



D1.2.2.2 MuMuMeSe

User study with tablet devices in school

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1 Introduction

The launch of the Apple iPad-device in the spring 2010 started out enthusiastic discussions of the opportunities that the tablet devices may bring for education. Even before hands-on experience on the device some bloggers on educational technology predicted that iPad or other tablet devices will transform the education. On the other hand, many reminded of the high expectations that earlier have been put on the one-laptop-per-child and mobile learning –programs but the programs have not in most cases brought about permanent remarkable changes in education and the effect on learning outcome has not been properly verified.

The tablet devices have at this point become a noteworthy platform for magazine, newspaper and book publishing. In the school world the changes are however slower, partly due to the scarce finances but also due to the special characteristics related to educational contexts: convenience and entertaining factors are not determinant if not the usefulness for the learning can be demonstrated.

In this study the significance of the tablet devices on the education was explored. In the first phase of the project the technology trends that will affect the education in the future were reviewed (D1.2.2.1). In the second phase, the combination of digital learning services and the use of tablet devices in schools was selected as a subject for the user study.

This research is a part of Next Media research programme. The research partners in this task are AAC Global, Sanoma Pro, Sanoma Media, Aalto University and VTT Technical Research Centre of Finland. The user study presented in this report was carried out mainly as collaboration between VTT and Sanoma Pro. Excellent cooperation with Päivänkehrä school and teacher Leena Leskelä in the user study is acknowledged, as well as Kuusimäki school and Saimaan Mediakeskus for the interesting discussions.

1.1 Examples of other tablet pilots in educational contexts

Many pilot projects with tablet devices in educational contexts have been launched since the devices have become available. Below are some examples of pilots where the approach has been relatively systematic and some results have been analysed and publicly reported. However, we have not yet found any peer reviewed publications concentrating on the use and impacts of tablets in educational contexts. Moreover, all the reviewed pilots have different kinds of goals, settings and stakeholder groups. Therefore we provide through these examples only a snapshot of what kinds of initiatives have been introduced, without any further conclusions.

- Cedars School of Excellence in Scotland offers iPad for each pupil in the school (ages 5-17). The devices have been in use since August 2010. The devices have fully changed the learning environments and practices in the school. The phases of introduction and evolved practices in teaching and studying have been documented on a blog: <http://speirs.org/>
- Oklahoma State University in the US had an iPad pilot program during autumn 2010. A study on the impact was also carried out. From a faculty perspective, the greatest benefit was having uniform hardware and software available across the class. This was critical when planning assignments and class activities. <http://news.okstate.edu/press-releases/929-ipad-study-released-by-oklahoma-state-university>
- The iPad program of Roslyn High School in the US was started in 2011 with a careful preparation, including arranging training for the teachers. Now all the 9th graders have received iPads. The devices allow students to create comprehensive digital portfolios of their work, and read digital books. Importance of paper savings also mentioned. <https://www2.roslynschools.org/district-offices/Pages/Superintendent.aspx>
- In Snösåtra skolan in Sweden the 1st graders are using iPads for “Writing to Read” (Trageton). The benefits of iPad (vs. laptop) are listed as:
 - Intuitive to use, no need to use a mouse and keyboard controls
 - Keyboard and text field on the same display, easier for the children to follow what they are writing
 - Fast to start up and open a document/application
 - Mobility, easy to carry along in various situations
 - Focus stays on the task at hand because no other programs are open at the same timeExternal keyboards were acquired anyway in order that the children will learn to use both hands when writing. <http://snosatraskolan2.blogspot.com/>
- Sormet-project (Everyday learning experiences in the integrated environments) in Finland started its first iPad-pilots in October 2011. The objective is in the first phase to determine the procedures required for introducing and maintaining the devices in the schools and to study what kinds of practices evolve when the devices are used in studying and teaching. <http://www.sormet.ejuttu.fi/>
- Houghton Mifflin Harcourt Publishing Company has launched HMH Fuse educational application for iPad. Algebra I-application was piloted in Amelia Earhart Middle School during one school year in 2010-2011. The effect of the application on the students’ math achievements was studied, e.g. by comparing the results of California Standards Test of the pilot group and a control group using the traditional printed math book. 78% of the pilot group scored at a level of proficient or advanced in the test, compared to 59% of the control group. Also other advantages were detected. <http://www.hmheducation.com/fuse/pilot-1.php>

2 Objectives of the user study

In the user study, the tablet devices were used in real educational contexts in order to evaluate their usability, usefulness and suitability for using existing learning materials, and to assess their potential in the future. The objectives of the study were:

- to study how the existing educational contents can be used with tablet devices
- to define what kind of unique features these kinds of devices could bring to learning and teaching
- to determine in what kind of contexts and with what kind of contents the device would bring most benefits to the learning

2.1 Research questions

The research questions were:

- What kind of unique benefits the tablet devices could offer for education? (e.g. in comparison to printed books and laptops)
- How does the use of tablets support the current teaching practices?
- How could the device support the reform of teaching practices?

3 Preparations and the methodology in the user study

3.1 Sanoma Pro's learning solutions

Sanoma Pro is the leading provider of learning and competence development solutions in Finland. It publishes materials for K-12 (all the subjects covered by the Finnish national curricula), vocational, university level and adult education, as well as consumer edutainment. For the vocational market and for the university levels, the focus is on languages, engineering, business studies, health care industries and social services. Also, a wide range of e-content is offered through extensive web services.

The educational services offered for basic education by Sanoma Pro form pedagogically planned entities combining printed and digital contents. For example for studying English as a foreign language in primary school, the educational material of Yippee-series for 4th grade comprises of a text book, an exercise book, a CD with audio files of vocabulary and book chapters, a differentiated exercise book, exercises on the internet service, a teacher's guide, a compilation of the solutions to exercises, a package of exams, a teacher's cd and electronic presentation materials and adaptable exam templates on the internet

service. The digital educational content for K-12 learning to schools and students is offered through Sanoma Pro's virtual learning environment service called "Työhuone" (ratkaisut.wsoypro.fi). The service comprises of diversified supplementary material related to the school book series, e.g.:

- teacher's guide
- templates for exams
- solutions to the exercises
- presentation materials
- exercises for the pupils

A computer with connection to internet and a web browser (Microsoft Internet Explorer or Mozilla Firefox) is required in order to be able to use the learning environment service. The following operating systems are supported: Windows XP/Vista/7, Mac OS X (Intel) and Linux. Mobile operating systems are not currently supported although some combinations work without problems (e.g. available audio files linked to language learning materials can be played almost on any mobile device).

3.2 Mobile devices and enhanced Internet content

An attractive and fascinating Internet based service is very difficult to create with plain HTML-language – an enriched content can often be seen almost as a minimal requirement nowadays. Several years ago Java was perhaps the best available technology for enabling more interactive features - such as capturing user's mouse movements and clicks - in a web page. By using Java technology the web application, say a game, was able to run inside a browser window without a need for the user to install any additional software (except a required Java-plugin which probably was already installed in some earlier time for the user's web browser).

At that time Java was widely supported in several hardware and software platforms, including Windows, Linux and OS X. For a content creator it was enough to program a Java web application, Java applet, only once and the applet was then able to run and operate in different web browsers regardless of the platform being used. During the last few years a new perspective was added into this scenario by mobile platforms, especially Apple's iPhone OS (later renamed iOS) and Google's Android OS.

Market shares between mobile operating systems have been under rapid changes recently. The first release version of Android was published in late 2008. Until now, during the past three years there have been a couple dozen new releases and every release has carried bug fixes and new functionalities and features. As an example, a common feature in other platforms such as copy and paste in a web browser was added into Android not until 2009. A strong competition for market shares is one of the reasons why some features are added with high priority and some of them are not planned to be added at all into Android or some other mobile operating systems.

In 2011, less than 5 % of web sites are still using Java for content enhancing. So, at present Java has lost out to competing technologies such as Adobe Flash and Microsoft Silverlight. The competing technologies offer at least the same functionality as Java and at the same time the content creation utilizing them is much faster and easier with new advanced development tools.

Even though almost any Android application is written in Java language there is no Java execution environment (Java Runtime Environment, JRE) in Android. Instead of standard JRE Android has a virtual machine optimized for mobile devices with, for instance battery life in mind. Java applications for Android are compiled to be executed on that special virtual machine environment which is not compatible with standard JRE. It means among other things Java web applications cannot run in browsers on Android.

In Android, Adobe Flash is supported since version 2.2 (May 2010). Possible limitations with different features are not only related to Android. For instance, Apple's iOS neither supports Java nor Adobe Flash.

The tablet devices that were preliminarily tried out for using various educational contents and applications during the project were:

- Apple iPad, operating system iOS 4.2
- Samsung Galaxy Tab 8.9", operating system Android 2.2
- Apple iPad 2, operating system iOS 4.3
- Motorola Xoom, operating system Android 3.0, updated later to Android 3.1
- Samsung Galaxy Tab 10.1", operating system Android 3.1

Of these devices the contents defined for the user study could only be run on Motorola Xoom and the new Galaxy Tab (both with Android OS 3.1). The weight and design of Samsung Galaxy Tab was more pleasant compared to Motorola Xoom, and therefore Galaxy Tab was chosen for the user study. The preferred size of the screen was defined as 10", since in this context (small children using the devices in the class room) ease of use of the virtual keyboard and suitability for the educational web sites were emphasised above small size and weight relevant for a mobile use on the go. Before the actual field test our own brief tests with optimal device setup were run; an everyday Internet browsing with content such as games, YouTube videos etc. was found fully functional and smooth enough.

However, the web pages in the planned learning service were found a bit problematic in the use with tablet devices. Some examples:

- There was quite a large amount web content created with Adobe Shockwave and Java. These were not functional at all.
- Adobe Flash based exercises were typically functional. In some cases the Flash content would have required also a real keyboard and a mouse and thus it was not possible to proceed with the exercise.
- Quite often a page layout didn't adapt to the tablet's web browser and the content of the page was out-of-screen without scrolling possibility. The content

became visible when the Tablet PC was turned vertically from horizontal position. (note: update to operating system 3.2, that became available for Samsung Galaxy Tab just after the pilot, fixed many of these problems)

- Typically Flash animations etc. were perceived similar way as the content would have played with a normal PC. In some cases, however, the rendering speed was significantly lower compared to a PC while some of the animation figures (fish) were totally malformed at the same time.

It would have been interesting to test the case in the last bullet point with updated Android 3.2.1 as its amendments include improved Adobe Flash support. It was not tested as the update was not available for the project in practise.

Technologies for creating rich internet applications are of course constantly evolving. In November 2011 Adobe announced they will no longer continue the development of the Flash Player in browser in any of the new mobile devices. By diminishing Flash in mobile devices Adobe is able to invest more in HTML5 which already today is widely supported on mobile devices. HTML5 is now the best solution for the rich content on mobile platforms according to Adobe.

3.3 Settings of the user studies

The school that was recruited for the user study was Päivänkehrä school in Espoo. It is a primary school (grades 1-6 in Finnish school system, ages 7-12) with altogether 556 pupils. The school is planning to acquire tablet devices for permanent use in the school in 2012. The English teacher had received Samsung Galaxy Tab for her use and familiarisation one month before the user study started.

The subject in which the devices were utilised during the user study was English as a foreign language for the third grade (9 years, their first year of studying English) and the sixth grade (12 years, fourth year of studying English). 24 pupils from each class participated in the study. The classes are divided into two study groups for English classes, i.e. there are 12-14 pupils simultaneously in the class room.

10 Samsung Galaxy Tab devices were delivered to the school, with pre-customised screen layouts, shortcuts and bookmarks to potentially useful educational web sites. Shortcuts to unnecessary applications were removed. The most familiar digital educational service for the teacher and the pupils is Sanoma Pro's "Työhuone" that provides content directly related to the printed school books that are also otherwise in use in the classes. Thus those tasks were the most convenient to incorporate into the teaching. The teacher was encouraged to also explore new contents and applications, and to think of new ways of utilising the devices in education. The devices were stored in the class room and used only during the English classes according to the teacher's instructions.

Wireless network is available in the school. The support and maintenance of the network is outsourced. The devices were also provided with SIM cards and flat rate data plan for internet use. The school also has its own ICT-support group comprising of teachers but at this point they had not yet had time to familiarise with the tablet devices.

A challenge in the research setting was that the tablet devices are **designed for personal use** and thus they don't support logging in to different user profiles and thereby access to personal (private) folders, emails etc. Therefore the pupils were advised in advance that they must not log in to any private accounts on the devices that are circulated in the class and also within different study groups. This model of use is similar to what will be taken into use in the school with their own set of devices during the spring 2012.

In parallel with the user study of the project the researchers also had the opportunity to visit Kuusimäki school in Lappeenranta where the pupils on the 4th grade (10-11 years old) had received iPads for seven weeks. The pilot was a part of the project Sormet (<http://www.sormet.ejuttu.fi>). In this pilot each pupil had got a device for his/her personal use, and they were allowed to use them both at school and at home. The devices were utilised in the studies of all subjects and during any classes (when relevant). The teacher of the class had set a goal for the pilot: she wanted to see if she and the class could manage seven weeks of teaching and studying without using printed work books, notebooks and separate hand-outs.

3.4 Methods in data collection

The purpose of this study was to enhance understanding of how tablet devices could be utilised in primary schools, what kinds of benefits they could bring and what kinds of challenges they might cause in educational contexts, and based on that, to assess future trends for digital learning materials and utilisation of technology in schools. For that purpose qualitative research methods are most suitable. The research material was gathered by a literature review, discussions with the stakeholders, and primarily, in a user study.

In the user study the views and experiences of the end-users were collected in observations during the classes, by interviewing the teachers (Päivänkehrä school and Kuusimäki school), in group interviews with the pupils and by a questionnaire to the pupils. The interviews were semi-structured theme interviews where only a few predefined questions were asked, otherwise the interviewees were encouraged to freely discuss about their views on the themes. The teacher in Päivänkehrä school also kept a diary during the pilot and the teacher in Kuusimäki school wrote in a blog (<http://www.sormet.ejuttu.fi/blogit/sopettajajenni>) about her experiences during the iPad pilot.

4 Results

4.1 Initial questionnaires

The pupils filled in a brief questionnaire in the beginning of the pilot. The questions relate to availability of a computer or a tablet device at home and access to internet. Based on the answers we got an impression of how frequently the children who participate in the pilot use computers and tablets on their free time and the extent they play games and study with computers. 50% of the 6th graders and 25% of the 3rd graders have a computer of their own and almost all of the children have the possibility to use a computer at home.

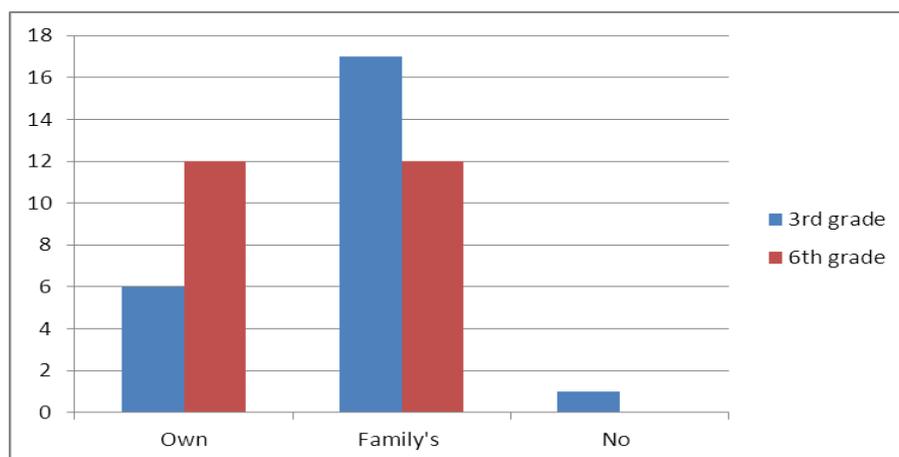


Figure 1. Computer available for use at home

Nine of the 24 pupils on the 3rd grade said that they have a tablet device at home (either own or someone's in the same household), on the 6th grade the figure was five (of 24). Many of the children emphasised in the discussions and in the interviews that even if they didn't have a tablet device at home, they have used one several times and can use it without problems. The interest and excitement around the devices was apparent also among the school children. Furthermore, some strong opinions on the preferable brands and operating systems were expressed.

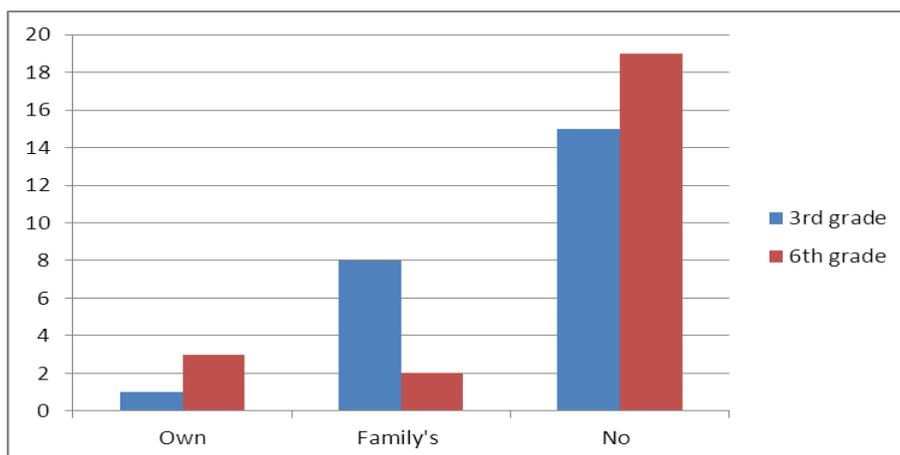


Figure 2. Tablet device at home

Two pupils on the 6th grade said that they have both an own computer and a tablet device. Many of the children can also access the internet with their mobile phone (40% on the 3rd grade, 71% on the 6th grade). On the other hand, there were several who didn't know if they can access internet with their mobile phone (33% of 3rd graders, 13% of 6th graders).

Currently the teachers in Finnish schools can't expect that the children would use computers for their homework. Therefore e.g. digital educational services can only be used in schools, and/or the teacher can advice that the pupils may use the digital material when in need for extra training or preparing for an exam, if they have a computer and internet access available on their free time. At Päivänkehrä school the English teacher takes the classes to the computer class twice during a term. She reminds the pupils of the opportunity to use the "Työhuone"-tasks also at home. Approximately half of the pupils say that they at least sometimes use computers for studying.

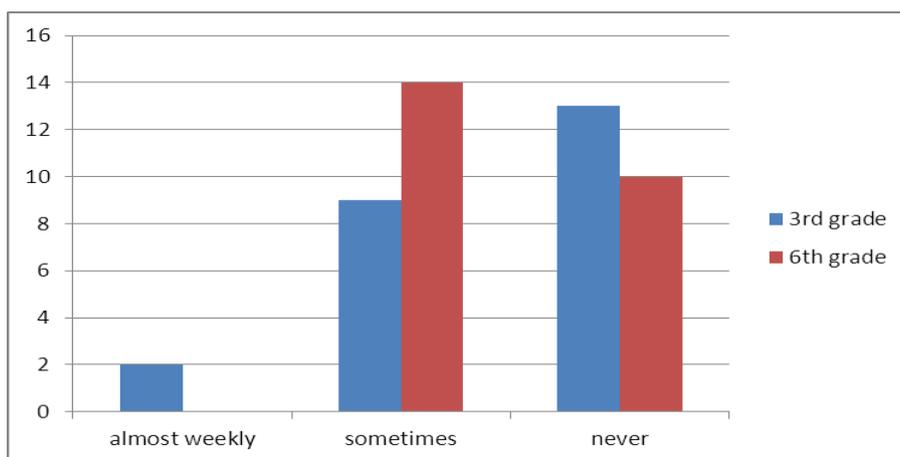


Figure 3. Use of a computer or a tablet device for studies on free time

The number of answers to the questionnaire is insufficient for making any wider analysis and drawing conclusions. However, some remarks of this group of pupils as interesting food for thought: The pupils who have an own computer/tablet device don't seem to use them more often for studies than those using family's shared device. On the 6th grade there is four respondents, who own a computer/tablet, and who don't play at all computer/console games. All the other respondents say that they play either a) several times a week or daily, or b) 1-2 times a week or less frequently. On the other hand, on the 3rd grade six of the seven pupils (86%) with a personal computer/tablet say that they play games several times a week or daily, compared to 41% active players of those in the class who don't have an own computer/tablet.

It is presumable that the figures above reflect more likely the genuine interests of the children and their families than any impacts of personal computers on leisure activities of the children. In any case it is obvious that the computers and internet are part of everyday life of the school children during their free time and that they are skilled in using the technology, but the utilisation for studying is occasional, both in school and for homework on free time.

4.2 Results from the teacher interview

The results from the interview of the English teacher are divided in two parts: 1) Experiences from the test period, and 2) Ideas and wishes.

Test period

- Generally, the test period with the tablets was better than the teacher expected, despite some technical problems that occurred (mainly problems with internet connection). The pupils understood the basic use of touch-screen quickly, 6th graders learned the use almost without any guidance.
 - The tasks performed during the classes: learning the use of tablet, recording oral exercises and dramas with video camera, doing Yippee-tasks on the Internet service, writing an essay.
- Easiest part during the period: Using tablet video camera during lessons. Teacher's role was easy and minimal, almost unnecessary. The pupils were very self-directed. Planning the lesson however took some extra time (0,5 hours). Using video camera was also the biggest change in teaching practices, since cameras had never been used before. The teacher had to discover ways of utilising the camera, thus new ways of teaching.



Figure 4. Pupils watching a video they have just recorded

- Most difficult part during the period: Yippee-tasks with 3rd graders. The actual lesson was hard for the teacher, there were problems with internet connection and some of the tasks didn't work with the tablets. Technical problems made the lesson especially hard. The pupils of this age needed a lot of assistance.
- Other teachers didn't have any role in the test period. The English teacher was the only one who was familiar with tablets. Even the school's "ICT-team", formed by teachers interested in technology, was not involved in the tablet testing.
- Comparison of computers, printed books and tablets after the test period:
 - Computer: everything works for sure. It's easy for the teacher to use and the tasks are experiential. However, separated computer class room is impractical.
 - Printed book: they are cheap and very easy to use. Annotating and browsing the content is easy. Still, books are a bit boring.
 - Tablet: It is fast, near, easy, updated and experiential. No cables needed and at the same time the pupil can search for current information and write. Technical problems are the weak sides of tablets, mainly problems with internet connection and compatibility with other devices.
 - Replacing printed books completely with digital devices and contents is not desirable for the teacher. Currently, the tablets could only be supplementary tools.
- Writing with tablet touch-screen and virtual keyboard was not a problem, and also the pre-installed word-processing application of the device functioned well.

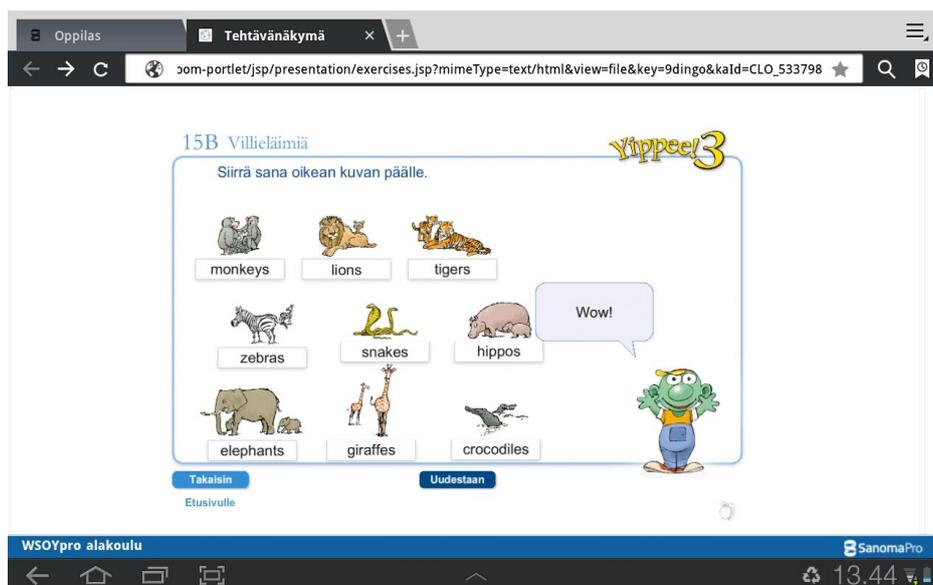


Figure 5. Screen shot of the tablet device and a vocabulary task on the internet service

Ideas and wishes

- **Evaluation / assessment of learning:** Communication is important and emphasised during English lessons. The tablet cameras enable oral exams in a new way, which are a new method for the teacher. The teacher hasn't used oral exams before. Use of tablets thus support evaluation and makes it easier, according to the teacher.
- **Differentiation:** Computers and digital content are good for differentiation, especially for good students. Often the use of computers is a reward for well performing students. However, there is only one computer in the class room, thus its use is very limited. Computer does not support poor students well in the class room, since the teacher should watch the student all the time. Tablets should first become more everyday-devices (like computers) and the hype should decrease, then they could be better used for differentiation. It would be good way to let good students do for example tasks on the familiar and well built "Työhuone"-internet service, if the tasks worked with tablet devices without problems. Tablets might also increase motivation of pupils who have difficulties in the subject.



Figure 6. Independent studying with the digital exercises in the class room. Each of the pupils receives immediate feedback.

- **Change in learning environment:** Current and updated information is always available through tablets in the class room. The pupils can find by themselves the information needed, thus learn information search skills, which are important in the work life. Tablets could also be used for collecting data (pictures etc.) during field trips. The teacher was also surprised how the pupils obeyed given rules: they didn't even try to surf on the internet without permission.
- When introducing tablets in school community, some teachers could envy others if everyone doesn't have the possibility to use them. On the other hand, according to the teacher, at a guess half of the teachers would not want to utilise tablets in their teaching. It is a question of attitude towards (new) technology. Many teachers probably need help in utilising the devices. The role of the school's ICT-team will be important. Outside support is probably not needed, except during initialization.
- Smartboard Notebook software would be good to have also in tablets, now it's used with smartboards in the class room. The integration of tablets and smartboards is important.
- The teacher's ideal in teaching is to create experiential lessons and make pupils use all their senses. Tablets would support this. It would be good that every desk in the teacher's class room would be provided with a tablet.

4.3 Results from the pupil interviews

Altogether 8 pupils (5 boys and 3 girls) were interviewed after the test period. Four of them were 6th graders and four 3rd graders.

According to the pupil interviews, the following aspects were seen as good and positive sides of tablets:

- tablets enable independent studying
- tablets bring novel feeling to studying
- tablets are fast; enable fast access to the internet
- tablets are small and mobile, easy and handy to use everywhere: the idea of the separate computer class room is outdated and impractical
- tablets support information search
- writing with touch-screen keyboard is OK; eventually it's more desirable than writing with paper and pen



Figure 7. Lack of a separate keyboard was not regarded as a problem during the pilots on the primary school level.

Compared with (desktop) computers, tablet's camera was seen as a good and novel feature. The use of video camera was also seen as the biggest difference between usual schoolwork and test period with tablets. Furthermore, tablets enable faster access to internet than computers, and can be used "on demand" everywhere. The idea of computer class room was seen as outdated, since the practices and rules related to the use of computer class room are not flexible enough (i.e. one can only enter computer class room at a certain predetermined time). The pupils obviously are familiar with the concept of "information search" and recognise the variety of search methods related to studying. Thus, they also expect easy and flexible access to these methods.

When comparing printed books with tablets and computers, books were seen as too stable without the ability to become updated. Internet provides more current information. However, replacing printed books completely with digital materials was not totally acceptable. Books were seen more reliable in terms of storing data and the structure of book was appreciated (book as "user interface" supports quick and easy browsing).

The pupils didn't see any problems in using the same tablet device for school work and leisure activities. Some problems might occur if a device is shared among a number of students: the personal passwords for different services will be saved in the tablet and thus access for one's personal user accounts is too easily available for other users as well. The question with private or shared device becomes significant in the school context. Unlimited internet access during the school day is desirable for pupils, but they recognise the possible problems and seem to accept the limitations and rules related to internet access.

4.4 Experiences of iPad pilot in Kuusimäki School

Additionally, the researchers had the opportunity to visit Kuusimäki school in Lappeenranta where the pupils on the 4th grade had received iPads for seven weeks. Each pupil had got a device for personal use, and they were allowed to use them both at school and at home. The class teacher was interviewed for this report.

The teacher had high expectations before the test period. She was an experienced user of ICT and also Apple's user interfaces, although she hadn't used iPad tablets before. Her goal was clear: to teach without paper (notebooks, work books, hand-outs) the whole test period. Only text books were allowed. Partly because of her physical disability (she used a wheelchair), printed materials were often an extra burden for her.



Figure 8. The tablet devices were used as notebooks and workbooks in Kuusimäki school

Test period

- Generally, the teacher was very satisfied with the use of tablets and the test period. The first two weeks were spent for getting things to work, but after that “*everything was just great.*” The tablets fulfilled all her expectations, according to her.

- Teaching without paper was a good experience for the teacher. It was possible to keep most of the materials in one place, inside the tablet, thus decreasing the amount of paper.
- The use of tablets increased social interaction among pupils. The pupils were able to help each other in using the devices and applications, and to perform tasks in collaboration as well. The teacher also asked older pupils to guide younger ones, which was especially motivating for the younger pupils.
- When compared with desktop computers placed in separate computer class room, social interaction and collaboration was more natural and easier with smaller and portable tablets. The pupils could move more freely inside the class room and perform tasks together with tablets.
- The use of tablets gave more flexibility in preparing lessons. The teacher was able to choose more freely when to work, and more spontaneous working increased. The line between work and leisure became more blurred and flexible, which was a good thing according to the teacher.
- Most of the pupils didn't encounter any problems in typing with the touch-screen. However, some students with motoric problems (slow development of hand coordination ability) found it difficult to use fingers for touching the right spot on the screen. This was not a common problem. Generally, typing with the touch-screen seemed to be as easy as typing with keyboard among pupils.
- Using suitable applications helped especially poorly performing pupils in producing texts, such as essays. For example, the pupils were able to choose a picture from the application, and write a story based on the selected picture. The pupils also recorder their own talking in order to memorize things (such as words and capitals) better. Some pupils recorded singing in order to prepare for music exam. This recording was mainly done without teacher's guidance.
- Tablets enabled multitasking fluently: The pupils were able to read, write, draw, send emails, and create audio and video files (etc.) with the same device at the same time.
- The parents reported that pupils' motivation for going to school in the mornings increased during the test period, and evidently decreased certain pupils' habits of being late from school.



Figure 9. The pupils had created their own animations during the iPad pilot

Further ideas and remarks

- A longer test period with the tablets could reveal more specifically the benefits and features of different applications suitable for different kind of students. Personalisation and differentiation is important.
- The most effective use of new technology in teaching is currently depending on the teacher's personal motivation and ability. This should not be the case, since equal opportunity to benefit from technology is needed for every pupil.
- The tablets support the teacher's idea of new pedagogical and learning culture. Learning does not take place inside the school building only, but expands to other places and leisure activities as well. The pupils could learn variety of things, which are currently taught inside the school, also during free-time through technology. The teaching in schools should emphasise more for example social skills, group work and responsibility.
- Motivation is the key to learning, and possibility to choose increases motivation. Tablets support freedom of choice. Even the youngest pupils should have more possibilities to choose. Freedom of choice also means freedom from time and space. Class room alone as a learning environment is too limiting.
- In the interview the teacher was asked if she preferred to have also the text books in the tablet device as electronic school books. The idea was novel for her and she had not thought of the possibility earlier. She thought that having books in the class room is mainly a tradition and habit, and she has become more critical towards books recently. According to her, books become outdated too quickly. Therefore she concluded that electronic school books in the tablet device could be a good idea.

- The question about personal device vs. school-owned (and shared) device is important. Different alternatives and arrangements required by each of them should be carefully considered in advance.
- The support needed for successful use of tablets can be categorised as follows: 1) Network and data administration support; 2) Technical support (related to devices); 3) Pedagogical support.
The wireless network is currently the biggest challenge.

4.5 Summary of the data from the user study

Below is presented a brief summary of the data (remarks and insights of the interviewed pupils and teachers) from the user study. The data are organised according to the research questions and the most important interview themes of our study. The points listed here represent the views that the interviewees seemed to agree on quite generally. It is however important to bear in mind that the divergent views, motivations behind the choices and understanding of the actual use contexts can be at least as valuable results of the study as the knowledge of the general trends.

• **Printed book vs. computer vs. tablet**

- Printed books: They are cheap, reliable and very easy to use. Annotating and browsing the content is easy. Book contents are well created, also visually, and pedagogically designed. When compared with possibilities enabled by new technology, books become outdated too quickly and are sometimes seen as boring.
- Computer: High-quality content is available, the tasks are experiential and the content and PCs are easy for the teacher to utilise. Usually everything works without problems. However, separated computer class room is impractical. Also, starting up the devices and logging into the systems is time-consuming.
- Tablet: It is fast, near, easy, updated and experiential. No cables are needed and at the same time the pupil can search for current information, read, write, draw and record. Technical problems are the weaknesses of tablets, mainly problems with internet connection and incompatibility with other devices and some content types.
- Replacing printed books completely with digital devices and contents is not (yet) fully desirable. Currently, the tablets could only be supplementary tools.

- **Unique affordances of a tablet**

- The mobility of the tablet devices and fast internet access provide flexibility for studying and teaching, and supports self-directed studying.
- Tablet supports evaluation of language learning in a new way (camera / oral exams).
- Tablet enables “multitasking”. The pupils are able to read, write, draw, send emails, and create audio and video files (etc.) with the same device without interruptions and change of equipment.
- Tablet touch-screen did not cause any significant problems; on the contrary its use was experienced as novel and fun. However, students with motoric problems may encounter some difficulties in using the screen. In general, among pupils writing with computer or tablet keyboard seems to be more desirable than writing with pen and paper.

- **Change in the learning environment**

- Biggest change during this 4 week pilot (2 hours of English/week): Use of video cameras. The cameras enable use of oral exams (in English lessons), which are new method for the teacher.
- Current and updated information is always available in the class room.
- Separated computer class room with scheduled hours of visit is seen as inflexible and outdated learning environment.
- Tablets support social interaction and collaboration. Small and portable devices are easy to handle. The pupils can move more freely inside the class room with tablets and perform tasks together.
- Joint use of tablet devices in the class room may cause problems in terms of data security and privacy.
- The support needed for successful use of tablets can be categorised as follows: 1) Network and data administration support; 2) Technical support (related to devices); 3) Pedagogical support.

- **Self-direction; does tablet motivate pupils to learn by themselves?**

- Especially 6th graders were very self-directed when they used video cameras for recording tasks such as interviews and dramas. Also 4th graders showed creativity in using tablets’ audio recording feature in order to prepare for exams and memorize things (iPad pilot).
- The pupils have the understanding and ability to search information from different sources – thus they should be able to use search tools and methods (such as tablet provides) more freely.

- Tablets support freedom of choice. Even the youngest pupils should have more possibilities to choose. Freedom of choice also means freedom from time and space.

- **How could the device support the reform of teaching practices?**

- Use of tablets could support the idea that learning does not take place inside the school building only, but expands to other places and leisure activities as well. The pupils could learn variety of things, which are currently taught inside the school, also during free-time through technology.
- The use of tablets provides more flexibility in preparing lessons. The class teacher in Kuusimäki school was able to choose more freely when to work, and more spontaneous working increased. The line between work and leisure became more blurred and flexible, which was a good thing according to the teacher.

5 Conclusions

The *mobility* of the tablet devices is a clear advantage in studying and learning. In the class room, the mobility supports flexible and collaborative studying, since the tablets can easily be carried from one place to another (or from one person to another), and can be used fluently for personal and group studying. The mobility differentiates the tablets from stable desktop computers, which are often placed in a separate computer class room, and even laptops that require more desk space and are more laborious to set up than the tablets. Smart phones would basically provide the same mobility and features (quick to take into use, unobtrusive when not in use) as tablets, but the advantage of tablets is the larger screen.

The mobility supports learning *outside the class room* as well. Informal and even accidental learning may occur through the devices in different contexts more easily. The possibility to create audio and video files supports self-directed learning outside the class room.

The opportunity to easily record with the tablet also creates new kinds of needs with respect to the applications and services. An effortless way to edit, share, aggregate and preserve the photos, videos and sounds that the pupils have recorded would enhance the documentation of the learning processes and enable even collection of rich personal learning portfolio.

The numerous *applications and web services* have the potential to provide new possibilities for learning. In everyday use and in time, it is likely that students and teachers will discover new ideas and ways to utilize the offerings available through tablets in their practices. Furthermore, in time, it is possible to find the most suitable applications and tools for different kinds of students, both those needing more advanced material and those having challenges in studies. The tablets with rapid access to educational web sites, variety of applications and other quality content would provide freedom of choice for studying, thus support self-direction and even increase motivation.

The response from the pilots on secondary schools in Finland has not been as positive as from the primary schools. For example in the Sornet-project's pilots some of the secondary school teachers have been frustrated with the problems in sharing files, different file formats and the necessity to download numerous separate applications in order to be able to carry out the planned tasks. The subject teachers have less possibility to adjust the class schedules if there are technical problems, the teachers and pupils may already expect similar operation of the tablet than of the computer and have some established practices and applications for studying that they are used to, and the pupils need to be able to work independently and to create and share documents. Therefore the introduction of tablets on secondary school is not as straightforward as on lower stages where already the mere increased utilisation of ICT and easy access to internet is valued.

The use of wireless devices, such as tablets, requires *well-functioning infrastructure*. The wireless network is crucial, and currently causes problems. The *support* needed for successful use of tablets could be categorised as follows:

- 1) Network and data administration support;
- 2) Technical support (related to actual devices);
- 3) Pedagogical support.

The pedagogical support could be provided by the school personnel, but for managing technical and network problems, outside support is needed. Naturally also providers of educational content play an important role in supporting the pedagogical work. The teachers in Finland generally appreciate the available high level school books that provide a well-structured frame for teaching, with support to differentiation, presentation materials, templates for exercises and exams and a guide for the teacher. As the tablet devices inevitably are becoming more common in schools, the demand for quality content and applications in Finnish and Swedish and suitable for the Finnish curriculum also increases. The educational content in the native language is particularly necessary in the primary school use.

The tablet devices also induce expectations with respect to the content. The devices are promoted to offer superb media experience with *interactive and engaging* elements. However, many of the earlier produced rich contents are not supported by the current tablet devices, as described in the chapter 3.2. At present HTML5 is gaining popularity for producing enhanced content for mobile devices due to its platform independence. The mobile publishing strategies are currently of great interest in the publishing field, and the challenges and benefits related to building *web-based applications or native applications* are widely discussed. In addition to the much debated impacts on the share of revenues and ownership of the customer data, the chosen strategies also have implications on how the users discover and use the offered content, service or application. This area was not covered in this study but it would be an important topic for further research, especially with regard to educational contexts.

If one tablet device is used by number of students, it may cause problems in terms of *privacy and data security*:

- The access for personal user accounts is often too easily available for other users, since personal passwords are saved in the tablet and logging out is not very simple.
- Acquisition, management and synchronisation of the applications and use of personalised settings on the tablet are more complicated when the device is shared between several persons.
- Personal pictures, videos and other files should be saved on a (web) service, not on the device, in order that they are not available for others and that they are not mistakenly modified or deleted.

The effective use of new technology is still much *depending on individual teachers' motivation and skills*. According to interviews, some (even many) teachers are unwilling to adopt technologies in their teaching and administrative duties. From the perspective of equality in education, every student should have an equal opportunity to benefit from technology (if the use of technology for learning has been decided on). Thus, teacher's personal motivation, attitude and skills should not be a barrier for the student. Support and training is obviously needed, and involving teachers in planning of technology use would lead to better results. Easy access to well-designed educational content that is clearly connected to curriculum and teaching practices might also encourage the more reluctant teachers to utilise technology.

The greatest potential of the tablet devices in primary schools may relate to the opportunity to utilise digital content and internet often and effortlessly and thereby the teachers (with the support from other stakeholders) would be able to create practices that are seamlessly integrated into the teaching and that efficiently support the pedagogical goals. The use of ICT could become mundane but valuable tool in education instead of occasional exciting visits to separate computer rooms.