2001). The latter aspect includes a broad understanding of communication, where the exchange may be supported by the use of ICT. It has been claimed that the quality of interactivity is more important for the level of learning outcomes and success than the content itself (Dave, 2000 as cited in Evans & Gibbons, 2007). Additionally, interactivity plays an important role in knowledge acquisition and the development of cognitive skills (Sim, 1997 as cited in Evans & Gibbons, 2007).

The term interactivity may be used without any reference to technology. However, the concept is most commonly used in situations where people
communicate with or through technological tools. In this way interactivity can be understood as a technological feature of mediated surroundings where people communicate and exchange information and interact with technology or with other people through technology (Bucy & Tao, 2007).

In studying schools, it is interesting to view the concept of interactivity from a pedagogical perspective, as pedagogical interactivity is reached through dialogue, for instance when students and teachers interact and cooperate (Beauchamp & Kennewell, 2010). Pedagogical interactivity takes various forms, from teacher-driven authoritarian dialogue, to different forms of open questions, discussions and reflections (Beauchamp & Kennewell, 2010). It is not a given that the quality of the pedagogical interactivity increases when technology is used (Lerman & Zevenbergen, 2007; Moss et al., 2007). Instead, pedagogical interactivity may decrease, because teachers provide more rapid presentations of academic material during lessons rather than emphasising discussions and higher-order thinking skills (Lerman & Zevenbergen, 2007). Nevertheless, technological and pedagogical interactivity have the potential to support and amplify each other. In this respect, Duan (2010) emphasised the importance of the encounter between dialogical teaching and the physical interaction with technology.

However, it is not always easy for teachers to utilise technology in their teaching, partly due to a lack of systematic development of digital competence across classrooms, subjects, and teachers (Egeberg et al., 2012; European Commission, 2013; Krumsvik, Ludvigsen & Urke, 2011; Tomte, Kårstein & Olsen, 2013; Vibe, Aamodt & Carlsten, 2009). It is therefore relevant to scrutinise pedagogical strategies among teachers when they start up using interactive technology in their classroom practices. In this paper, we define pedagogical strategies as how teachers apply various pedagogical approaches with technology. This could involve issues such as: 1) how they prepare, train, and plan for teaching; 2) how they carry out their teaching and implement their instructions; and finally, 3) how they evaluate the process and outcome of the two previous steps.

Interactive Whiteboards for Teaching and Learning

Our literature review shows that the majority of IWB research focuses on subject-specific use such as natural sciences, mathematics, and language. Furthermore, we found a considerable amount of studies exploring relatively small cases and only a few extensive comparative studies. Many of the articles are based on the UK reform of IWB use and attempt to evaluate the importance of IWB for teaching and learning (Gillen, Staarman, Littleton, Mercer & Twiner, 2012; Glover & Miller, 2007; Higgins, Beauchamp & Miller, 2007; Lewin, Somekh & Steadman, 2008).

Teacher competence is highlighted as particularly important in the implementation and use of IWBs in school (Miller & Glover, 2010). Bal et al. (2010)
claim that teachers also need to identify potential benefits of technology integration, in order to make use of it. Wolfgang, Lauritzen and Mortensen (2011) argue that teachers observed in the Danish Nordic SMART report possess good basic ICT skills, but that their digital competence is not sufficiently connected with the teaching content or the pedagogy in the classroom. According to Lopez (2009), teachers will struggle most in the initial phase of IWB integration, but as soon as they reach a certain level, their use and skills improve rapidly. Teachers reach what Lopez describes as a tipping point. Teachers who have participated in courses or received support from mentors seem to be more capable of creating a good learning situation in the classroom (Lopez, 2009; Winkler, 2011), because they are able to use the interactive aspects of the IWB and are comfortable trying out new methods and approaches.

Teachers need to develop a variety of competencies to be able to use the IWB to develop their teaching practice (Manny-Ikan et al., 2011; Schmid, 2010; Underwood & Dillon, 2011). Glover and Miller (2007) and Miller and Glover (2010) argue that an innovative approach to continuing professional development in the educational use of IWB later results in good practices. Successful integration of IWBs in schools requires well-prepared changes and development in the whole school culture (Avidov-Ungar & Eshet-Alkakay, 2011; Glover and Miller, 2007). Teacher attitudes towards change in general are also important for successful integration of technology (Avidov-Ungar & Eshet-Alkakay, 2011; Yang, 2012). On the basis of these findings, it is claimed that clear and supportive leadership, thorough planning, dedicated time, and involvement of all relevant stakeholders are prerequisites for a successful implementation (Hartley, 2007).

IWB technology has limited value in schools if not based on pedagogical reasoning (Marzano, 2009; Sundset, 2009; Underwood & Dillon, 2011). Several studies have concluded that the subject-specific didactic potential of IWBs is not fully utilised (Beauchamp & Parkinson, 2005; Miller, Averis, Door & Glover, 2005; Türel & Demirli, 2010; Wolfgang et al., 2011), and an IWB does not automatically lead to a significant change in pedagogical approach among teachers (Avidov-Ungar & Eshet-Alkakay, 2011). Underwood and Dillon (2011) furthermore stated that the introduction of an IWB is often accompanied by unrealistic expectations of change, as teachers seem to adapt the use of IWBs to existing practices rather than going through educational transformation (Kershner, Mercer, Warwick & Staarman, 2010; Lopez, 2009; Schmid & Whyte, 2012).

Many research articles report that the interactive whiteboard is a tool for teaching but not necessarily for learning. It is also pointed out that research tends to provide a teacher’s perspective on the IWB, while the student perspective is lacking (Kershner et al., 2010; Maher, 2012; Türel, 2011). That being said, some research findings claim that the IWB is a good teaching tool as it allows the teacher to focus more on the students, as well as simplifying
planning, organisation, and presentation of the lesson (Mercer et al., 2010). The IWB also motivates and makes teachers more active in their own teaching according to Sundset (2009). Türel (2011) shows that the IWB has a positive impact on student motivation and engagement. Beauchamp, Kennewell, Tanner, and Jones (2010), but also Mercer et al. (2010) argued that the IWB makes it easier to attain and retain student attention and concentration. Sad and Özhan (2012) found that students feel that an IWB improves their learning due to factors such as visualisation, contextualisation, effective presentations, test-based use, student participation, and so on. Bal et al. (2010) followed this up by referring to studies that claim the IWB has a positive effect on student motivation, because the IWB increases the interaction between students and teachers. The meanings of dialogue, discussion and collaborative activities for student learning are strongly emphasised by many theorists. Hennessy (2011) and Warwick, Hennessy and Mercer (2011) asserted that the IWB could be an important mediating tool and a useful element in student learning in semi-autonomous and cooperative activities. Mercer et al. (2010) also found that the IWB has many useful features to support student exploratory conversations. The IWB can therefore generate and maintain a dialogic space in teaching and learning processes.

Research shows, however, that the introduction of IWBs has not resulted in more collaboration, communication, or interaction between students (Beauchamp & Kennewell, 2010; Blau, 2011; Schuck & Kearney, 2007). Therefore Gillen et al. (2007) claim that the teacher-centred, whole-class approach of IWB teaching happens at the expense of dialogue in the classroom, as the traditional role of the teacher remains (Hall & Higgins, 2005). Indeed, so far the IWB is mainly located in teacher territory rather than being in the student domain. The introduction of an IWB increases the amount of classroom instruction and one-way communication from teacher to student (Beauchamp & Kennewell, 2010), also interaction between the teacher and students remains very traditional and is not so much characterised by interactivity (Beauchamp et al., 2010; Hennessy, 2011). According to Beauchamp et al. (2010), the value of creative and improvised elements in the classroom is thus not managed well enough.

**Tablets in Teaching and Learning**

After the launch of the iPad in 2010, a new generation of tablet devices hit the market, selling at a rapid pace. Although these devices were not originally developed for educational purposes, there has been a great deal of interest all over the world in testing tablets in this regard (Clark & Luckin, 2013; Hu, 2011; Hylén, 2013). Some schools immediately saw the potential and started full-scale projects just after the first iPad was introduced (Speirs, 2011). The interest in implementing tablets in education arose prior to research on the matter. The tablets were therefore introduced into schools without much research-based evidence that they would actually enhance learning. Looking at other technologies, such as IWBs and learning management systems, we
see the same tendency. Research rarely sets the agenda when it comes to implementation of various ICT in schools.

Our literature review shows that the majority of relevant literature on tablets is evaluation reports of pilot projects (Burden, Hopkins, Male, Martin & Trala, 2012; Clarke & Svanases, 2012; Clarke, Svanases & Zimmerman, 2013; Heinrich, 2012; Clark & Luckin, 2013; Hylén, 2013; Lorentzen, 2012). As an initiative from school owners, these pilots have often been evaluated externally. The purpose has been to give school owners, school leaders, teachers, and other decision-makers information about the use of tablets in education. The reports cover different aspects concerning implementation and administration, as well as technical and pedagogical matters.

The iPad Scotland evaluation (Burden et al., 2012) showed a positive view of the use of tablets for educational purposes, as technology seems to facilitate the achievement of many core curriculum aims, and engages both students and teachers. Ubiquitous access to the Internet, apps, and other tools related to the tablet alter the dynamics in the classroom and facilitate seamless learning (Clarke & Luckin, 2013). Personal ownership also plays an important role in levels of motivation, interest, and engagement and self-efficacy. A study conducted at the University of Oslo also confirms the importance of ownership for adapting new technology (Culén, Engen, Gasparini & Herstad, 2011).

The development of communicative competence among students and the differentiation of instruction, were examined in a report from Denmark (Lorentzen, 2012). They experienced tablets as intuitive to use, allowing younger students to take on an active role as producers of content rather than mere consumers. When students make simple multimodal texts, reflect, convey, and present to the class, they develop subject-based knowledge, as well as a communicative competence. The report concluded that the teacher must facilitate educational use of the tablet, as the tablet does not facilitate learning on its own.

A study by Jancke and Kumar (in press) revealed that the teaching design with tablets is more informal and challenging for the students, bringing them to the forefront, while giving the teachers a supportive role creating a new didactical approach. The traditional practices were transformed into complex learning processes, with an active co-construction of knowledge (Jancke & Kumar, in press).

These are only a few examples of research and evaluation reports that have been conducted on the use of tablets in teaching and learning. Despite a few shortcomings, the general impressions are that tablets do have many positive features for educational purposes. Research indicates that the practice of teaching is changing towards a more student-centred knowledge production (Jancke & Kumar, in press), as students take a more active part in the learning process (Gasparini, 2011) and explore the possibilities of technology in collab-
oration with the teacher (Burden et al., 2012). Cooperative learning and collaboration between students also seem to be strengthened by the use of tablets (Brueland, 2012; Hylén 2013; Munkberg, 2012).

Key Findings from Research on Interactive Whiteboards, Tablets, and Interactivity

These highlights from recent research make it clear that interactive technology in itself does not necessarily improve teaching and learning. Interactive technology does often have the potential to ease and improve work processes; however, this potential is not always realized. By implementing interactive technology in the classroom with a clear pedagogical grounding, both teachers and students will gain new opportunities in teaching and learning situations. The following is a list of key findings and conclusions from our literature review and contextual background on the use of IWB and tablets in schools:

- Teacher competence in use of interactive technology for educational purposes needs to be strengthened.

- Even though IWBs and tablets may be moving from being a novelty technology to a truly interactive tool in schools, the most important step is to change practices, based on research on IWBs, tablets, and other mobile technologies.

- The IWB is currently a tool for teaching rather than for learning. Teachers should share the IWB more with the students, as they still tend to support a teacher-centred focus, whereas tablets support a student-centred approach.

- IWBs seem best suited for teaching whole classes and to a lesser extent support other forms of organisation such as group work, dialogic learning, and individualised instruction. Tablets, however, do seem better suited for individual work and small groups working together with one or several tablets.

- The introduction of IWBs and tablets in schools has not led to a transformation of pedagogical practices in the classroom. In order to have a real impact on learning and student development, the use of IWBs and tablets needs to utilise more of the various features embedded in these technologies as well as being supported by solid pedagogical approaches.

To conclude this overview of research findings, we would like to emphasise that interactive technology is interactive only when used as a tool for reflection and cooperation, in the interaction between humans or between a human and a technological device. Interactivity depends on someone or
something with which to interact. Therefore, the way technology is used determines what kind of interactivity will emerge, or whether we can even talk about real interactivity or mere interactive technology used in teaching and learning.

METHOD

The method section is organised into five parts: case descriptions, data collection, ethical guidelines, validation of data, and interpretation.

Case Descriptions

Two cases provide the data for this study. The cases consist of two schools, which are used to give rich empirical descriptions of technology use in the classroom (Eisenhardt & Braehner, 2007). Both schools were selected on the criteria of being in the initial phase of implementing interactive technologies. School A started using IWBs in 2010, and school B started using tablet devices in 2011. Common to both schools was a desire to cooperate with researchers who were interested in studying and documenting the process of technology implementation, giving feedback, and promoting reflection on the process and the pedagogical dimension in the integration. School A is located in Drammen, a small Norwegian city, with approximately 500 students in grades 1–10 from rather heterogeneous socio-economic family backgrounds. The school leaders at school A decided to use IWBs as part of a Nordic collaborative project, with the aim of gaining experience in the pedagogical use of IWBs. The teachers from school A did not have much experience with interactive technologies for educational purposes prior to starting with IWBs. As a consequence, these teachers had to learn how to master the technology and to use technology in their own teaching.

School B is located in Oslo, the largest city in Norway. The school has approximately 250 students in grades 1–7, mainly from a homogeneous socio-economic family background. The school is considered a pioneer school for developing students’ digital competence. School B was in a process of renewing many of their student desktop computers but, following the suggestion of a parent, former member of the school board, decided to try tablets instead of PCs in some of the classes. One purpose was to gain experience with the use of this technology for teaching and student learning. In the autumn of 2011, students from two 6th grade classes and two 2nd grade classes each got their own tablet. However, in this paper we only include data from the use of tablets in the 6th grade classes. The teachers from school B did not have any experience with tablets in education, but they did have experience with using technology in their teaching, and were confident with their own skills in using technology for learning purposes.
Data Collection

Data from school A was gathered in June 2011 and September 2012. Observations and interviews were carried out with three teachers and two groups of students in 2011. A follow up interview with the three teachers was conducted in September 2012. The teachers in school A had a primary responsibility for applying and trying out the interactive resources, and several researchers participated in the observations and interviews.

At school B, data was collected through observations in three lessons, one interview with the teachers, one with the school leaders and two group interviews with students. The data was collected between October 2011 and February 2013. The interviews took place in the spring term of 2012. Two teachers and two school leaders participated in the study. The students were divided into two groups, with seven students in each group. The students were selected from the two classes and were mixed groups of boys and girls with varied school performance levels. There were also several informal meetings with the school leaders, the teachers, and the school owner in the planning of the piloting project.

Overall, the analyses for this paper build on the two interviews with the teachers from school A and the interviews with teachers and students, as well as classroom observations conducted in school B. In both cases, the interviews were practice-related, as the interview guides were developed based on observations of lessons. Interviews from all the schools were recorded and transcribed.

Ethical Guidelines

For both schools, data collection was reported to and approved by the Norwegian Social Science Data Services (NSD) to ensure research ethics, data security, and privacy rights.

Data Analysis

After transcribing all the interviews, we coded and explored the content in the interviews according to pre-described categories (e.g. interactivity, teacher preparation, pedagogical design, motivation, instruction and discussion). We identified and evaluated teacher reflections and statements in the interviews to illustrate the two research questions connected to the case studies: 1) Which pedagogical strategies do Norwegian teachers utilise when starting to use IWBs and tablets in their teaching? 2) How is the concept interactivity evident in the teachers’ use of IWBs and tablets?

After having roughly sorted the interviews, we developed the categories and systematically looked for content from the interviews revealing how the teachers perceived the process of preparation prior to the use of the interactive technologies. Here we were concerned with both the formal and infor-
mal arenas for learning and development in practical and educational use of IWBs and tablets. We were also concerned with the various pedagogical approaches and what strategic choices teachers make when starting to use interactive technology in their classrooms. First, we looked at the teachers’ answers evolving around this, but we also examined student responses about motivation and what aspects they considered positive in the use of interactive technology in the classroom. Second, we were concerned with what teachers and students experienced as particularly challenging with the interactive use of technology. Here we did a thematic coding of the student and teacher experiences and found several interesting aspects when comparing the use of IWBs and tablets in the classroom. The empirical data also revealed patterns showing both the positive aspects of interactive technology use in teaching and learning, and the more challenging aspects. In our analysis and discussion of interactivity, we found that interactivity goes beyond technology, as it captures the relationship between teacher, student, and communication. In our analysis of the transcribed texts, we concentrated on both concrete answers to questions about interactivity and other answers that illustrated the theme.

Validation

Validity of a study depends on attaining transparency in how the interviews were conducted and achieving consistent interpretations of the data material (Cohen, Manion & Morrison, 2011). The two cases differ from each other in the amount of researcher involvement. In School A, several researchers were involved in the development of the interview guide and conducting interviews, providing an additional quality assurance, whereas there was only one researcher present as an observer at school B. Although the researcher at School B acted independently, she took part in the school and school owner’s pilot project and was able to follow the project from the beginning for an extended period. The interviews were conducted in collaboration with a representative of the school owner. In both cases, the interviews were transcribed and the transcription serves as documentation of what was discussed in the interviews. The interviews were analysed some time after they took place. It should also be noted that the main theme in this paper, interactivity, was not the key focus when the interviews were conducted. There are certain challenges associated with such re-reading and analysing interview data in terms of new issues. On the one hand, we explored the interviews with the subject matter of the research questions, and on the other hand, it can be challenging to deal with nuances or ambiguities in the interview text that cannot be clarified or expanded with new questions. We have therefore chosen to be careful and modest with how we interpret ambiguities or inconsistencies in the interviews. Interviews were held and transcribed in Norwegian, and then the transcripts were partly translated into English for the purpose of this paper.
DISCUSSION

Case A: The Interactive Whiteboard School

In the autumn of 2010, three teachers in two 6th grade classes started to use IWBs in their teaching. The researchers followed some of the lessons in Norwegian and Mathematics. Examples from this case study will be discussed below.

In the beginning, when the IWBs were introduced, the teachers' competence in the use of IWBs for educational purposes had to be strengthened.

Interviewer: Did you find it intuitive to use an IWB?

Teacher A3: It is not like riding a bike.

Interviewer: What do you mean?

Teacher A2: You can use some of the basic functions even if you do not have any previous knowledge of computing, but for educational use, it depends on you knowing the special features and capabilities.

Teacher A3: Now it is easier to use the IWB, but I cannot do everything with the IWB.

Teacher A2: You need training/courses to attain optimal use of IWBs.

First, the teachers in Case A had little experience with the use of IWBs. Prior to the start of the autumn semester, the IWB supplier offered three teachers a two-hour crash course on how to use the IWBs. This course was the only organised training the teachers were offered before they started using IWBs in their teaching. It was otherwise expected of teachers to set aside time for self-study, testing, and reviewing examples from other teachers on how to implement IWBs in their teaching. This expectation was clearly not met.

Interviewer: Do you share materials and instructions with your colleagues?

Teacher A2: I have not shared anything.

Teacher A3: It is easy to share with others, but we do not do it.

Teacher A1: I try, but no one uses what I have made.

Teacher A3: I find information online, but I revise it.

Teacher A1: Sometimes I get tips and ideas, but I make my own teaching plans.
Second, IWB may be moving from a novelty technology to a truly interactive tool in school. The three teachers explained how extra time and effort was necessary in order to get started with IWBs. In their opinion, it was necessary to be well prepared for class and therefore good planning was a prerequisite for the use of IWBs. It also appeared that when adding more interactive elements into the teachers’ presentations, the interactive elements needed to be designed or programmed in advance, for example the use of a quiz with clickers or competitions involving revealing an image piece by piece. However, the occurrence of these examples of interactive activities was quite rare, partly because they required extra effort and equipment (clickers).

Third, the IWB is currently a tool for the teaching rather than for the learning. One teacher experienced how the use of additional software made presentations of and discussions about fractions in mathematics more visible and interactive, for example, when showing how one cake could be divided into four equal pieces before putting the four pieces together again, remaking the original cake. This is one kind of interaction between teacher and technology for educational purposes, where particular software makes it possible to show how fractions are made and what they represent. Student-centred approach shifts focus from the teacher to the students and includes active, cooperative and inductive use of the IWB during the lesson.

Fourth, IWBs seem to be best suited for teaching whole classes and to a lesser extent support other forms of organisation such as group work, dialogic learning, and individualised instruction. In our study, the IWB ended up being primarily used as a tool for presentation, i.e. to connect the computer with the IWB in the same way as the computer can be connected with a projector or monitor. IWBs moved from being used in various ways to being mostly used for presentations of new material, going through assignments and summarising previous instructions. The teachers were pleased because they experienced having a good grasp of the material that should be presented, and good classroom control as they were facing the students and thus keeping an overview of class behaviour.

Fifth, the use of IWBs does not always lead to a transformation of pedagogical practices.

Interviewer: Do you send students to the IWB?

Teacher A2: I let students use the IWB when the students work in groups.

Teacher A1: I cannot see that it improves learning to send more students to the IWB. They do not know the program, and they are therefore dependent on assistance from others.

During the first school year with IWBs, the teachers regularly organised student group work with tasks on the IWBs. However, in follow-up interviews...
we learned that they stopped doing so after a while. There were two reasons for not having students working on the IWBs: first, the teachers felt they lost control over the learning process, and second, they experienced a greater focus on technology than on educational use. This finding probably has something to do with teaching style too, even though this is not explicitly stated in the interviews.

Case B: The Tablet School
In the autumn of 2011, students in two 6th grade classes each received a tablet intended for educational purpose.

Teachers and Students Start Using Tablets
The teachers participating in this project were selected because the school leaders considered them highly qualified in the pedagogical use of technology. The goal for the pilot project between the school and the school owner was to see how tablets could be used in school and whether they could replace computers, as the latter often causes challenges, for example in terms of beginning a lesson.

The teachers in this study did not participate in a course in pedagogical use of tablets before starting, as there does not exist any formal course, apart from some introduction courses and support from consultants. This situation obliged teachers to experiment on their own with how to use tablets in their teaching. The teachers were promised some compensation in the form of time off, but this is very often difficult to realise in the hectic schedule of a school. The tablets were given to the teachers before the summer holiday, so they could explore various applications before school started. The teachers had personal smartphones and experiences with these proved useful, as the teachers were used to the tablets’ operating system and the use of apps. However, using the tablet in a pedagogical manner was new to them, so they actively involved students to get a better understanding of the potential in various applications.

Teacher 1: We have found most things out ourselves. We have downloaded apps all the time, tested them...and then we got the students to test them. Finding out what works and what did not work.

Teacher 2: And the students are as good, if not better than us, to find out how they can make use of different things. So all we have to do is give them an app, and they will find out how to use it.

The teachers cooperated closely, and this appears to be an important factor for the development of their teaching skills with tablets. Cooperation can also motivate the teachers to explore the educational possibilities with the device further.
Teacher 2: Yes, we talk together all the time, sharing apps, finding things out.

Teacher 1: I do not think there is anything that one of us does that the other one doesn’t.

The students were very positive about the use of tablets in the classroom and were highly motivated from the start. The teachers were all equally enthusiastic, but curious about how the tablet could be a productive part of learning and not only for consumption and entertainment. They were surprised by how well suited the tablet was for learning:

Teacher 1: I remember I was a bit sceptical about how the students would use it [the tablet]... if they would look upon it as merely a toy, or.... I am very surprised that they did not look upon it as a toy, they used it [the tablet] for what it is worth and they use it as much as they can.

**Interactivity and Tablet Computers**

The vast number and variety of apps, the touch-screen display, size, portability, and the user-friendly interface are all characteristics of the tablets. The interactive apps bring a different experience in the classroom than the programs used by the computer. The teachers noted that the apps could replace many of the programs that they previously used on the computer.

Teacher 1: No, this is something completely different from what we have on the computer.

Interviewer: But can they replace each other, complement each other?

Teacher 1: Yes, they can. They’re much more interactive the ones we find on tablets.

Interactivity is one aspect that is highlighted, but we do not know yet how this influences the learning outcome. From the classroom observations and interviews, it is quite clear that the use and exploration of different apps are motivational for both students and teachers. In terms of interactivity, the touch-screen and interactive programs point to technical interactivity. In this section, we argue for other features that that are important for interactive learning.

Having the tablets stored in the classroom has in a way altered classroom practices, as the accessibility is increased and the threshold to use technology is lowered. The teachers do not need to use the computer labs, which require booking in advance. The tablet can be used whenever needed, which permits spontaneous and useful activities, saves a lot of time and enables students to use the technology more often.

Student 1: We have replaced everything with the tablet.
The tablets also have an impact on the didactical design of teaching, as both students and the teacher can be more impulsive, for instance when they want to look up something on the Internet. This gives a more relevant, hands-on way of learning, similar to learning outside school. Time saving can also be seen in relation to the functionality of the tablet. For example, when the students want to share their work, they can easily display it on the IWB in the classroom, using a wireless connection.

From the classroom observations and interviews, it was apparent that tablet use influenced the way students worked together, as it facilitates collaboration. This is something the students also pointed out.

Student 1: I feel it is much easier to work together now, in a way....

Student 2: Yes, it so much easier to sit together at the desk. Before, we had 20 books on a tiny little desk. Now we only need the tablet, then... I feel we can do more together.

The teachers also confirmed this finding. From the observations, we saw that they used the room in different ways, by working in groups and changing placement when they wanted, in and out of the classrooms. When students got an assignment, they concentrated on it and were occupied in solving the task. The students either sat alone or on the floor in a group discussing and helping each other. It should, however, be stated that these classes have a very homogenous student group with a very good working atmosphere, but the tablets nonetheless clearly engaged the students.

Linking the concept of interactivity to how students work, the previously discussed example demonstrates pedagogical interactivity. The tablet facilitates a different style of collaboration. We see students getting more active in their learning process, working together and with the teacher in the background helping out when needed. Since the tablets were all new to the teachers and students, and the teachers were not the only experts, teachers and students both explored the tablets together. The pedagogical interactivity to which Beauchamp and Kennewell (2010) referred emphasised dialogue, when students and teachers interact and cooperate. There is reason to believe that tablets lead to more dialogue between students and teachers, but also result in a more student-centred learning approach than the use of the IWB does.

Discussion and Further Research

Based on the literature review as well as the interviews and observations from the case studies, we will answer the research questions stated in the beginning of this article:

1 In our two cases, which pedagogical strategies do Norwegian teachers utilise when starting to use IWBs and tablets in their teaching?
2 How is the concept interactivity evident in the teachers' use of IWBs and tablets?

Looking at the first research question, there is no doubt that teachers are using explorative strategies when they start using interactive technology. In both the IWB case and the tablet case, we clearly saw how the teachers experimented and tried out different ways of planning, preparing for and teaching their students. It was interesting to follow the teachers over time as their explorative strategies became more and more advanced. This was evident both in planning and preparing as well as in how the teachers taught and evaluated the students.

Another aspect of pedagogical strategies influencing teaching and learning with interactive technology has to do with collaboration. From our empirical data, we found how the teachers emphasised finding examples of teaching programs and teaching resources online or searching for relevant apps. The teachers explained how they adapted examples and ideas from other teachers as their own personal teaching style and approach. The teachers did not join or participate in larger networks or online communities. Linguistic and cultural barriers, but also different pedagogical approaches and views on how to integrate interactive technology in the classroom, can partly explain this.

One interesting finding related to teacher expertise and experience being necessary for teachers to possess basic digital competence in order to participate in the projects involved. However, it became clear that the educational (subject knowledge) or the didactic competence of the teacher was equally important. From our data, it became evident that a good "interactive" teacher possesses solid professional and didactical knowledge, together with subject knowledge in addition to basic digital competence.

When considering how the concept of interactivity is evident in our studies and considering the second research question on interactivity, we explored how pedagogical interactivity is not dependent on technological interactivity or vice versa. Moore (1989) defined three types of interactions: the relation between a student and content, the relation between a student and teacher and, lastly, the relation between students. Moore claimed that interaction between student and content is fundamental for all learning experiences. The relation between student and teacher adds an additional layer, and gives the student the chance to combine his or her understanding with feedback from the teacher, which in turn leads to increased motivation. The last of the three aspects, the relation between students, might have a stimulating and motivational effect on younger students, as they are often less self-driven and motivated than older students. We see clearly on the use of tablets in case B that the students are highly motivated and perceive technology as promoting their learning and adding a new dimension to group work and collaborative problem solving.
Interactivity is a good starting point for learning, because it invites both students and teachers to reflect on teaching and learning. Conversation and cooperation are important aspects, and interactive dialogue can contribute to learning by supporting rich forms of dialogue, as we have shown in our cases on the use of IWB and tablets. Hennessy (2011) argues that interactive technology might help in concretising and creating knowledge, because it opens up a dialogical sphere where personal and shared meaning can be negotiated. This also coincides with our findings. In the case of IWB, we saw how the interactive whiteboard was used in group work, and for whole-class collaboration and reflection, whereas the tablets were used in smaller groups for collaboratively solving assignments etc. In other words, given that technology is used in a way that encourages shared experiences and dialogue, it may facilitate richer learning situations.

We see that interactivity is evident as students manipulate interfaces, when they use the devices to cooperate and when there is good dialogue between them, as well as between the students and the teacher(s). One of the great aspects of interactive technology is thus how it can contribute to greater dialogue and reflections on thematic subject issues, teaching and learning styles, assessment and evaluation of student work and so forth.

Comparing our two cases, the schools in both Case A and Case B were in the initial phase of using IWBs and tablets, something that made the data quite rich when it came to the “starting-up” processes and reflections on first time users and integration of technology. We see that the teachers’ pedagogical strategies when starting to use interactive technology are influenced by various approaches. In our cases, we also notice that the accessibility to learning resources is quite central in the use of IWBs, as are the challenges of the limited continuous professional development for the teachers.

However, when viewing Case B on the integration of tablets, our findings show a more dynamic and spontaneous use of interactive technology, tablets in this case, as compared to traditional classroom teaching and technologies. Another essential difference between the IWBs and other interactive devices such as tablets and smartphones is that while the former are developed for collaborative use, for instance as a tool in classroom instruction, the latter on the contrary are developed more for individual use and operation (Way & Johnco, 2009). The size and shape (the nature) of the technology affect interactivity. While IWBs are great for whole-classroom discussions and whole-class teaching, the tablets are more suitable for smaller groups and individual teaching activities and dialogues. However, the tablet can easily be shared on a big screen like an IWB, for instance to display student work or as a starting point for discussions. It is quite obvious that the large screen of the IWB does influence the audience, and it is relatively easy to engage the whole class in lessons with the IWB as the central point of the discussion. However, the unique user-friendliness, networking and collaboration possibilities of tablets might provide even greater pedagogical opportunities than the use of IWB does alone.
Considering the road ahead, based on the challenges the teachers and students met in our cases, we would like to mention the use of proprietary software and open educational resources as one of the issues that needs greater attention. This is a complicated debate that future research needs to address, in addition to how these aspects might influence the working environment of the teacher who wishes to start using interactive technology. In addition, the lack of high quality digital resources for use on IWBs and tablets is evident. Various initiatives and publishing houses are working on these issues, and development is moving swiftly. However, the culture of sharing is also quite new among Norwegian teachers, which makes it challenging to establish or maintain sharing platforms. Finally, one of the main challenges is the need for continuous professional development of teachers. We see that teachers welcome support when starting to use interactive technology in their teaching, not only technical support, but also support on the pedagogical use and integration in their teaching.

With this in mind, it is highly relevant and important to ask: “is the potential embedded in interactive technology in fact realized in schools?” Such a question can form a framework for further research into interactive technologies in the classroom. By introducing interactive technology, we do not automatically create interactivity. This means that pedagogical interaction may just as well be reached through dialogue and reflection, without the use of technology. In this paper, we have documented examples of the traditional use of IWBs, whereas it seems tablets could renew the pedagogical approach to teaching and learning. It is not a given that bringing interactive technology into a learning situation will increase learning outcomes or even the quality of the pedagogical approach. Overall, with good subject knowledge, basic digital competence and clear pedagogical goals aiming at interactivity, reflection, and collaboration, IWBs and tablets have much to offer both students and teachers. It is thus not the technology that defines interactivity, but the use(r) and the pedagogical implementation of the technology.

REFERENCES


