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PEER REVIEWED ARTICLE

Use of tablets in primary and secondary school – a case study

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ABSTRACT

Norwegian schools are increasingly implementing tablets in school and there seems to be a need for more research within this area to examine how this implementation affects pupils' learning processes. This article focuses on the use of tablets in pupils' learning and the extent to which pupils become more involved in the planning, implementation and assessment of their learning. We used a qualitative research approach and case study to investigate six classes at three different schools: four classes in one primary school and one class each in two secondary schools. Our sample included 134 pupils and 14 teachers. Fieldwork involving observations, interviews and surveys (quasi statistics) was carried out to examine the research questions. The case study shows that tablets play a certain role in pupils' learning processes, especially in the achievement of learning goals and access to the Internet. However, there is a clear diversity in how the pupils use the tablets in their learning processes, in particular a difference between primary and secondary school. The practical implications of the study indicates that the challenges lie in changing teachers' practice by implementing a digital didactic method that provides the teacher with a greater understanding of, and better opportunity for, interaction with pupils during the learning process.

Keywords

ICT, Tablets, assessment for learning, qualitative research, case study

INTRODUCTION

On 21 June 2013, the Stoltenberg II¹ cabinet in Norway appointed a committee to assess the degree to which the content of schooling covers the skills that

1. <http://blogg.regjeringen.no/fremtidensskole/>

pupils will need in society and working life in the future. In the report “Pupils’ learning in the School for the Future” (NOU, 2014:7), the committee notes that our access to information in today’s technology-based society is almost unrestricted, thereby placing new demands on pupils’ ability to select, evaluate and use knowledge. This is borne out by Ferrari (2013), who is concerned that technology should contribute to the development of pupils’ independence in the learning process, that they should learn by working together with others through technology, and that they should share knowledge with each other. It is then that pupils develop their digital literacy. Frønes and Narvhus (2011) note that the results of PISA 2009 show that Norwegian pupils’ use of computers is only minimally linked to performance in reading, natural sciences and mathematics. Research by Beckman and Lockyer (2014) also shows that there is no correlation between the frequency of data use in schools and pupils’ performance in tests or examinations, and the PISA 2012 (OECD 2015) confirms this. This is also supported by the SMIL study (Krumsvik, Egeland, Sarastuen, Jones and Eikeland, 2013; Krumsvik, Jones, Øfstegaard and Eikeland, 2016), which highlights the fact that the degree to which the use of ICT increases pupils’ learning outcomes depends on access to digital resources in the subject area, and the teacher’s digital literacy and ability to adapt lessons to pupils’ requirements. On this basis, and in order to gain further insight into how tablets can contribute towards supporting pupils’ learning, the main aim of the study is to examine if, and eventually how tablets contributes towards promoting or inhibiting pupils’ participation in planning, implementation and assessment for learning. Although the international literature on use of tablet computers in education often distinguishes between primary and secondary school pupils (e.g., Wollscheid et al. 2016; Clarke and Svanaes 2012), our case study position itself towards both primary and secondary school. The reason for this is that Norway has a national curriculum that is (intentionally) marked by a coherence between primary and secondary school, and we wanted to examine such similarities and differences between these two school stages with regard to the use of tablets.

LITERATURE REVIEW

The development of Web 2.0 brought radical changes to the conditions for the use of technology. Male and Burden (2013) describe it as follows:

The implications for education caused by the development of twenty-first-century technologies are enormous and anticipated change probably ranks alongside the introduction of the printing press in terms of historical importance (p. 2).

The use of technology can enable pupils to become active in the formation of their own learning environments, and the view of learning as a collaborative and socially situated process has taken hold in fields that work with education technology (Collins and Halverson, 2009; Selwyn, 2012; Genlott and Grön-

lund 2016). Mayer (2010) describes learning *with* technology, such as situations wherein technology is used for the purpose of promoting learning, and is concerned with the human *construction of knowledge* as a framework for learning. What Lai (2004), the Norwegian Directorate for Education and Training (2012) and Monitor (2013) define as the development of competence is the capacity to *obtain, understand* and *use* information, as well as the possession of *digital judgement*. This is a way of thinking that can be linked to sociocultural learning theory, with an emphasis on human actions through the use of cultural tools (Kongsgården and Krumsvik, 2013). The role of technology is to help the teacher guide the pupil's cognitive processing of information through the learning process. This is supported by Wiliam (2010, 2011), Shute (2008) and Hattie (2012), who point out the importance of integrating assessment and teaching. However, if assessment and teaching are to be integrated, the pupils must take part in determining their own goals (Zimmerman, 2012) to set the direction of the learning process (Kongsgården and Krumsvik, 2013) in what Harasim (2012) calls constructivistic collaboration, in which teacher and pupils interact throughout the entire learning process. This is what Farell (2001) calls "collaborative circles", or the learning environment in a class. The use of technology can make these processes more flexible and transparent² for both pupils and teachers. Based on the expectations that ICT will be a catalyst for change in learning processes, however, Yang (2012) has reservations regarding the teacher's capacity to take on new ways of working. His research shows that teachers often follow a pattern that is laid out in the subjects of the teacher's lesson plan, which defines the syllabus of the teaching and provides guidelines for the educational approach to teaching. In order to succeed here, there must be room to share experiences and ideas in the faculty such that the teacher can move from being a communicator of content to being a person with overall responsibility for a "learning expedition" (Jahnke and Norberg 2013; Krumsvik et al. 2013). However, the recent published PISA-study *Students, Computers and Learning: Making the Connection*, (OECD 2015), reveals that both teachers and pupils still struggle to apply the technology for learning processes in school.

The first tablets were produced only five to six years ago, and the use of tablets in teaching is therefore a new experience. There has been limited research on the consequences of their use in the context of learning. Foote (2012) describes experiences from her own school, where teachers and pupils alike were given individual tablets. After a year of use, she says: "it's clear that the devices have changed a lot about how our school works" (p. 26). The tablet is an all-in-one tool, where pupils plan, produce, take notes and save material etc. Maintaining an overview is easy, it is easy to carry around, and the pupils are more creative. The tablet gives easy access to information when it is needed, "on a point-of-need basis" (p. 26), and she describes the change at her school as follows:

2. 'Transparent' in this article means that the technology makes 'visible learning' processes more common, which, for example, means that the teacher more easily can see where the pupils are in their learning processes through presentations, collaboration and learning analytics tools (e.g. Knewton).

This has become normal for our campus – to work together, to collaborate, to learn together, and to use technology as an aid (Foote 2012, p. 27).

These findings are also confirmed by other researchers (Fisher, Lucas and Galstyan, 2013; Burden, Hopkins, Male, Martin and Trale, 2012; Hultin and Westman 2013; Beckman, Bennett and Lockyer, 2014) who show that pupils use technology far more often after receiving a personal digital tool than when they have had to stick to the school classroom or computer lab. Teachers did the same when they were also able to use a range of different technologies to present teaching content, such as different tablet apps or a smart board. But is increased use enough when we talk about pupils' learning? For example, Beckman et al. (2014) bring up an interesting point when they note that some pupils (aged 14–16 years) said they felt that writing on a keyboard had a negative impact on their own learning. As one pupil put it:

It's like I'm paying attention more to what I'm writing (when using a book) and it's just easier to remember. It's more manual work than just typing it up on a laptop and forgetting it. It's more like you're copying something; you're not actually learning it (Beckman 2014, p. 356).

What does this mean? This issue is examined by James and Engelhardt (2012), whose study looks at how brain activity, when perceiving letters, is affected in different ways: either when the pupils have previously written the letter by hand (pencil); by using a keyboard on a computer, or when they recognise the same letter from among other letters on a sheet. They base their investigations on children (5 years old) and see that brain activity increases in central areas of the brain in a completely different way in those who have written the letter by hand than in those who have typed it on a keyboard or recognised it on a sheet. The researchers explain this by saying that when writing by hand, it is necessary to plan and execute the “action”, but this is not needed in the same way when we type the letter or look for it among other letters. This is interesting, not least because tablets are now becoming more widespread right down to nursery level. Mueller and Oppenheimer (2014) carried out their investigations on different ways of taking notes among students at university level. Here, participants who had taken notes on notebook computers performed worse on tests of both factual content and conceptual understanding compared to students who had taken notes by hand, or in normal paper writing. The researchers claim that technology can have a negative effect on educational performance, particularly when it is used to make note taking easier. However, the research review by Wollscheid et al. (2016) of the impact that digital tools have on primary school students' writing skills is important to consider in light of the discussion above, since it examined 10 studies within the area. Furthermore, when dealing with reading and writing in the digital era, Genlott and Grönlund (2013) examine how literacy skills can be improved through the learning of reading by writing; Åkerfeldt (2014) focuses on the reshaping of writing in the digital age. These are studies of high relevance for the topic.

However, from a critical point of view this strict distinction between writing notes on tablets versus with paper and pen can be questioned because, today, writing on paper, using digital pens with tablets, and using keyboards with computers seems to be increasingly mixed together both in different classrooms, and at different times within the same classroom. It is therefore important to monitor this development further to avoid jumping to conclusions too hastily.

When we consider reading from a screen, Frønes and Narvhus (2011), in their report “Elever på nett” (Pupils on the Internet), studied the different skill levels of pupils in the digital reading test in PISA 2009, which shows that pupils’ socioeconomic background appears to be less significant for their mastery of digital reading. The researchers also examined differences between schools, looking at the variance for digital reading and for reading on paper, and found that it is 19% for digital reading but about half that (10%) for reading on paper (Frønes and Narvhus 2011). The researchers see this as remarkable:

In other words, the difference between the schools for the same pupils in the same tests is greater for digital reading than for reading on paper, and it is natural to think that this is due to different digital practice in the schools (Frønes and Narvhus, p. 112).

Variation in teachers’ digital practices in school were also found in the SMIL study (Krumsvik et al. 2013; Krumsvik et al. 2016) and were explained by teachers’ high or low digital competencies and class management skills, and thereby their skills to integrate the technology into their didactical practice. Further, Murray and Olcese (2011) believe that the way that tablet technology is used from an educational and teaching perspective is still fairly prosaic and is of little use in bringing about change. They state that the background for this is clear: although many teachers today give lip service to collaboration and the construction of knowledge in social contexts, they are often “caught up” in traditional pedagogy, which means that is teacher-centred rather than learner-centred. The challenges, therefore, do not lie primarily in the use of technology, but in teaching methods and didactical practices that are increasingly being confronted with newer theories on how people learn. This is supported by Selwyn (2012), who points out that research has established that the use of technology has not revolutionised the school system or pedagogy; instead, what has taken place is more an evolution.

The Danish study by Jahnke and Kumar (2014) studied how teachers integrated iPads in 15 different classrooms. One of their main findings was that the strength of tablets lies in the potential of collaboration and feedback in the learning processes, as well as teachers adopting tablets as a vital part of their didactical design. Despite this Clark and Luckin (2012) state:

However, whilst some recent studies on adaption and use of iPads made reference to monitoring students’ learning, giving feedback and improved

ease of sharing assessment and grades, as yet these were few in number (p. 10).

To sum up we can say that while educational authorities around the world have seen technology in schools as a tool to change learning, research indicates that so far this is not reflected to a great extent in schools. Even if research on tablets so far has shown similar findings, there are still few case studies examining how tablets affect either academic skills among pupils, or assessment of learning practices, and whether there is a sustainable alteration of teachers' didactical practices when tablets are integrated. Due to this, we wanted to examine this issue in more depth in three Norwegian schools, and the following research question and sub-research questions are raised:

How can tablets as a tool contribute towards promoting or inhibiting pupils' participation in planning, implementation and assessment for learning?

1. What is the relationship between pupils' use of tablets and academic skills, and how do pupils and teachers perceive this relationship?

2. In what ways do pupils perceive tablets in assessment practices, and how are these assessment practices reflected in teachers' didactical practices?

METHOD

A qualitative approach using case study was used to examine these research questions and the main reason for this was that:

“Both qualitative and quantitative researchers are concerned with the individual's point of view. However, qualitative investigators think they can get closer to the actor's perspective by detailed interviewing and observation. They argue that quantitative researchers are seldom able to capture the subject's perspective because they have to rely on more remote, inferential empirical methods and materials” (Denzin and Lincoln 2012, p. 9).

To be able to examine these research questions on a more concrete level, we considered it necessary to apply quasi statistics (Maxwell 2005) (surveys) as the main method in the first research question, triangulated with focus groups, observations and field dialogue (Fossåskaret et al., 2006), with focus groups and quasi statistics as the main methods in the second research question, triangulated with observation and field dialogue.

We investigated six classes in three different schools: four classes at a primary school and one class each in two secondary schools. The participants in this study numbered 134 pupils in total, and 14 teachers. Of the pupils, 77 were from primary school (7th year, aged 11–12 years) and 57 were from secondary

school (10th year, aged 14–15 years); of the teachers, 7 were from primary school and 7 from secondary school. The schools in the sample are average Norwegian medium sized urban schools, with a heterogeneity pupil mass from households with both high, middle and low SES, a share of minority language children and in general quite representative for Norwegian schools.

We have chosen to investigate this as a case study (Creswell, 2009; Stake, 1995; Yin, 2009) because we studied authentic practices at the schools, with all the entailed complexity, and thus:

A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2009, p. 18).

It is quite common to use methodological triangulation to enhance the validity of case studies (Denzin and Lincoln 2012), and in this study, we applied surveys (quasi statistics), focus groups, observations and field dialogues to be able to answer the overall research question and the two sub-research questions. We also applied Mathison's (1988) three analytical "lenses" for critically considering convergence between the different methodological entry points attached to each research question. These analytical "lenses" are: *Convergence*, *Inconsistency* and *Contradiction* that combine to critically examine whether "teachers practise what they preach" (i.e., whether good intentions are realized through the teaching).

Since the study examines how tablets can contribute towards promoting or inhibiting pupils' participation in planning, implementation and assessment for learning, the research questions and analysis of the data address these issues. The first area is "the use of tablets in pupils' learning processes and participation in their own learning", in which we examine the relationship between different learning activities and the use of tablets, whether and how pupils collaborate when solving tasks, the interaction between pupils and between pupils and teachers in learning work, and differentiation between the use of sources, learning materials and tasks. The second is "use of tablets in assessment practices with emphasis on assessment for learning", in which we examine interactions between pupils and between pupils and teachers in the assessment work, and the frameworks for and visualisation of the assessment.

We carried out fieldwork at each school one day per month for ten months and observed how pupils and teachers used tablets in teaching with a focus on activities and interactions, independent of subject area, as a strategy for the observations (Merriam, 2009). Emic perspectives were important to this case study, but also to the external perspective from us as researchers throughout the long-term field work at the schools:

(...) an outsider researcher, with enough time to develop close acquaint-

ance, could accurately observe and interpret meaning, without being limited by the insider's tendency to overlook phenomena so familiar they were taken for granted and had become invisible. As the anthropologist Clyde Kluckhohn (1949) put it in a vivid metaphor: "It would hardly be fish who discovered the existence of water" (p. 11) (Denzin and Lincoln 2012, p. 49).

The total amount of time spent at each school in fieldwork was approximately 70 hours (total of 140 hours), and we had our primary focus on the subjects of Norwegian (45 hours), Mathematics (49 hours) and Social Science (43 hours) in both primary (7th Grade) and secondary school (10th Grade). We developed an observation protocol associated with the research questions of the study and based on Merriam's (1998) six observation strategies: the physical setting; the participants: activities and interactions: conversation, subtle factors and your own behaviour (1998, p. 1234–1235). During these observations, we focused on the whole class, based on the research questions and the preliminary findings so far in the study. We used the observation protocol for this purpose and, in addition, wrote field notes that complemented the observation protocol on more general issues, as well as preliminary questions or topics for the field dialogues after the observations. The observations were made at lower secondary school A one Tuesday per month in the school year 2013/2014 (except June and July 2014); in lower secondary school B one Monday each month in the school year 2013/2014 (except June and July 2014), and in primary school one Thursday every month in the school year 2013/2014 (except June and July 2014).

At the end of the observations each school day, we met with the teachers and had a field dialogue (Fossåskaret et al., 2006) during which we discussed and clarified what we had observed, and recorded the teachers' experiences from the session based on the focus areas in the observation protocol. These field dialogues were important to bring up important issues and questions that were not foreseen and to discuss these in light of our observations and preliminary findings (Fossåskaret et al., 2006). This was an important validity check of our preliminary interpretations from the observations, and we recorded these field discussions (Aase and Fossåskaret, 2014) with the teachers in a sound file laying the basis for an electronic survey (quasi statistics, Maxwell 2005). One of the reasons for using quasi statistics in this case study is on the advice given in Becker's critical analysis: "One of the greatest faults in most observational case studies has been their failure to make explicit the quasi-statistical basis of their conclusions" (Becker 1970, pp. 81–82). In addition, Miles and Huberman followed this up in 1994: "(...) there are three good reasons to resort to numbers: to see rapidly what you have in a large batch of data; to verify a hunch or a hypothesis; and to keep yourself analytically honest, protecting against bias" (p. 253). Thirdly, we wanted to examine any relation between variables in this case study as part of the study, and quasi statistics are well suited to this purpose. Thus, we conducted a survey of all the pupils in 7th and 10th grade. In 7th grade, the number of the participants was 72 in total at one school, where 63 answered the survey (response rate 87.5 %). The sample in the secondary schools comprised 57 pupils at two schools, where 51 answered the survey

(Response rate 89.5%). The pupils answered the survey using their tablet at school in classroom settings with teachers. The surveys were conducted at lower secondary school A on 6 March 2014, at lower secondary school B on 7 March 2014, and at the primary school on 14 March 2014.

The surveys were constructed based on the research question, previous research and preliminary findings in the fieldwork and observations. The main theme in the survey was how pupils perceived the use of tablets in their learning processes and how this affected assessment practices. The raw data from the survey was converted to SPSS for analyses, such as frequency tables and simple correlations with a Pearson correlation coefficient, in order to see the direction and strength of the covariance between chosen variables (Eikemo and Clausen, 2012) with special relevance to the research questions and the preliminary findings in the fieldwork. With this backdrop, we selected an “explanatory sequential design” (Creswell, 2012) whereby we followed up the observations and the quasi statistics (survey) with focus group interviews. “Focus group interview refers to a group interview where a moderator seeks to focus the group discussion on specific themes of research interest” (Kvale 2007, p. 30). The intended use of the focus group was therefore attached to the research questions and the fact that “Interviews can also provide additional information that was missed in observation, and can be used to check the accuracy of the observations” (Maxwell 2012, p. 41).

Based on what emerged from the surveys, observations and relevant theory, we drew up an interview guide (Kvale and Brinkmann, 2009; Krumsvik 2014) and used it for both students and teachers: “Interviewing gives us access to the observations of others. Through interviewing we can learn about places we have not been and could not go and about settings in which we have not lived” (Maxwell 2012, p. 1). At the primary school level, 39 pupils were interviewed, divided into 9 groups by random selection from class lists. At the secondary school level, 54 pupils took part, divided into 9 groups selected by the teachers. The focus groups at lower secondary school A consisted of 5 groups of 6–7 pupils carried out on 13 May 2014. At this school, one teacher group comprising 4 teachers was interviewed on 21 May 2014. The focus groups at lower secondary school B consisted of 4 groups of 5 pupils carried out on 5 May 2014, and one teacher group of 4 teachers carried out on 5 May 2014. The focus groups at the primary school consisted of 9 groups of 4–5 pupils carried out on 26 and 27 May 2014, and one teacher group of 6 teachers carried out on 27 May 2014. We transcribed the interviews ourselves and used the “constant comparative analysis method” (Corbin and Strauss, 2008; Creswell, 2013; Postholm, 2010), developed from grounded theory (Strauss and Corbin, 1990), in analysing the data. This was conducted first by “generating” a “conceptual category” from the empirical evidence and allowing this to serve as a relevant theoretical abstraction from the data gathered. For example, interviews with pupils who were using tablets revealed that using them provided access to an expanded number of information sources; this resulted in the our abstraction of the category tagged “multiple sources” (Glaser & Strauss, 1964). Terms

such as “multimodal sources” have replaced the pupils’ original words. Some categories are “abstracted” from terms used by interviewees and informants; these are “in vivo” concepts, and they tend to label the processes and behaviours to be explained – in other words, they are descriptive. For example, the pupils’ experience of an expanded number of information sources as a consequence of using tablets (instead of text books) will affect the pupils’ knowledge production to which the in vivo category of “knowledge production” is linked, and is explained by the “constructed” category of “multiple sources” (Glaser & Strauss 1964).

Through this process, the views expressed by the informants were made into shorter formulations and the interviews were then coded into categories and related to the quantitative survey data (quasi statistics, Maxwell 2005). The data from the observations were then related to the interview data and to the quantitative survey data (quasi statistics, Maxwell 2005). Thus, in order to answer the research questions and enhance the internal validity, we have combined several research methods (triangulation) in our case study design (Yin, 2009). In the last phase of this methodological triangulation, the quantitative and qualitative elements were linked together to give a more unified representation, and increased validity. As regards the ethical part of the research, the NSD (Norwegian Social Science Data Services) have approved the application from the researchers to conduct this research project.

There are several limitations in this case study and these are especially related to the problem of generalizing our findings to larger populations of schools.

RESULTS AND DISCUSSION

In this section, we will present the results of the case study. Because we have applied observations, quasi statistics, field dialogue and focus groups, these are linked together in the presentation of the results to provide a more unified representation, which is a common way to report case studies.

USE OF IPADS IN PUPILS’ LEARNING PROCESSES AND PARTICIPATION IN THEIR OWN LEARNING

The quasi statistics applied in this study made it possible both to relate different variables to each other and to examine the quasi statistics in relation to the observations, focus groups and the field dialogue. In this part we wanted to examine the first research question: What is the relationship between pupils’ use of tablets and academic skills? As can be seen in table 1 there are moderately significant correlations between the three variables: “Having an iPad makes it easier to get an overview within different subjects”, “The ability to collect learning material from different sources (Internet, textbooks etc.) makes it easier to achieve the learning goals” and the students’ perception that

“Using an iPad made me more competent”. The correlations do not tell us anything about causation or causal relationships, but they are able to tell us something about the strength of the relationship expressed as Pearson’s R. The variables “Having an iPad makes it easier to get an overview within different subjects” with “Using an iPad made me more competent” revealed the highest correlations among the three ($r = 0.38^{**}$).

TABLE 1. CORRELATIONS BETWEEN TABLET VARIABLES, PART 1 (N=63, PRIMARY SCHOOL).

	1 Use of iPad	2 Learning goal	3 Overview
1 Use of iPad	–		
2 Learning goal	0.31*	–	
3 Makes me more competent	0.38**	0.34**	–

Note. * correlation is significant at 0.05, ** correlation is significant at 0.01
 “Having an iPad makes it easier to get an overview within different subjects” (1 Use of iPad), “The ability to collect learning material from different sources (Internet, textbooks etc.) makes it easier to achieve the learning goals” (2 Learning goal), “Using an iPad made me more competent” (3 Makes me more competent).

In the focus groups with the pupils, we followed the quasi statistics and tried to determine *why* they experienced some academic progress³ after receiving a tablet. What all the focus groups note is that it becomes easier to maintain an overview of the individual subject areas after receiving a tablet. Each individual subject area has its own folder and the focus groups made it possible to dig deeper into this (beyond the quasi statistics and correlations):

If I have Norwegian then I write Norwegian... if I have English then I write that (pupil 3, group 3, primary school).

And so you get a better overview of individual things... you don’t need to remember all the books... you’ve got it on the tablet (pupil 2, group 9, primary school).

Observations in the fieldwork confirmed that it is easier to keep track and get back to where one left off, or to add something to what one has previously written with tablets at this level. Observations and field dialogue with teachers also revealed that pupils who had forgotten to bring their tablets and needed to write in a notebook would take a picture of their notes and store it “in place” on the tablet. The observations revealed that the pupils were also very self-confident users of the tablets and the findings from these observations in the fieldwork confirmed the significant correlations between the three variables in the quasi statistics in table 1. On this basis, we found a good *convergence* (Mathison

3. Academic progress: the self-reported learning progress the pupil perceives they have made in the subjects.

1988) between the quasi statistics, the focus group, the observations and field dialogue attached to research question 1 in primary school. However, what was the result in secondary school? In this part, we wanted to examine the first research question in relation to pupils in secondary school.

The three variables used among secondary pupils were similar to those for primary school pupils with the exception of one, which in primary school was: “Having an iPad makes it easier to get an overview within different subjects,” while in secondary school was: “Having an iPad has made it easier for me to access information from different sources”. As can be seen in table 2 there is moderate significant correlation between the two variables: “Having an iPad has made it easier for me to access information from different sources” and “The ability to collect learning material from different sources (Internet, textbooks etc.) makes it easier to achieve the learning goals”. These variables revealed a moderate correlation ($r = 0.39^{**}$).

TABLE 2. CORRELATIONS BETWEEN TABLET VARIABLES, PART 2 (N=50, SECONDARY SCHOOL).

	1 Use of iPad	2 Learning goal	3 Access inf.
1 Use of iPad	–		
2 Learning goal	–0.08	–	
3 Access inf.	0.02	0.39**	–

Note. ** correlation is significant at 0.01
 “Having an iPad has made it easier for me to access information from different sources” (1 Use of iPad), “The ability to collect learning material from different sources (Internet, textbooks etc.) makes it easier to achieve the learning goals” (2 Learning goal), “Using an iPad made me more competent” (3 Makes me more competent).

In the focus groups, we noted that the pupils in the primary and secondary schools share in common the fact that they have everything in one place once they have received a tablet, and they feel that there is more coherence in their schoolwork. Another condition cited by the pupils is the ability to extract information in different subjects or tasks in a much simpler, faster way once they have received a tablet and are connected to the Internet.

Faster to find information (pupil 3, gr.2, secondary school)

Before we got iPads, it was difficult for us to find facts and things like that... presentations came to just a couple of sentences... now we usually have a lot of pages and loads of facts... and stuff like that (pupil 1, gr.2, secondary school).

When you have technology, I think it's much easier to go into depth... you can click through links and new documents and find out more (pupil 3, gr. 1, secondary school).

The pupils also highlight the importance and value of having access to teaching materials from different sources when they work in groups and have to give presentations. As the pupils say in the interviews:

Because now we can search for information... before, we had to go to the books... and we took quite a long time to find out what pages it was on... now we can just look it up on the net... get more varied information (pupil 2, gr. 3, secondary school).

There are many advantages to the iPad... when we had a topic on more recent conflicts... it's no use just reading books then... then you can check the internet on the iPad every day to see if anything new has come up about the conflict you're looking at... then (pupil 3, gr. 6, sec. school).

As one teacher put it (in the interview):

The iPad provides an approach to inductive learning... that the pupils' supply of different sources brings out the pupils' capacity to make a decision about the knowledge... look for different sources... make a decision on them and process them... to be able to justify their use of them (teacher 5, sec. school).

The observations and field dialogue with teachers confirmed the same tendency as found in the significant correlations in table 2, where tablets are related to easier access to information from different sources, making it somewhat easier to achieve the learning goals. On this basis, we found a good *convergence* (Mathison 1988) between the quasi statistics, the focus group, the observations and field dialogue on this topic. However, if we compare primary school (table 1) with secondary school (table 2) we can recognise fewer significant correlations in secondary school and a slightly different perception of the tablets' value in learning processes than in primary school.

But how can we understand the use of tablets in relation to the competence aims⁴ in the curriculum (LK06) and academic skills? Within the concept of competence (Lai, 2004; Norwegian Directorate for Education and Training, 2012 and Monitor, 2013), there is emphasis on the capacity to *obtain, understand* and *use* information, as well as to exercise digital judgement. Based on observations and field dialogues, our findings in the case study indicate that when the pupils need to put together information from different sources and assess its relevance so that it becomes meaningful, pupils' skills are developed

4. The competence aims are learning goals in the subjects in the national curriculum for primary and secondary education.

and the capacity for critical reflection and digital judgement is stimulated. Collins and Halverson (2009) have similar findings, and in general tablets might help pupils to monitor and evaluate their own progress in relation to their own achievement of learning goals, where digital media literacy (Barron and Darling-Hammond, 2010; Ferrari, 2013; Jonassen et al., 2009) becomes an important set of skills that the pupils need in order to use the technology strategically for learning. Technology that allows people to influence each other, to collaborate and to create and share information increases the potential for supporting pupils' self-regulated processes (Zimmerman, 2012). The teachers in our study confirm that the tablet has "opened up" their methodology, where the pupils are made independent to a far greater extent in terms of gathering and assessing relevant information.

I think they've gotten better at retrieving information... interpreting and reformulating it in their own heads... and then it also becomes much easier... then you own the text (teacher 2, primary school).

This is what Dumont and Istance (2010) are referring to when they say that technology can enable pupils to become active in the formation of their own learning environments. Once each of the pupils had received a tablet, it was important for the study's research questions to ask the pupils whether there had been any change in collaboration. At the primary school, the pupils said that when they collaborate, they each write on their own tablet to ensure that everybody sees the group's work. They retrieve material from different sources and discuss what is to be included in the exercise.

I think we learn more because we discuss together... talk about it in a way (pupil 2, group 9, primary school).

When we're working on the same topic (group)... each person can make their presentation (save it on the tablet)... and if there is anyone who writes something that other people have not written... then they can extract it... then (pupil 3, group 4, primary school).

From the observations in the fieldwork in primary school we recognised that the tablet makes learning easier when the learning process involves more interaction, interplay and participation rather than passive consumption of information or knowledge, which is similar to findings in Dumont and Istance (2010). We observed that, through the use of technology, primary pupils more easily enter into a learning community, where they share their understanding of the tasks they meet and where the knowledge is distributed (see also Kongsgården and Krumsvik, 2013). However, the secondary schools offered a slightly different picture.

It is maybe my biggest criticism of the iPad... that there is maybe not enough joint work and contact (pupil 3, group 5, secondary school).

We have fewer discussions in the group... lose contact a bit... and we learn less (pupil 2, group 4, secondary school).

Reading things ourselves... and then discussing them is a better learning process... than just reading it and entering it into the iPad and “there you go” (pupil 2, group 1, secondary school).

From these focus groups and fieldwork, we interpret the utterances of the secondary pupils as expressing that once the pupils each have their own tablet, it becomes easier to get online, find material and enter it into a collaborative writing tool without necessarily discussing and reflecting on it within the group. What Farell (2001) calls “collaborative circles”, where groups negotiate a common viewpoint through dialogue and collaboration that then take the work forward, has become what Harasim (2012) calls “corporation”, where a division or distribution of the work takes place and the pupils lose sight of the whole. When we asked whether this could have been done in another way, whether the pupils could subsequently have discussed what was entered, one pupil answered:

Yes, but then the teacher would almost have had to force us to do it (pupil 2, group 9, secondary school).

As one teacher also describes it:

What I see coming in more in a collaborative writing document like that is a bit more cut-and-paste than before... so that, even if the document is more rich, it might not be quite as self-produced... rather, it’s a collection of different materials that were put together previously... maybe... and then processed... that can be good, of course... up to a point (teacher 4, secondary school).

It is the teacher’s responsibility to provide for self-regulated learning and development of learning strategies through guidance and advice on how certain learning challenges or tasks are to be solved (Zimmerman, 2012). What we observed happening in this process is that the teachers used the same didactic approach as the one they used before the pupils received tablets. They have seen the pupils’ processes along the way, but they have not interacted through the technology or by means of physical guidance to ensure that the pupils continued to maintain the collaboration as a collaborative method (Farell, 2001; Harasim, 2012; Zimmerman, 2012; Kongsgården and Krumsvik, 2013). When we then asked about the pupils’ experiences with taking notes on tablets or typing on keyboards, they replied:

When we write on an iPad... it’s like trying to finish as fast as possible... so you don’t think about what you’ve written down... in a way... you’ve already written it down (pupil 4, gr. 2, secondary school).

When you write in pencil... then you haven't actually just pressed the key... you've thought about how you need to have an m and an e to write "me" when you're writing in pencil... it is a bigger process to write a text in pencil than on an iPad... there you're just pressing buttons... then you're done... like... that is how I feel then... when talking about what we learn best from or remember best from (pupil 3, group 2, secondary school).

When I write in my notebook... then I don't think so much about the fact that I'm going to write... but more about what I'm thinking about and what I'm going to write (pupil 4, gr. 5, secondary school).

When we asked whether it is because writing on a tablet is too slow, the pupils replied:

No, because it's too fast... when you're writing in a book, you take longer... and then you understand it better (pupil 3, group 3, secondary school).

I get a lot more ideas when I write on paper with pencil... when you have to sit and think and write something... it is hard to think and make a mind map on an iPad (pupil 2, group 3, secondary school).

Looking at pupils' responses here, they correspond well with findings from other research (Berninger et al., 2010; James and Engelhart, 2012; Mueller and Oppenheimer, 2014). To sum up this section, we have seen in the quasi statistics that there are several significant correlations between pupils' use of tablets and academic skills, but it differs across primary and secondary school. This is also confirmed through the focus groups, observations and field dialogue which show a good *convergence* (Mathison 1988) across this methodological triangulation. However, in the second part of this first research question dealing with more concrete qualitative experiences, we found that primary pupils and secondary pupils' perceptions of tablets as a learning tool were quite different, where secondary pupils have far more negative experiences with tablets regarding academic skills than do primary school pupils. From our fieldwork and observations this might be related to teachers' traditional didactical practices where tablets only become an "add on" to the traditional classroom pedagogy with limited contribution to a real alteration of pupils' learning processes.

USE OF IPADS IN ASSESSMENT PRACTICES WITH EMPHASIS ON ASSESSMENT FOR LEARNING

In this section, we will examine the second research question: How do pupils perceive tablets in assessment practices? Using quasi statistics we examined the frequency of feedback first in primary school (table 3) and then in secondary school (table 4).

We examined the pupils self-reporting (on a Likert scale from 1–6) regarding following statements: 1) Since we got iPads, I get feedback on my tasks more often, 2) In their feedback, teachers tell me what I should continue to work on, 3) Since I got an iPad, my work has become more visible to my teacher, and 4) I get advice from fellow students on how to improve, using my iPad to demonstrate my work.

As can be seen in table 3, it is reasonable to state that the frequency of feedback on primary pupils' work and the value of this work have increased since the pupils received tablets. The scores are generally high on all the variables with an average of 5.08 across all the variables.

TABLE 3. FREQUENCY OF FEEDBACK, PRIMARY SCHOOL (N=63)
(LIKERT SCALE FROM 1–6 – 1 IS "DON'T AGREE" AND 6 IS "AGREE").

	Mean	SD		
1 Got iPad	4.89	1.48		
2 Feedback	5.21	1.48		
3 Visible	5.63	1.10		
4 Fellow stud.	4.51	1.48		

Note. 1) Since we got iPads, I get feedback on my tasks more often, 2) In their feedback, teachers tell me what I should continue to work on, 3) Since I got an iPad, my work has become more visible to my teacher, and 4) I get advice from fellow students on how to improve, using my iPad to demonstrate my work.

In light of the fact that the primary pupils now show what they are working on to the teacher more than before, we can state, based on our observations and fieldwork, that it is reasonable to claim that the use of tablets has made pupils' work more transparent to teachers and pupils. Teachers in the focus group confirm this when they say that they have been testing the pupils much less since all of them received tablets.

The fact that they all have iPads... has meant that, in presentations, we (the teachers) can easily see what everyone has done... or is doing... if we didn't have iPads, we wouldn't be able to do that... it would require so much more time... which means that we use presentations much more than we would have done if we didn't have iPads (teacher 7, primary school).

The field dialogue revealed that since pupils' work is also accessible via Apple TV, teachers now have a better overview of where the pupils are than they felt they had in the more traditional tests. One pupil responded in this way concerning this issue:

Before... when we didn't have iPads... we used to have these weekly tests (Fridays)... where we were meant to be able to reach the learning objectives... then it was just a question of what we had as a learning objective

that week... to show whether we were following and that kind of thing...
(pupil 1, group 6, primary school).

When we ask the pupils in focus groups whether they feel that the teacher sees what they do as much now as before, they reply:

Yes... or maybe even a bit more... because we have more presentations now... because it's easier to do with iPads... it's easier to show things like mind maps... homework... presentations... things like that, and films
(pupil 1, group 5, primary school).

We show things through the iPad fairly often (pupil 2, group 2, primary school).

Based on this, we find that there is *convergence* (Mathison 1988) between the quasi statistics, focus groups, observations and field dialogue concerning how primary pupils perceive tablets in assessment practises. The pupils' high scores on the survey examining formative⁵ feedback practices are also reflected in focus group, observations and in field dialogue. This indicates that the primary pupils have good experiences and attitudes regarding tablets for assessment practices.

But how is this situation in secondary school? As can be seen in table 4, we examined the pupils' self reporting on a Likert scale from 1–6 regarding the following statements: 1) Since we got iPads, I get feedback on my tasks more often, 2) Teachers give formative feedback when I work on assignments, 3) The feedback from teachers are related to learning goals, and 4) Receiving feedback helps me in my learning process.

**TABLE 4. FREQUENCY OF FEEDBACK, SECONDARY SCHOOL (N=50)
(LIKERT SCALE FROM 1–6 – 1 IS "DON'T AGREE" AND 6 IS "AGREE")**

	Mean	SD		
1 Got iPad	3.43	1.34		
2 Formative FB	4.14	1.18		
3 Learning goal	3.96	1.24		
4 Learning proc.	4.02	1.39		

Note: 1) Since we got iPads, I get feedback on my tasks more often, 2) Teachers give formative feedback when I work on assignments, 3) The feedback from teachers are related to learning goals, and 4) Receiving feedback helps me in my learning process.

5. The term 'formative assessment' is the qualitative feedback the pupils receive from their teachers and pupils during their learning processes, and in Norway this is similar to the term 'assessment for learning'.

As can be seen in table 4 the quasi statistics revealed that at the secondary school level, the scores are generally moderate on all the variables with an average of 3.88 across all the variables. Compared to the average of 5.08 in primary school this is considerably lower and is an indicator of different perception of assessment practices among secondary pupils.

The most interesting findings are that secondary pupils perceive the use of tablets as not having resulted in significantly more academic feedback from the teachers (scored 3.43, see table 4, *Since we got iPads, I get feedback on my tasks more often*) as well as feedback related to learning goals (scored 3.96, see table 4, *The feedback from teachers is related to learning goals*). From our observations and fieldwork these findings might be related to teachers who do not change their pedagogy when integrating tablets and who generally intervene in the pupils' learning processes to a lesser extent. We observed that in such classroom pedagogy, the technology itself has not contributed towards any sustainable changes (similar to the findings from Kongsgården and Krumsvik, 2013; Selwyn, 2012). An example of this from our fieldwork was when pupils used Dropbox to make their work accessible to the teachers. But when we asked whether they get any feedback on what has been entered, the pupils reply:

No... (pupil 2, group 8, secondary school).

No... I think it's more like... yes... now I want to see what you've done (pupil 2, group 5, secondary school).

When we asked whether they know what they need to continue working on with a topic or exercise in order to develop, they replied:

No... not really (pupil 2, group 2, secondary school).

This experience is also confirmed by teachers in the focus group, who said:

I have not used technology that much for written work... but had a round of self-assessment in relation to oral work. Spoken work is very indirect... with the iPad, we recorded sound performances (sound and images), and were able to discuss the experience of what had happened in a completely different way... they were able to do a self-assessment of their presentation (teacher 1, secondary school).

The schools are equipped with Apple TVs, and when we asked the pupils whether they think it would be useful to get feedback through them, they replied unanimously:

Yes... (secondary school: pupil 2, group 2; pupil 4, group 2; pupil 2, group 3; pupil 7, group 4)

However, if the pupils are to use the learning goals they must be presented understandably and make sense in the learning work, as Kongsgården and Krumsvik (2013) found. An important strategy here is assessment for learning, which means clarifying, sharing and understanding the intentions of learning (Hattie, 2012; Shute, 2008; Wiliam 2010). In order to achieve this, feedback during the process must be interpreted as assessment communication between two parties, both in order to look back on what has been achieved and to look forward to future targets. When we asked in focus groups whether they get opportunities to change the products and present them again, pupils reply:

No... once we've presented... then we're finished (pupil 4, group 1, primary school).

We don't usually get the chance to improve it and show it again... we get the chance to improve on the next one (pupil 4, group 6, primary school).

It seems like the pupils feel that it is frustrating that they cannot do anything with the answer once they have received feedback from the teacher, for example on submissions.

You sit and write and answer an exercise the teacher has given... but you don't know if what you're writing is what the teacher wants you to write (pupil 4, group 2, secondary school).

By means of feedback, from other research we know that the teacher could integrate assessment and teaching in order to increase pupils' involvement in their own learning process and to give teachers an insight into their own teaching (Wiliam, 2011), while this could also contribute towards stimulating pupils' metacognition and self-regulation (Shute, 2008; Hattie, 2012; Zimmerman, 2012). If the teacher interacts in the pupils' learning processes and helps them to enter into a learning community based on the distribution of knowledge, this can increase pupils' belief in their own capabilities and their motivation for learning. However, Mayer (2010) is concerned with another issue: if technology is to promote and support individual learning as well as collaborative learning, this requires a demanding educational input on the part of the teachers. The potential of technology can easily be underexposed, due in part to the extent to which teachers feel bound to the curriculum and the requirements for documentation of achieved learning by the pupils, which is often reflected in a traditional form of assessment in Norwegian schools.

I could ask them each to write a document... could be more a kind of process-oriented writing... where I could comment on concrete things in the text... and give them a type of feedback that they need to get a good final product... in relation to assessment for learning... that it was a good thing... but then that would have to be at the expense of another form of documentation... so that when I get the finished product, I don't need to write that much more into that text... then they have received feedback

along the way... instead of at the end... and that could be a way of helping the pupil during the process instead of just assessing the finished product... and that would go much faster than grading it at the end (teacher 5, secondary school).

It is easy for a conflict to arise between the teacher's own educational convictions and the educational emphasis in the establishment of an existing curriculum and how the assessment of a subject area should then be carried out.

To sum up this section we have seen in the quasi statistics that primary pupils have far more positive perceptions of tablets in assessment practices than secondary pupils have. This is also confirmed through the focus groups, observations and field dialogue that show a good *convergence* (Mathison 1988) across this methodological triangulation. But how are these findings reflected in teachers' didactical practices? Based on our fieldwork, focus groups and observations, we will claim that in primary school it seems as though tablets have been integrated in a more reasoned manner, along with a change in the teachers' didactical practice because of this implementation. In secondary school it seems like teachers' still have a more traditional didactic approach whereby tablets are treated more as an "add on" to the existing classroom pedagogy, and with limited contribution to modification of pupils' assessment practices. From our empirical material and fieldwork in this study, we see a tendency for primary school teachers to handle this better than secondary school teachers.

DISCUSSIONS AND IMPLICATIONS

The overall research questions of this study were: *How can tablets as a tool contribute towards promoting or inhibiting pupils' participation in planning, implementation and assessment for learning?*

Conclusion

This study shows that the use of tablets has made it easier for both pupils and teachers to use technology in teaching and learning on a general level. User-friendly technology, one-to-one access, fast broadband access to the Internet and various online sources mean that pupils are handling the technology and have high self-confidence in using tablet technology. The exercises and assignments that the pupils are receiving have changed; they are more open and challenge pupils' assessments of relevance to the problems they need to solve. However, the case study also shows that technology is only used to a limited extent in a didactic perspective beyond the individually-based, with options to synchronise data across tools and share with several users in order to work on the same document at the same time. We know from other research that there are teaching methods and learning processes that would not be possible without using technology (Murray and Olcese, 2011), but are these applied in our

schools? We found that the potential of technology here is in making pupils' learning processes transparent to teachers and pupils and making the pupils complicit in their own learning work and that of others, but this is only partly achieved in these schools. The primary schools seem to handle this well, and it was observed that the technology contributed towards stimulating pupils' assessment of their own work and that of others, developing pupils' capacity for self-regulation and development of learning strategies, and increased collaborative learning (in secondary school, however, this was quite different). We also saw examples of how the use of technology (like tablets) can support different assessment practices in order to promote pupils' learning.

Based on our case study, we will make the claim that it is important to devise a didactic method whereby the pupils themselves seek to create meaning by adopting an active approach to the material, as expressed in a broad concept of competencies (Lai, 2004; Norwegian Directorate for Education and Training, 2012 and Monitor, 2013). This requires that learning goals and criteria are understandable and make sense to the individual pupil, where the use of tablets can contribute to making these processes transparent for teachers and pupils, as Kongsgården and Krumsvik (2013) found.

However, this case study also shows that cloud services, in which data can be shared across individual digital tools, are not used to any great extent. We found that there is a potential for development here by, for example, creating files where several users can share, work on the same document at the same time and access various resources, as well as give the teacher an opportunity for increased interaction with the pupils in their learning work, as Murray and Olcese (2011) also found. Another important perspective that is raised by this case study is that several pupils say they learn better by writing in longhand than on a keyboard when taking notes from a lesson. These findings are supported by researchers such as Beckman, Bennett and Lockyer (2014), James and Engelhart (2012) and Mueller and Oppenheimer (2014). More research is needed here, not least because an increasing number of municipalities have been providing tablets for their pupils from the very first year of school. The study also shows a big difference between when pupils look up information from flexible sources, assemble different information, and form their own content and understanding as a basis for presentations, as compared to when they "passively" take notes to enter into a subject area on the tablet, or solve an exercise set by the teacher (similar to findings from Beckman et al., 2014; Kongsgården and Krumsvik, 2013). When all is said and done, this may be a case of developing the teacher's didactic skills and digital competence (Krumsvik, Jones, Øfstegaard and Eikeland 2016). However, for change to take place in the teacher's educational practice, where a traditional didactic method is challenged by the implementation of technology in order to develop a new digital didactic method, space and opportunities must be provided for both educational change and development by giving teachers scope to share experiences and ideas, as Mayer (2010) has pointed out.

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