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Introducing The iPad in A Norwegian High School
How Do Students and Teachers React to This Technology

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Abstract

This thesis studies the use of iPad in a Norwegian classroom. The aim of this thesis is to evaluate how suitable the iPad is in a classroom, what are the advantages and disadvantages of using it and if it can produce increased motivation towards learning among students. To conduct this evaluation in a realistic setting, a class with 15 students together with 5 teachers were each provided with 1 iPad. A set of qualitative data gathering activities were selected; observations, focus group meetings and interviews. Through these activities empirical data was obtained for further analysis and discussion.

The findings indicate that the iPad hold many advantages in a classroom, but not without disadvantages. iPad's convenient size made reading easier for the students. Multiple means of content representation and possible ways of expression provided students with options in learning. It was found an increase in motivation among several of the students. The disadvantages are that the iPad requires extensive training, if it would be used to it fullest potential and not as another substitute to a laptop computer. Lack of educational content, such as multimedia enriched books are needed to increase learning, because PDF versions of textbooks does not introduce anything new except increased portability.

From this work, the project team has gained deep insight in how the iPad should be introduced in schools. We are particularly pleased with how many of the students used the iPad to solve tasks and used it with their schoolwork. The teachers in this thesis are positive towards the iPad's educational capabilities, and this thesis will provide constructive information for anyone considering using the iPad in school and what kind of experiences and difficulties to expect.

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INTRODUCTION

This chapter describes the background for this thesis. The first section will explain the context of the project, followed by a section on the motivation behind the project. The last sections will describe the project's goal, research questions, research methodology and domestication theory.

1.1 PROJECT CONTEXT

This project is the master thesis from the Master of Computer Science program at the Norwegian University of Science and Technology (NTNU). The thesis is written during the last semester of the program.

1.2 MOTIVATION

On March 31st 2011, a Google search for "iPad + school" returns approximately 171,000,000 results. This section describes both the trends in the tablet industry and the educational opportunities the iPad facilities, and how it motivated me for this thesis.

1.2.1 *Trends in The Tablet Industry and Educational Opportunities*

Anderson [2011 (accessed June 5, 2011] explain the recent trends as: *"Since the invention of the Internet, innovators have developed new and unexpected ways to access the information provided by the Internet's total global connection. Development of new software only goes so far, and there is an increasing need to re-imagine the way that humans interact with computers. Tablet computers represent a new tool to use primarily for information access and analysis in a more simple and compact manner than with a traditional personal computer. As the number of tablet computer users continues to increase, another group of technologically curious consumers is joining the tablet revolution - the education industry."*

After the introduction of iPhone and iPod Touch, Apple Inc. has created a familiar platform with multi-touch support, finger gestures and a built-in accelerometer that introduced new features that people grew to love very quickly. Developers are constantly finding new ways to explore and utilize this technology, with more creative games and other sorts of apps. Through Apple's websites in the educational category, Apple touts the iPad as "it's poised to change the learning landscape." Apple Inc [2011 (accessed February 15, 2011]. The iPad offers an interesting alternative from textbooks and other ways of learning and interacting with each other in a new way that challenges the old, traditional way of learning.

Currently, Apple's iPad currently holds about 75% of the tablet computer market Strategy Analysts [2011 (accessed June 3, 2011] . Educators are aware of iPad's and other tablets' possibilities, and a number of analysts are forecasting that it is just a matter of time before tablets will replace textbooks Walsh [2011 (accessed March 4, 2011]. The possible advantages of tablets are many. Portability, accessability for people with disabilities, increased interactivity, and instructional benefits are just a few potential benefits. Heavy backpacks can have serious impact on children's backs and posture MediLexicon International Ltd. [2011 (accessed March 7, 2011], and that is why tablets and the iPad are good alternatives for carrying around several heavy books. Cedar's School of Excellence in Scotland is the prime and front most example of an excellent educational iPad program, and paves the way for more schools to follow. Speirs [2011 (accessed January 16, 2011].

Equipping an entire classroom with tablets is definitely a tough challenge. It would be very difficult to implement, but so is education in general. Students need to learn to use the technology that will meet them in the business life, and teaching them how to solve computer-oriented tasks is considered fundamental in order to survive our techno-centered society. Thus, tablets have the possibility to fulfill many different and complex needs for both students and teachers.

1.2.2 *Personal motivation*

In the depth project preceding the thesis, I myself conducted a study of the potential of the iPad as a pedagogical device. To quote myself: *"The key findings in this paper is that the iPad has great pedagogical potential, yet there exists little information on how this potential is utilized as many pilot projects are still in their early phases of deployment. Technology has been used in Norwegian schools for years, however the amount of use various enormously and both students and teachers report they find the use of and the educational material presented on computers antiquated and boring. There has been a shortage of integration between the school curriculum and technology, and it has often been each teacher's own decision to the extent technology is used in education. The iPad with its 'micro-mobility'- features can bridge the gap between the school curriculum and technology as long as it is used where appropriate. "*

The approach to this project will hence be to further evaluate the potential of the iPad in an educational setting. The release of iPad in Norway coincided very well with this approach, and I was fortunate enough to be part of Sør-Trøndelag County Authority's research project to further investigate iPad's educational potential.

Another aspect of my personal motivation is my increased interest in different teaching and learning techniques, and how technology can help students that perform poorly in school. According to PISA [2011 (accessed April 16, 2011], Norway score OECD average in skills in mathematics, science and reading. I take great interest in tomorrow's learning and teaching techniques and how we can focus on creating successful learners. With further research extending this thesis I am confident we can that iPad-based teaching have the ability to produce increased levels of engagement both in class and with homework.

1.3 PROBLEM DESCRIPTION

The iPad offers an attractive alternative from textbooks and offers other methods of learning and interaction in a new way that challenges the old, traditional way of learning. What are the advantages and disadvantages of using the iPad in a Norwegian classroom?

This master's thesis will investigate what can be gained from incorporating the iPad in an educational setting and what can be learned from these experiences. The strengths and weaknesses of using an iPad in a classroom will be discussed in detail, together with if the iPad can create increased motivation and engagement in class participation among students.

1.4 RESEARCH QUESTIONS

To explain the source for my research questions, we can revisit Section 1.2.2. I wish to explore how students and teachers natively use the iPad. How will it perform to basic tasks such as writing, which is considered to be a challenge and requires a learning process with the iPad.

"There is very little evidence that kids learn more, faster or better by using these machines," said Larry Cuban, a professor emeritus of education at Stanford University. "iPads are marvelous tools to engage kids, but then the novelty wears off and you get into hard-core issues of teaching and learning" Tween-Tribune [2011 (accessed April 15, 2011]. It seems likely the iPad can create a somewhat Hawthorne[1] effect to learning, but it also represents a new threshold in teaching so perhaps this indeed is the time that technology, besides from laptop computers, finally takes hold and goes in to full scale in the educational system. Given the limited time period of this project, it is unlikely we can experience any significant, traceable increase in learning, rather we have to put more of our faith in feedbacks from teachers and students.

A teacher's most fundamental task is to meet the challenges of engagement for a very diverse group of students within education, and consequently enable and stimulate students' learning. The iPad exhibits promising potential for meeting those challenges. Only technological excitement and stimulation alone will not suffice. It must be used within the school's curricular conceptions, and support the wide arrange of teaching and learning techniques to assist all kinds of learners.

This iPad project also face other challenges - teacher training, technological infrastructure and at later stage, outside

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1 A term referring to the tendency of some people to work harder and perform better when they are participants in an experiment.

this project, sustainable funding to keep technology functioning and up to date.

This are my main ideas and thus come to ground in my research questions:

RQ1: What are the strengths and weaknesses of using an iPad in an educational setting?

A note here is how it especially manages in a Norwegian classroom, given most of the apps are in English and there exists very little textbooks and curriculum material available in Norwegian for the iPad.

RQ2: Can the iPad produce increased motivation for learning?

1.5 RESEARCH METHODOLOGY

Most research methods can be placed in one of the two main categories, quantitative and qualitative methods Oates [2006]. Quantitative methods are used when one seeks a broader understanding of a phenomenon. Testing a hypothesis statistically or testing a causal connection are examples of quantitative methods of research. This is usually achieved through statistical methods to verify or falsify a hypothesis. Qualitative methods are used when a deeper understanding is needed, and one wants to know more about a phenomenon. The aim could be to understand human behavior, thoughts, actions, experience or expectations. To achieve this, the researchers have to use themselves as instruments by interviewing and observing the users. All of the methods used in this thesis fall under the category qualitative re search methods, but simultaneously, quantitative data can be generated from them. Data collection is a key part of user-centered activities to identify needs and establish requirements and make evaluations Aune [1996].

1.5.1 *Observation*

In order to capture data, observation is a good source when the goal is to find out what the users in reality do and how they use a device. The observer is able to study the actions of the users, but method of observation alone is not a significant source of information to conclude why the users choose their actions.

I chose an overt observation method, in which the participants knew that they are being observed; whilst participants in a covert observation do not know that they are being observed. A reoccurring challenge to researchers conducting overt observations, is that there is little or no way to know whether, and to what extent, the participants have changed their behavior as result of knowing that they are being observed Oates [2006].

1.5.2 *Interviews*

An interview is a conversation between two or more people (the interviewer and the interviewee) where questions are asked by the interviewer to obtain information from the interviewee. Interviews are a valuable technique to obtain detailed information about, in this case, a research topic. One can get information about feelings and experiences that can be difficult to obtain otherwise Oates [2006]. Some people find it difficult to express their thoughts and feelings in larger groups, and hence find it easier to talk one-on-one.

Interview as a data collection method can prove to be a time consuming process, as it requires you to arrange interviews, prepare questions, orchestrate the interview and transcribe it before analysis can be carried out. In order to focus on non-verbal information in addition to verbal information, the interview should be recorded so one can go back and further analyze it. The negative aspects of interviews are that performing the interview is time consuming and transcribing it afterwards takes time. The interviewee may for some reasons not be truthful and provide complete answers. Therefore, with this in mind, interviews should only be conducted on key people in the research, and should in any case be kept at a minimum Oates [2006].

There exist different types of interviews, where the most common ones are structured, semi-structured and unstructured. The main difference is which detail the interviewer wish to control the interview and its direction regarding freedom to talk during the interview.

1.5.3 *Focus group*

A focus group is a form of qualitative research in which a group of people are asked about their opinions related to a specific topic Edmunds [2011 (accessed February 14, 2011]. Questions are asked in an interactive group setting where participants are free to talk with other group members.

The facilitator leads the group of participants through a discussion, normally based on a set of questions regarding the main topic. Focus group is an excellent method for the researcher to gain knowledge about the participants' attitudes, beliefs, desires and their reactions HHS Web Communications and New Media Division [2011 (accessed February 13, 2011].

A focus group also comes with disadvantages, such as limited control over a group compared to one-on-one interviews. Groupthink can occur, and be disturbed by overindulagence by some members.

In this research the focus group did not evaluate any prototypes or test any specific features, but rather functioned as a discussion where different topics regarding use of the iPad as a learning and teaching tool. The group participants was part of the decision process and analyzed and evaluated their teaching methods with the iPad, together with tackling and overcoming technical hindrances.

1.5.4 *Action research*

One of the approaches to how the research will be executed and documented, is the theory of action research. Action research is typically undertaken in a school setting. It is a reflective process that allows for inquiry and discussion as parts of the research. It is normally practiced as a collaborative activity amond colleagues exploring challenges and searching for solutions to situations experienced in school. It can also focus on ways to improve instruction and increase student achievement. Action research is deliberate, solution-oriented investigation that is group or personally owned and conducted. It is characterized by spiraling cycles of problem identification, systematic data collection, reflection, analysis, data-driven action taken, and, finally, problem redefinition Johnson [1995]. The linking of

the terms "action" and "research" highlights the essential features of this method: trying out ideas in practice as a means of increasing knowledge about or improving curriculum, teaching and learning Kemmis and McTaggart [1988]. The purpose can be school based curriculum development, professional development, systems planning, school restructuring, and as an evaluative tool. The processes in action research can help teachers learn what it is that they are able to influence and they make changes that produce results that show change. The process provides the opportunity to work with others and to learn from the sharing of ideas Ferrance et al. [2000]. Reasons for performing action research fall into three categories: to promote personal and professional growth, to improve practice to enhance student learning, and to advance the teaching profession Johnson [1995].

The active participation of teachers and others is part of what makes action research a viable and useful tool for this project. The investment of time and energy by all of the participants provides a sense of ownership and a connection to the process and outcomes. Project members will analyze their own teaching methods and try to better utilize the principles of the research and the results and ideas that come up in their teaching as according to Johnson [1995]. This is what we will try to accomplish in this project. Tight integration with the teachers, listen to their difficulties and identify the problems, reflect upon and propose a solution (if possible) or workaround, and then collect data from the result.

1.5.5 *Method and Approach*

This study will use a qualitative explorative approach combined with action research when applicable, due to its relevance to the research topic. Qualitative research involves a methodical collection, coding and analyzing of data. Qualitative research aim to gather an in-depth understanding of human behavior and the reasons that govern such behavior Australian Bureau of Statistics [2011 (accessed May 21, 2011]. This strategy is used to dig deeper into a problem, understand the situations and actions, and to discover new information. Data collecting methods in qualitative research

includes observations, workshops, interviews, prototyping, and evaluation.

The primary methods in this thesis for data collection are focus groups, interviews and observations. The information obtained from an activity will be evaluated and brought forward to prepare and to execute in the next activity. This will further generate more qualitative data. These methods were selected to encourage more detailed responses and reactions from users about the iPad's pedagogical capabilites, usability, user value, and as a teaching and learning tool.

The focus group will concist of me as a technical consultant and observer, project manager, 5 teachers and the IT operations manager of the school. The team will meet together every week for approximately 1 1/2 hours to discuss the different topics described above. Observation and problem solving together with the class was conducted on a weekly basis.

1.5.6 *Ethics and Privacy in this Project*

All quotations are anonymized to protect the privacy and identity of the teachers, students and other participants in this study. All quotations from observation, focus groups and interviews are translated from Norwegian to English.

1.6 DOMESTICATION THEORY

Domestication is a concept within media and communications studies, but also within studies of the sociology of technology that has been developed to describe and analyze processes of (media) technology's acceptance, rejection and use. The emergence of the domestication concept represented a shift away from models, which assumed the adoption of new innovations to be rational, linear, monocausal and technologically determined. Rather, it presented a theoretical framework and research approach, which considered the complexity of everyday life and technology's place within its dynamics, rituals, rules, routines and patterns Aune [1996].

As a starting point, domestication was used as a metaphor for the transformation of an object from something unknown, something "wild" and unstable, to become known,

more stable, "tamed" Aune [1996]. At a metaphorical level we can observe a domestication process when users, in a variety of environments, are confronted with new technologies. These "strange" and "wild" technologies have to be "house- trained"; they have to be integrated into the structures, daily routines and values of users and their environments. When the domestication of technologies has been "successful", the technologies are not regarded as cold, lifeless, problematic and challenging consumer goods at the root of family arguments and/or work-related stress, but as comfortable, useful tools ± functional and/or symbolic ± that are reliable and trustworthy Aune [1996]. Mobile phones and television are good examples of tools that people have learned to trust and have become part of the daily routine.

Wyatt [2003] argues that non-use of technology is a strategic decision, made because the technology does not appear particularly beneficial or interesting, or because of active resistance. Thus, we have to be aware that ownership or use of a particular technology or a set of technologies may be enforced as well as resisted.

The domestication model in Table 1 describes the model of consumption of technology, specifically media and ICTs Habib [2003].

Rather briefly explained, the commodification stage occurs when the artifact enters the environment of the potential user who currently hold his or her own preconceptions and personal preferences.

They may form an opinion based on a number of factors such as the reputation of the company or companies participating in the development of the product, the "look" of the product, its functional claims but also its more symbolic claims Habib [2003]. In relevance to this project, this is when the iPads are handed out to the students for the first time and each of them from before have their own opinion of the device.

Appropriation is when the user begins to use the artefact in his or her environment, and where the artefact is used through habituation and hopefully fruitful utilization. Issues of mastery are also significant. Any object or technology has to be understood before it can be used.

The concept of conversion can be especially valuable within an academic institution where it potentially may

Individual consumer or potential consumer		
Commodification		The potential consumer imagines, 'constructs' the product
Appropriation		The consumer buys and accepts the artefact into his or her domestic environment
	Objectification	The artefact finds a physical place within the domestic environment of the consumer
	Incorporation	Use of the artefact is fitted into the consumer's domestic time
Conversion		The consumer signals his or her consumption of the artefact to others (display of competence, of ownership, etc.)

Table 1: Consumer's actions throughout the stages of domestication in a consumption context. Habib [2003]

be several information channels, such as different courses and sharing experiences between users. Students could exchange opinions of the device as a learning aid and how well it integrates with the school curriculum. Users might talk about it in conversations with their family and friends and share their experiences to aid others.

The domestication theory is not considered to be one of the main topics in this research, but it is worth noticing and the fundamentals of domestication theory do pinpoint many important aspects worth considering and to be aware of. The magnitude of how many students will reach the conversion stage, and how in general the user will welcome the device. Compatibility with existing systems and file formats is an important keyword if the user would incorporate the device in its domestic time. Experiences acquired from the user sitting next to you may very well influence an individual's attitudes around the device's complexity, usability and its general purpose.

PRESTUDY

2.1 REPLACEMENT AND TRANSFORMATION

Adopting technology is typically performed in two different stages; replacement and transformation. Many schools have adopted the replacement stage, which entails to take an existing resource and replace it with a somewhat identical digital resource. The simplest and most known example of this is to replace a paper textbook by the same textbook in PDF/e-Book format on for example an iPad. This is useful if the purpose is to "test" new technology and measure how well it replaces the original resource.

Transformation is when a process or a resource is completely transformed in how it is used, taught or handled. In this context, it would be to completely rebuild the method for learning. More radical, but this can also yield unexpected effects that no one would have thought of before the transformation process started.

These are the two processes that most education sections have to decide between when a decision has to be made to which process they wish to practice. The most rational choice of the two is the replacement process, as the iPad has just recently entered its second product cycle and there exist little information about its pedagogical advantages. In general, ICT use in school has focused on replacement and not transformation. In light of this, perhaps this is why the implementation has not proven as effective as many had hoped for. Replacing books and other processes with ICT, simply means doing the same thing only with a different tool. Perhaps this is also why ICT, especially in school, often is tied down with heavy restrains.

The way iPad is designed makes it a device to be owned, not shared. Each user makes it their personal device. When looking at the iPad, it is important to break out of the old mindsets. To replace all of the laptops with iPads will not necessarily yield much good. iOS[1] does not in a clear way

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1 iOS is Apple's mobile operating system used in iPad

distinguish users and his or her files. The switch from using computers to iPads is not, and should not be attempted, in a swiftly manner. The reason is because of the classical mistake that people tend to use new technology the same way they used the previous one, without looking at the advantages and possibilities that exists in the new technology, and therefore does not benefit and exploit it to its fullest potential. The dangers of doing the same, only in new ways, is clearly a challenge that needs attention. When introducing a new device, it does not necessarily need to follow the exact same work pattern as the old device and before, in many cases it is a good thing to not follow the same workflow as before. Detailed information and extensive education in the use of the device is crucial, and the principles of UDL in Section 2.4 pinpoints several of these important goals. Attempts to change higher education for the better might fall prey to moves that, in effect, will employ technology to cement existing paradigms instead of creating new ones that will generate true educational reform Privateer [1999]. A glum comment from Weizenbaum [1976] explains his views about the advent of the computer : *"Yes, the computer did arrive 'just in time.' But in time for what? In time to save—and save very nearly intact, indeed to entrench and stabilize—social and political structures that otherwise might have been either radically renovated or allowed to totter under the demands that were sure to be made on them. The computer, then, was used to conserve America's social and political institutions. It buttressed them and immunized them, at least temporarily, against enormous pressures for change"*. Weizenbaum points out that the computer is just another tool for doing the same things that were done before. Do teachers, or perhaps educational institutions, wish to only replace existing ways with new technology, or transform the learning experience by utilizing and exploiting new technology in order to create a greater learning experience? Nickols [1999] explains his thoughts of the challenge facing education: *"At its simplest, the challenge facing education is to adapt to changed conditions. The high-risk alternative to adaptation is increasing irrelevance, continued encroachment by more responsive organizations, and eventually (to borrow another phrase from the business world), a trip to the boneyard. The choice might be obvious—but it is far from easy. At stake are egos, careers, professions, institutions, lives, and to some extent the future of society."*

Cutrim Schmid [2008] equipped English language classrooms with interactive whiteboard technology, and pointed out that students argued *"a drawback of having easy access to resources is that it may encourage laziness towards the students, if the teacher 'spoon-feeds' them."* Students from the study indicated in the interviews that the use of multimedia resources also meant that the teacher could draw upon a greater variety of resources to provide more complete explanations. As a result, the students understood concepts, meanings and ideas with less effort. For some students this could be negative from the point of view of the development of effective learning strategies, since outside the classroom they need to apply more active strategies in order to discover the definition of words, understand new concepts and apply the newly acquired knowledge in real situations.

This can be extracted to the potential of technology to supply such a vast amount of information, could make students less willing and likely to "imagine" or "to attempt" to understand different concepts and ideas. In the end, it could lead to students become "lazier". Having access to potentially unlimited information does not necessarily result in increased interest in the topic, but to think of the all the vast information as "always accessible" and the need to learn and grasp is no longer nurtured in the same way, because the student can instead look it up online in a matter of seconds. Technology allows a seamless access to various multimedia resources, a potential risk exists of using technology mainly to give lessons and lectures a fresh look, rather than focusing on making the best pedagogical use of these resources.

2.2 SAVING AND STORING DATA

One problem that has been around since people started using computers, especially prevalent in school, is how to and where to store the data or files. In the 90s, people used floppy disks to save important data. Every time before they left the computer, they had to spend a few minutes saving their recent changes to a document, select the floppy disk as destination and wait for it to finish. The floppy disk would eventually wear out and become corrupted, or the

user would lose it resulting in important data lost forever if no backup existed.

Today, people use USB flash drives for moving files around. Based on the same idea as floppy disks; rewriteable storage. The differences are increased storage, durability, and smaller in size. The fact remains that when a user wishes to save a document, he or she has to do the following: From the File Menu, Select Save As -> Select where the file will be saved (often going through a folder hierarchy), or select the USB flash drive -> Safely disconnect the flash drive. The flash drive must not be pulled out before safe removal is completed, or data may be incomplete or become corrupted. Next time the user wish to work on the same document, the same scenario has to be repeated in reverse order.

The iPad does not use the above scenario to store and open files. When a user is inside an app and content is created, the data is automatically stored within the app. In a word processor, the normal procedure is to press something like "New" and the document is created without forcing the user to go through the process of selecting where it has to be stored. Some word processors feature a file manager similar to a computer to let the user organize in a familiar environment. Especially in a classroom setting this comes in very handy. You do not have to save anything, only press the home button and it is still there when you get back. The only important part is to not forget to sync the iPad to its iTunes library in order to stay in sync and backup data. Should the iPad get stolen or broken, the data is still on the computer and can be restored on another iPad.

Another approach to store, access, create and edit files is with the third-party app Dropbox. Dropbox can synchronize files online and across multiple computers and other supported devices automatically and simultaneously. It allows seamless transfers between your iOS devices and any other computer or device you have from Macs to PCs. Dropbox creates a folder on the computer, and the user drag and drops whichever files he or she want to share to other authorized devices. A free account gives 2GB of online storage, with up to 100GB available for paying customers. Dropbox uses version control to stay in sync between different peripherals when files are created or modified. Files can be opened in offline mode, and it syncs once

Dropbox senses an internet connection. A file created on the computer, can be opened in the Dropbox app on an authorized iPad, and Dropbox will automatically display a list of supported apps that can open the document and the user can continue working.

A public folder within Dropbox can be used to share files with other teachers or students. This makes it possible for the teacher to create and share subfolders for each student, giving each student the opportunity to upload their work to this folder so that the teacher can easily review and comment on their work.

One problem yet to be solved in an elegant matter, is how to export back to DropBox from the iPad. Using the "Open in..." function in iOS, all files can be opened in other apps that support the document type, but this creates a local copy of the file from the Dropbox server on the iPad. Dropbox Inc. has released an API that let developers implement DropBox functionality into their own apps. Most of the apps only supports export back to e-mail, so by opening a document through Dropbox, once the user is done the document has to be e-mailed back to an e-mail account and then uploaded to Dropbox. As more and more apps support Dropbox, users can work on their documents on the iPad without the inconvenience of exporting back to e-mail and therefore make the whole process more fluent and familiar to the user. This can be seen as a lack of functionality in iOS. A method to transfer files from application to application is lacking.

The whole sense of this is that people should not need to worry about carrying a USB flash drive wherever they go, or where they stored the file. Everything is stored "in-the-cloud" and is accessible anywhere and anytime. Cloud computing services are valued for its capacity to enable collaboration over the Internet, and for its flexibility in handling the complex computing demands inherent in the IT work of schools. The only caveat is that internet access is required. Data is still stored on the iPad, so nothing is lost if there is no internet access available, but the dangers of single point of failure exists.

Since the beginning of operating systems the same basic analogy has been prevalent. Files are stored in a hierarchical file system. "Windows" on top of each other in the graphical user interface are used to represent applications that are

controlled with a pointing device. There is a "desktop" underneath where files and application shortcuts can be saved.

From a computer science standpoint, it makes sense. From a user's standpoint, it does not. The desktop metaphor is hardly that intuitive. For example, take the task of trying to find a picture from vacation. Is it in a folder on the desktop? Is it in 'My Documents\My Pictures'? Maybe it ended up in 'C:\Program Files\Some Application\Some Unpredictable Directory\Timestamp\Photos'? While there have been numerous attempts to make file browsing easy, it can still prove to be a complex task. However, many users have now grown accustomed to the desktop metaphor and thus change may require a period of time necessary to adjust.

Reding [2011 (accessed April 6, 2011] explains his view on iOS' file system:

"The iPad is set to change the way people store and share files, and where people do not have to worry about computer's occasional absurd complexity. There is no "desktop" on the iPad, just a space for apps, and only apps. If you save a picture to the iPad, it is in a common repository and nowhere else. All the videos are in the video apps, all the music is in the iPod apps. Instead of a file window with open and save panels, each app displays the files that is stored in its own repository at launch for the user to navigate through directly. Delete the app and all of its related files are cleaned out together with it. The user never thinks of interacting with "files" stuffed into a hierarchical file system. That file system is there, underneath everything, but it's been shrouded from view."

There is a reason why Apple did not simply port the OS X operating system to iPad, but chose to hide the file hierarchy to the user. The clutter of thousands of files stored in folders spread around is complex compared to the file storage design in iOS. Apple just recently presented iCloud, which is their answer to cloud storage of files Apple Inc [2011 (accessed June 13, 2011]. Automatic syncing of files among all of the user's authorized devices built in to all of Apple's apps seem to be a great solution for the individual user. While iCloud will not be released until fall 2011, it remains unclear how users can simultaneously share files and folders in a similar way to Dropbox, and thereby iCloud does not appear to be a valid solution for schools. Schoolwork is about turn ins and submitting work

to be evaluated. There is no way to do this without sharing and sending files. And this is one of the reasons why products like Dropbox exist.

2.3 EFFECTIVE CONTRIBUTORS

With iPad, the flow of documents to and from the iPad could, as discussed in Section 2.2, transform the process of submitting homework as one example. When in class, students would collaborate together with their iPads and share their work. The iPad incorporates some of the "micro-mobility" collaboration features as introduced by Luff and Heath [1998]. Compared to the old way of trying to turn a desktop computer monitor around, or a laptop where the power cord must be treated carefully in order to share the work with someone else, this way of collaboration offers a very appealing potential. Better yet the situation of three or four students crowded around one computer trying to collaborate where each of them are trying to point on the screen and grab the attention.

Another factor of importance is that students and youth are very efficient of consuming content. Kaiser Family Foundation [2009] found that young Americans aged 8 -18 years spent an average seven hours and 38 minutes consuming media in a typical day in 2009—an extra one hour and 17 minutes with media per day since 2004. The research shows that this increase can be largely attributed to widespread adoption and use of new mobile and online devices, in particular media-enabled mobile phones and MP3 devices such as the iPod. Searching for information becomes an increasingly all-pervasive activity for students and teachers alike. If a student were asked how he or she finds information today, the most common answer would sound something like "Google of course..". Through the web, content is easily accessible and copy and paste is used frequently as a tool for "creating" content for its own purpose. Buckingham et al. [1995] claimed: *"There is a fundamental difference between the 'passive' knowledge that is developed through critical analysis and the 'active' knowledge that derives from production"*. Answers are not always just a Google search away, and students could end up copying and pasting whatever they find and in reality not learn

anything from the experience. Instant collaboration and sharing using technology transparently with a strong focus on the actual task, with just as much focus on the road towards the goal than the goal itself is one direction the adaption of technology can direct learners. Additionally, allowing the students to take the iPad home after school, gives them opportunity to pick up where they left whenever they want. With its always-on functionality, the class or learning experience does not necessarily end at the chime of the school bell.

Thus we come back to today's situation for every teacher: This is a challenging time to be a teacher. New policies and changing demographics are making schools more diverse than ever. It is the responsibility of educators of today to not only place technology in the hands of students, but to try with their best effort to grasp how to make this technology a part of their continuing learning experiences. Society is using new ways to communicate, share and collaborate, should not school do the same? Students use new media and technologies to create new things in new ways, learn new things in new ways, and even communicate and share in new ways with people from all around the world. This new way of everything also reflect back to their school work. Unfortunately, students report they feel like they are stepping back in time when they go to school Green and Hannon [2007]. Students strongly assert that technology is important to their education Farris-Berg [2005]. They indicate that while many educational institutions are experimenting with a diverse range of digital tools, the approaches used are not always creative or innovative. Virtually all students use the Internet to do research to help them write papers or complete class work and homework assignments. Most students also correspond with other online classmates about school projects and upcoming tests and quizzes. They frequent web sites pointed out to them by teachers—some of which have even been set up specifically for a particular school or class Levin and Arafeh [2002]. An understanding of the differences between how different technologies are used by students both in school and in their daily lives, and most importantly how students are motivated to use technology as a medium in their studies, is important to review what to be the best practice of use of technologies in school. Structuring these activities into

school, together with the iPad, can provide teachers with the opportunity to build upon some of the student's existing practices. This is crucial, possibly because the single biggest problem facing education today is that our digital immigrant instructors, who speak an outdated language (that of the pre-digital age), as already demonstrated, are struggling to teach a population that speaks an entirely new language Prensky [2001].

2.4 UNIVERSAL DESIGN FOR LEARNING

Universal Design for Learning is an educational framework that guides the development of flexible learning environments. The framework is an approach to improve the quality of education across grade levels and courses for all learners, and create environments that can adjust individual learning differences National Center On Universal Design For Learning [2011 (accessed February 16, 2011].

The majority of the experimental studies are focused on the benefits of providing students with choices in the learning environment. Other studies focus more specifically upon the importance of providing students with greater autonomy and control in order to develop a sense of ownership for their own learning. Universal Design for Learning *"is a set of principles for curriculum development that give all individuals equal opportunities to learn. UDL provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone–not a single, one-size-fits-all solution but rather flexible approaches that can be customized and adjusted for individual needs."* National Center On Universal Design For Learning [2011 (accessed February 16, 2011].

We saw in Section (2.1) that Cutrim Schmid [2008] reported that easy access to resources could make students lazy. National Center On Universal Design For Learning [2011 (accessed February 16, 2011] explains this by that non-educators often make the mistake of equating access to information with access to learning. In reality, these are two separate goals. In fact, increasing access to information can actually undermine learning, because it sometimes requires reducing or eliminating the challenge or resistance that is essential to learning. The difference between access to information and access to learning is parallel to the kind

of heavy lifting done by a professional mover versus done by a body builder. The professional mover is eager to get the job done as fast as possible with the least amount of work. To accomplish this, the professional mover uses tools as lifts, trucks and other devices to get the job done with minimal wear and tear. The body builder wishes to accomplish something with this job: strengthen his muscles. Therefore, he seeks challenges and lifts weights, and is on the lookout for opportunities to build strength and gain weight, focusing on support muscles not being trained and increase resistance for those that are Center for Applied Special Technology [2011 (accessed June 3, 2011].

The goals of learners are more similar to the body builder than to the professional mover. UDL is established on this difference. Education aims to not only make information accessible to students, but to make learning accessible. As the body builder needs to know what kind of muscles that requires exercise, the teacher must know the instructional goal in order to find a suitable structure to teaching each course or to a specific problem. Let us say a teacher sets the goal of assisting a student to increase his or hers enthusiasm towards reading. Handing out a book in a digital format would undermine that goal rather than support it. Even so, if the digital book required interaction from the user, and perhaps included audio/video material, and the teacher knew the student would respond to that, then giving the student access to such a tool would support the defined goal.

Principles of the UDL Framework:

PRINCIPLE 1: Multiple means of representation to provide learners various ways of acquiring information and knowledge

PRINCIPLE 2: Multiple means of expression to provide learners alternatives for demonstrating what they know

PRINCIPLE 3: Multiple means of engagement to tap into learners' interests, challenge them appropriately, and motivate them to learn

These principles share one common direction and guidance: to provide students with a wider variation of options in learning. To adapt to such a broad specter of learners teachers have to deal with today, the curriculum must be designed to offer a range of options for using and access learning materials and tools. There should be to as little extent as possible difference in learning opportunities to a student with or without disabilities. The attributes of digital media most relevant and applicable to education are their flexibility, portability, capacity to be networked together and their accessibility.

Good pedagogy also includes effective and ongoing evaluation, not only to measure a student's progress, but also to adjust instruction and to evaluate the effectiveness of methods and materials. Continuous evaluation enables teachers to ensure that the goals they have set and the methods and materials they use continue to support students' progress.

These are the stripped down guidelines for UDL:

1. Provide Multiple Means of Representation

    a) Provide options for perception

        i. Customize the display of information and provide alternatives for auditory and visual information

    b) Provide options for language and symbols

        i. Define and clarify grammatical concepts and illustrate key concepts

    c) Provide options for comprehension

> > > i. Highlight critical features and support memory and transfer. Provide additional information for those you wish to learn more.

> 2. Provide Multiple Means for Action and Expression

> > a) Provide options for physical actions

> > > i. Provide varied ways to respond and interact with materials. Integrate assistive technologies

> > b) Provide options for expressive skills and fluency

> > > i. Allow choices of media for communication and provide ways to enhance practice and performance

> > c) Provide options for executive functions

> > > i. Guide goal setting, support planning and process management

> 3. Provide Multiple Means for Engagement

> > a) Provide options for recruiting interest

> > > i. Increase individual choice and enhance relevance and value together with reducing threats and distractions

> > b) Provide options for sustaining effort and persistence

> > > i. Heighten goals, vary levels of challenge and support and increase collaboration and communication

> > c) Provide options for self-regulation

> > > i. Guide personal goal-setting and expectations

If we look at the functionality and discuss educational purposes of the iPad, the iPad give the impression to be a good fit together with the above presented goals of UDL. To provide the students with choices and alternatives and to let them learn the material in the way they feel suit them the most is significant in order to increase motivation and engagement. In addition to provide students with alternatives, one must also pursue options to sustain effort and persistence (from goal 3.b). Otherwise one can end up with

in the same scenario as the body builder vs. the professional mover, where the student always opt for the easier, known way of solving tasks to get the job done instead of being constantly challenged to new levels and exercise different ways of problem solving. The iPad in the classroom provides students with options in materials, tools, content and in several different formats. Read the book with iBooks, listen to it as an audiobook, and perhaps even download it from iTunes U as a video lecture where a professor has a discussion session about the book. Solve math equations displayed on the iPad, or challenge a classmate in who can solve it the fastest with an app that supports two iPads competing. As UDL guideline 3.a suggests, it is important to provide students options for recruiting interest. To give a student the individual choice of how he or she wishes to learn could enhance the relevance of the goal, as long as it is completed within a controlled environment. If the content is available as text, audio, video or maybe even incorporates a way to interact with the student, it provides the student various ways of acquiring information and involves several different senses in order to enhance learning as studies uncover people could benefit by the material being presented in diverse ways Mayer [2001]. With several alternatives, if available, teachers can easily make learning accessible, not only provide information accessible through a textbook.

2.5 MENTAL MODELS

In the words of Peter Senge: *"Mental models are deeply held internal images of how the world works, images that limit us to familiar ways of thinking and acting. Very often, we are not consciously aware of our mental models or the effects they have on our behavior".* Senge [2006]

Norman describes mental models as: *"In interacting with the environment, with others, and with the artifacts of technology, people form internal, mental models of themselves and of the things with which they are interacting. These models provide predictive and explanatory power for understanding the interaction."* Gentner and Stevens [1983]. The way we solve problems and how our behavior is molded, are both helped from our mental models. The changes in surroundings can change our mental models and understanding. Typically, the bur-

den is on the user to learn how a software application works. The burden should be increasingly on the system designers to analyze and capture the user's expectations and build that into the system design Norman [1990]. People tend to blame themselves when they have difficulties using a system, especially when they believe that others are able to use the system and that the task is not very complex. In fact, the problem may be a design flaw and many people may have the same problems. Users feel guilty and do not want to admit that they are having trouble or do not understand how a system works Norman [1990].

A mental model is generally:

- Incomplete and constantly evolving

- Usually not accurate representations of a phenomenon; typically contain errors and contradictions

- Ungenerous and provide simplified explanations of complex phenomena

- Often contain measures of uncertainty about their validity that allow them to used even if incorrect

- Can be represented by sets of condition-action rules.

The theory of mental models is an interesting analysis of why users act the way they do, and can help pinpoint issues and suggest measures in order to better enhance the user experience. This is strictly considered as an addition to iPad's pedagogical capabilities, but also to shed light on how easy users find the iPad to use from the very beginning. If users find it confusing, and do not know where to look for certain functionality, it is often more difficult to justify the use of new technology. Butler and Sellbom [2002] reported in their research on barriers to adopting technology for teaching and learning that "*faculty sometimes have a hard time learning to use things because of bad design: things don't work the way people expect, controls map poorly to the devices they control, or controls are hard to figure out.*" *Training can solve this problem, but both the problem and the need for training could have been avoided by better design.* Consequently, faculty can also fail to see the potential of new technology and develop a concern that technology might not be critical for learning and whether it is worth their effort to learn

many of the available technologies, given the skepticism
that those technologies facilitate learning in higher educa-
tion. These concerns are unquestionably worth a look and
to be considered to have an effect on iPad's pedagogical
abilities.

2.6 conceptual framework for computer supported collaboration learning

Price et al. [2003] discussed how traditional computer-
supported learning environments have demonstrated an ex-
ample of how to promote collaboration, but only in largely
constrained settings such as a classroom. With mobile com-
puting and communication technologies, new opportunities
arise for a wider range of collaborative interactions. They
constructed a framework that uses multiple collaborative
interactions that facilitate diverse forms of reflection and
to explore different types of learning processes. The de-
signed learning experience first took place outdoors where
they used walkie-talkies for remote collaboration. PDAs
were used for displaying information together with GPS
for tracking purposes. The pedagogical goal was to sup-
port the development and applications of scientific enquire
skills when learning about ecosystems and habitats. The
second phase took place in an informal classroom where
the students shared a computer, and reported back and con-
solidated together about what they just had experienced.
Finally, the third phase was back out in the woods to exper-
iment more and reflect on what they discussed during the
classroom setting.

The primary focus of the study was to discover how dif-
ferent types of collaborative interactions engender reflection
in learners, and what kind of patterns of communication
might emerge in the process of the different interactions.

In short, Price et al. [2003] discovered that new pervasive
technologies have enabled the design of different learning
experiences from traditional ones. Different collaborations
have different processes underlying them and trigger differ-
ent kinds of externalizations from learners. It enabled them
to identify the mechanisms that may engender particular
externalizations that are an important part of reflection.

The iPad could fit very well into this framework, and it would be interesting to see this exercised once more with the iPad. Instead of using two separate devices out in the woods for displaying information and tracking, students can use iPad for both purposes. Once students discovered a new ecosystem, a plant or something else uncertain, a scientific app may have the answer or Wikipedia is right there. Students can take notes directly, share experiences and present to each other what they just found on the internet to others, while they are still studying the plant/artifact. Students can reach the teacher through a VoIP app, like Skype, and ask questions or to clarify tasks. This would require the 3G-version of the iPad, or a nearby MiFi[2] network setup.

What the iPad can offer, besides the already discussed part, is to be one whole device, instead of the need for three or more separate devices that together share the same purpose. If equipped with the iPad, the students are provided with an already known tool and can focus on the learning objective. Instead of just sharing technology together, students are provided with different tools that encourage different kinds of interactions.

2.7 CONSTRUCTIVIST TEACHING METHODS

There are many different approaches to teaching. Unfortunately not every approach works for every teacher, student, or class. Many teachers have different philosophies about teaching and will apply their philosophy in their classroom. The constructivist theory of learning has been found to be very effective in many different circumstances. Educational Broadcasting Corporation [2011 (accessed May 3, 2011] describes constructivism as basically a theory, based on observation and scientific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, we are active creators of our own knowledge. To do this, we

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2 A compact wireless router that can act as a mobile Wi-Fi hotspot

Traditional Classroom	Constructivist Classroom
Curriculum begins with the parts of the whole. Emphasizes basic skills.	Curriculum emphasizes big concepts, beginning with the whole and expanding to include the parts.
Strict adherence to fixed curriculum is highly valued.	Pursuit of student questions and interests is valued.
Materials are primarily textbooks and workbooks.	Materials include primary sources of material and manipulative materials.
Learning is based on repetition.	Learning is interactive, building on what the student already knows.
Teachers disseminate information to students; students are recipients of knowledge.	Teachers have a dialogue with students, helping students construct their own knowledge.
Teacher's role is directive, rooted in authority.	Teacher's role is interactive, rooted in negotiation.
Assessment is through testing, correct answers.	Assessment includes student works, observations, and points of view, as well as tests. Process is as important as product.
Knowledge is seen as inert.	Knowledge is seen as dynamic, ever changing with our experiences.
Students work primarily alone.	Students work primarily in groups.

Figure 1: Traditional Classroom vs Constructivist Classroom Image Courtesy of Educational Broadcasting Corporation [2011 (accessed May 3, 2011]

must ask questions, explore, and assess what we know Educational Broadcasting Corporation [2011 (accessed May 3, 2011]. This concerns our mental models from Section 2.5. A wide variety of methods claim to be based on constructivist learning theory. Most of these methods rely on some form of guided discovery where the teacher avoids most direct instruction, but rather attempts to lead the student through questions and activities to discover, discuss, appreciate and verbalize the new knowledge.

The Information Age is based on rapidly increasing and changing information, and the goal of education is no longer to train students to store and retrieve mastered information. The ability to recall and explain a concept does not necessarily reflect understanding, nor does it guarantee that students can apply and use the concept in a meaningful way Julyan and Duckworth [1996].

Some of the arguments against constructivist teaching techniques includes raising questions about the emphasis on group work and how this can produce the phenomenon

"group think" and the ideas of the more active students may dominate the group's conclusions. Figure 1 shows the differences between a traditional classroom and a constructivist classroom.

Mayer [2004] explains in his research "*The research in this brief review shows that the formula constructivism = hands-on activity is a formula for educational disaster".* In developing this instruction these educators produce materials that require learning to be behaviorally active and not be "cognitively active". That is, although they are engaged in activity, they may not be learning Kirschner et al. [2006]. Mayer [2004] recommends using guided discovery, a mix of direct instruction and hands-on activity, rather than pure discovery: *"In many ways, guided discovery appears to offer the best method for promoting constructivist learning."* Kirschner et al. [2006] further claims that *"not only is unguided instruction normally less effective; there is also evidence that it may have negative results when students acquire misconceptions or incomplete or disorganized knowledge".*

To further explore how the iPad relate to definitions of cognitive tools and technologies, Jonassen and Reeves [1996] provides us with a definition of cognitive tools and explains that cognitive tools can be used to support either "instructivist", behavioral objectives for learning or constructivist learning. *"Cognitive tools and the goals, tasks, culture, resources, and human collaboration integral to their use enable learners to engage in active, mindful, and purposeful interpretation and reflection. In traditional instruction, active refers to stimulus, response, feedback, and reinforcement conditions that help students mirror accepted views of reality, whereas in constructivist learning environments, active learners participate and interact with the surrounding environment to create their own interpretations of reality."*

If a complex problem is being analyzed and an internet search proves to aid with valuable information to assist in the problem solving process, then the newly discovered information becomes an input of data into the problem analysis and unification of the newly formulated solution. A student writing a new blog entry or wiki article or creating a mind map, while simultaneously searching the web to collect information is single-handedly assembling new information. Then the tool is not the vital part, but rather how it is utilized. Currently, the App Store does not feature

many cognitive tools, but rather tools for retrieving and organizing information. It is very limited of tools that let you take new information, and build new knowledge formulations. However, there are many mind mapping tools on the market that allow you to break ideas about, connect them, and re-organize them.

Dascal and Dror [2005] describes cognitive technologies as *"in this sense, can be characterised as those systematic means created by humans and used by them for the achievement of cognitive aims, including either cognitive states or cognitive processes that lead to such states or help significantly to reach them. As these technologies are used in our cognitive processes, as they cognize with us and for us, they influence and impact the very way we think and affect the very nature of cognition. As cognitive technologies advance, they shift from being mere tools that aid cognition to having constitutive roles in shaping cognitive processes themselves"*. Naturally, it depends on the apps created by developers in order for the app to create "cognitive processes" to the user. Mind maps is an example that illustrates the potential to create "cognitive processes" together with the user.

2.8 MULTIMEDIA LEARNING

In this Section multimedia learning is described, together with an example in Section 2.8.1.

Neo and Neo [2001] explain that multimedia is "the combination of various digital media types, such as text, images, sound, and video, into an integrated multisensory interactive application or presentation to convey a message or information to an audience.

Mayer [2003] describes potential benefits of multimedia by which that humans possess visual and auditory information processing capabilities, multimedia, as he explains, takes advantage of both capabilities at once. In addition, these two channels process information differently, so the combination of multiple media is useful in calling on the capabilities of both systems. Meaningful connections between text and graphics potentially allow for deeper understanding and better mental models than from either alone."
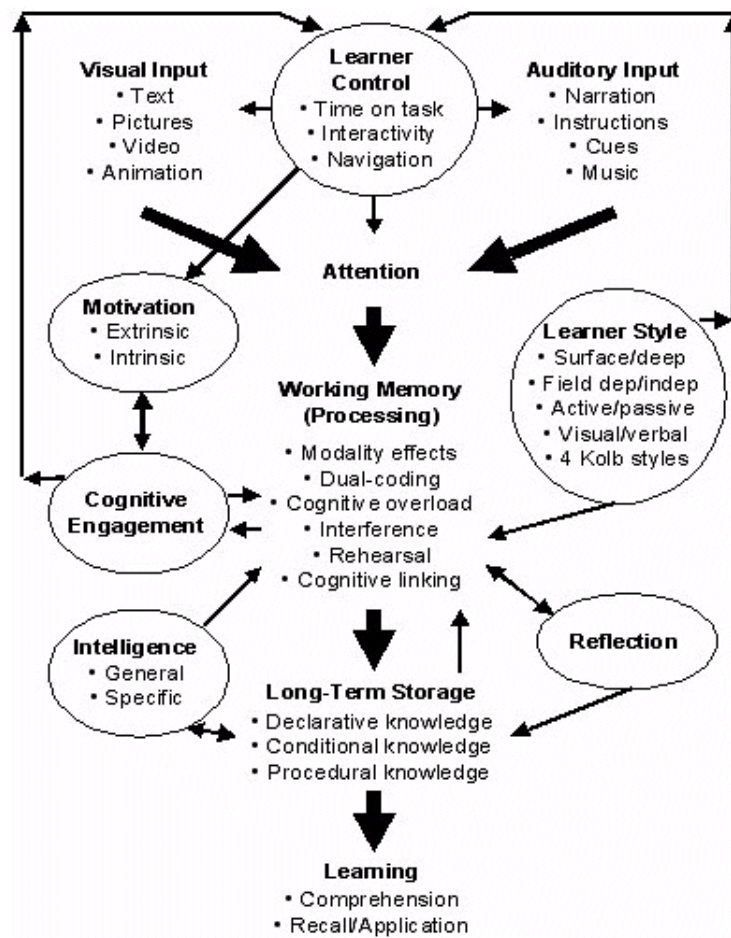
Figure 2: Multimedia Learning.
Image Courtesy of Hede [2002]

Hede [2002] offers a model of the myriad factors that affect the potential for learning from multimedia in Figure 2.

This model can help designers consider what factors that are more likely to affect learning. Inconsistent learning can be the outcome from multimedia learning, but this can often be blamed on many inconsistencies and how the overall instructional design was in order to achieve effective learning. Again, multimedia can be used to achieve greater learning but this is not achieved through a myriad of multimedia all at the same time.

Clark and Mayer [2007] introduced principles, displayed in Table 2, that influence the effectiveness of multimedia. These principles originate from cognitive science's understanding that the limitations of working memory and methods for encoding into long-term memory.

Principle	Description
Multimedia	Learning from text and graphics is better than from text alone.
Spatial Contiguity	Learning from corresponding text and graphics is better when the corresponding text and graphics are presented near each other.
Temporal Contiguity	Learning from corresponding text and graphics is better when the corresponding text and graphics are presented simultaneously rather than consecutively
Coherence	Learning is better when there is no superfluous text, graphics, or sound.
Modality	Learning is better with animation and narration than from animation and on-screen text.
Redundancy	Learning is better with animation and narration than from animation, narration, and on-screen text.
Individual Differences	The effects from these principles are stronger for low-knowledge and high-spatial learners than for high-knowledge and low-spatial learners.

Table 2: Multimedia effectiveness.
Courtesy of Clark and Mayer [2007]

The cognitive (learning through understanding) theory of multimedia learning, demonstrated that learners are better able to transfer their learning given multimodal instruction Mayer [2001]. Students learned better given multimedia with animation and narration, than from animation and text-based materials. In order words, they were better when it came to applying what recently learned after receiving multimedia rather than only visual instruction. Mayer [2001] calls this the Modality principle. If verbal information is encoded auditory it reduces the cognitive load of the learner and they are better able to handle that incoming information. However, adding interesting but extraneous material (i.e. material that may be related to the topic but does not directly support the educational goal of the task in question) could potentially cause the learner to use minimal cognitive resources on less important processing, therefore leaving less cognitive capacity for important processing, thus referring to the redundancy principle. Stick to the relevant, and keep the learning material focused on the objective instead of adding supplementary information. Research suggests keeping the additional information at the end, or separated in case the learner wish to explore more SEG Research [2008].

Dubois and Vial [2000] investigated how different multimedia presentation methods affect the learning of foreign language vocabulary. Adding an image to a sound and text presentation can be of noteworthy assistance to learners, but only under certain conditions, as indicated by their research. Their findings pointed to that the use of images in itself was not advantageous for later recall, but the association links that the students created while processing the information. The conclusion came to "adding another medium does not turn out to be more productive if the added information is ineffective in facilitating in-depth processing of the information".

Human factors researcher Najjar [1998] looked at existing research on how multimedia affects learning and found that these practices could be beneficial for learning effectiveness:

- Select media with the best characteristics for communicating the particular type of information – for example, graphics help people retain spatial information better than text.

- Use multimedia specifically to support, relate to, or extend learning, not just as embellishment.

- Present media elements together so that they support each other.

- Use multimedia that effectively employs verbal and visual processing channels to help learners integrate content with prior knowledge (this is called elaborative processing).

- Allow learners to control, manipulate, and explore positively impacts learning and elaborative processing.

- Use familiar metaphors and analogies, feedback, and personalization to augment motivation.

- Encourage learners to actively process and integrate rather than receive passively.

- Match assessments media to presentation of information media.

So how can we design good multimedia applications? The purpose of multimedia is not to incorporate multiple media, loaded with fancy effects, or add complexity, which as mentioned earlier, can undermine the learning goal. Use each medium to its advantage and to combine media so that the potential learning is greater and more effective than using single elements alone. This also represents the goals from UDL in Section 2.4

Figure 3 summarizes the multimedia learning principles from SEG Research [2008] and are similar to points presented above by Najjar [1998].
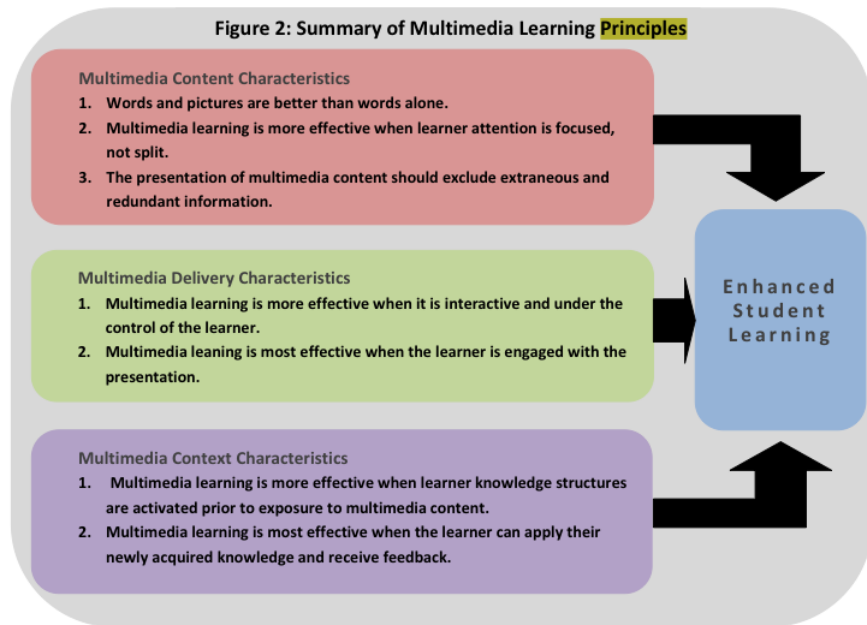
Figure 3: Multimedia Learning Principles
Image Courtesy of SEG Research [2008]

The contribution that Connolly and Stansfield [2006] believe such technologies can make to overcome the difficulties in teaching are :

- providing a challenging and complex real-world environment within which to apply their theoretical knowledge.

- overcoming difficulties in dealing with ambiguity and vagueness.

- developing and applying transferable analytical and problem-solving skills.

- developing self confidence and increased motivation.

- allowing students time to reflect upon their practice.

With the above multimedia design principles and the teaching difficulties technology multimedia learning can overcome, one should take in consideration the importance of presenting information in different ways. Some students may prefer to learn from print, while others may favor a visual presentation of information or someone teaching you

the basics, like a mentoring role. Students who prefer visual and auditory, especially combined, is certain to benefit extra from multimedia learning.

2.8.1 *Our Choice*

Push Pop Press released in April 2011 the book Our Choice Push Pop Press [2011 (accessed June 6, 2011]. It is an app that works on every iOS device and is a new digital reading experience. The 400-page book becomes a portal to video, photo, and information graphics and demonstrates how powerful an aid technology can be to the cause of knowledge.

In Our Choice, as pictured in Figure 4, photos can be enlarged with a pinch or folded out twice their size, while some include audio of Al Gore explaining what you see. The user can tap the corner of any photo to see where on the planet it was taken. Slivers of audio and clips of video are not just glued on as a demonstration of technical glitz. They provide genuine expansion of the text. In many cases, both brief videos and images are used to explain the situation in a way that would be difficult to match with any number of well-chosen words. But perhaps most impressive are the charts and data, which can be played with in ways that make the info vastly more approachable than it might be in a static form. It allows the user to slide his or her finger along the screen to see the huge jump in the world population since the beginning of humanity, as well as the concurrent rise in carbon emissions. Another, making use of the accelerometer in the iPad, lets the user blow into the microphone to see the blades of a wind turbine turn, and beads of electricity flow into a house. The potential for this technology in learning is very promising.

This book embrace many of the principles listed by Najjar [1998] and Mayer [2001]. The user can manipulate, explore and media elements are presented in a non-intrusive way. One can choose to read the book throughout, without paying attention to multimedia features, or opt in to further investigater. One pinch out brings the user back to the overview, which displays an overview of the chapter pages. Some features are missing if this would be considered a serious alternative for learners. It does not have the op-
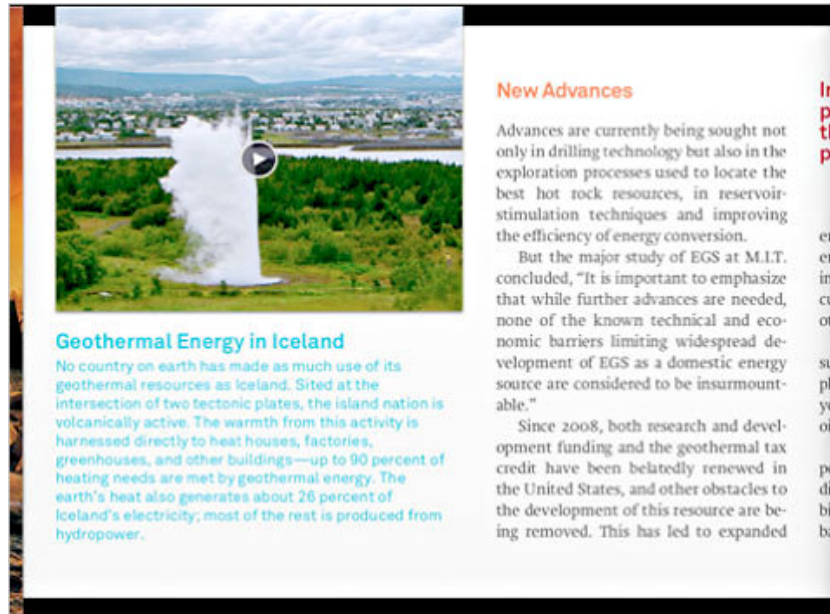
Figure 4: Our Choice
Image Courtesy of Push Pop Press [2011 (accessed June 6, 2011]

tion for selectable text, no search, no changing font size, no bookmarks, no notes/annotations, and no page numbers. However, these features are often looked as secondary features that are easier to add at a lager stage. One can consider Our Choice as a mere first draft, and could pave the way for increased attention to the future of books + technology.

2.9 MIND MAPS

Mind maps was first coined by Buzan [2011 (accessed June 3, 2011]. Mind maps is, by definition, a graphical method of taking notes. The visual basis of mind maps can help people distinguish words, ideas, and other keywords, normally with different colors and symbols. A mind map often starts out around a single keyword in the center, which then uses a tree branch format to which associated ideas, words and concepts are added around. Many who prefer to associate words with visual representations use mind maps. Mind maps is not a tool or app that is exclusive to the iPad in any way, and can be found in many different implementations. Even so, iPad touch interface and finger gestures is a fairly new technique for creating mind maps,

and we believe it might be found slightly more intuitive to use touch, and thus to replace pencils or mouse and keyboard on a computer which is the conventional of creating mind maps.

The effectiveness of learning with mind maps has been widely discussed, and Farrand et al. [2002] found that among a group of undergraduate students that *"the mind map technique has the potential for an important improvement in efficacy. With the mind map technique there is an estimated increase of 10% without any change in motivation, and an increase of 13% if there were such a change".* Farrand et al. [2002] found that the motivation in the self-selected study technique group was higher than that in the mind map group. A potential reason for this is explained by that there often is resistance to use memory strategies as study aids, especially among males, which have been reported reluctant to use many memory strategies and rather adopt more conventional techniques.

Evrekli et al. [2009] studied the effectiveness of using the mind maps study technique to improve factual recall from written information. Their study showed that *"Mind Mapping improved the long-term memory of factual information in their participants by 10%. However, before mind maps are generally adopted as a study technique, consideration has to be given towards ways of improving motivation amongst users."*

Mind maps was used in this project as a study aid tool, and is further introduced in Sections (3.6) and (5.2.1).

2.10 ICT IN NORWEGIAN SCHOOLS TODAY

Hatlevik et al. [2009] investigated students and teachers digital competence by looking at the use of and the general attitude towards use of ICT in elementary school and high schools in Norway. Typically, it is each teacher's own competence and workflow, together with unsystematic leadership in schools that is the bottleneck within schools in Norway today. Available ICT equipment is a requirement for learning and teaching with ICT, but it is not a sufficient premise for pedagogical and educative use of ICT. It is crucial that together with proper education and competence from teachers, the infrastructure are available and that schools and the teacher have developed and defined

learning goals. Hatlevik et al. [2009] reported that a motivated and competent teacher that also has support from the school board has far greater presumptions for using digital tools in teaching. Digital tools affect students' performance in school and his or her own digital competence when they are used in a systematic, professional and pedagogical way, the report concludes.

Institutional factors like separate classrooms and age-defined groupings can inhibit the use of technology in schools. Most of the students go through a continuous block of courses over the years. Each school day often consist of many different courses, and this time frame limits the opportunity to vary teaching activities, and demands more planning from the teacher to use ICT on a daily basis. The use of dedicated rooms also adds extra time to bring the whole class to the "computer room". It seems most of the time, institutional factors have not been considered when implementing new technology in school activities in Norway. Failure to integrate technology use into the required curriculum may result in technology being perceived as an instructional add-on Valdez [2005].

The main points for ICT in schools can be summarized into:

- ICT use in school should be at the students skill level, not the teacher. This implies the use of ICT should be creative, explorative, fearless, and not tied to what is "common practice".

- Teach students useful things that can only be learnt in school. Touch writing, personal information management strategies and skills, and expertise in holding presentations. Students maintain that schools should place priority on developing programs to teach keyboarding, computer, and Internet literacy skills Levin and Arafeh [2002]. How to insert and rotate pictures in a presentation program students often learn by themselves or from others.

- ICT in school is about content and access to all of it, and the possible learning outcome by using it.

- Sharing is caring. Modern technology today is blogging, Twitter, Skype, Dropbox and Google Docs to

name a few. It works on every platform and support teaching and collaboration.

Chizmar and Williams [2001] investigated the use of instructional technology techniques, and respondents identified the lack of time to learn as the most critical factor in adoption of Web-based instructional technology. Butler and Sellbom [2002] explains that not every faculty are innovators when it comes to technology. Many would prefer some help to learn such things as what tools to use for developing Web sites, or for editing graphics or digital video. Many campuses have programs to aid faculty. Butler and Sellbom [2002] asks this important question regarding for technological training in school: *"Are they the right ones, and how can faculty know?"*.

3

INTRODUCTION TO IPAD - PROJECT LAUNCH

This Chapter will describe the implementation of the primary empirical methods, describing the sequence of events relevant to the research questions posed in Section 1.4. The observer's role is to record group interactions and behaviors as objectively as possible using various qualitative inquiry tools as introduced in 1.5. Detailed and accurate descriptions of the observations including relevant context information are required to communicate and describe how the different incidents emerged and happened.

The goal of the observations and focus group meetings was to observe and obtain feedback to how the students and teachers used the iPad in their daily classroom routine. This chapter will describe the observations, focus group meetings and other relevant information from the start to one month in the project. Relevant information past this time is further introduced in Chapters 4 and 5.

3.1 PROJECT DESCRIPTION

This project is brought together by the Sør-Trøndelag County Authority, where I was allowed to function as a technical advisor and observer and represent the Norwegian University of Science and Technology. The goal of the project is to investigate the advantages and drawbacks of using an iPad in a classroom. This report and thesis will serve as a project report and discussion concerning the project goal.

The Vocational Studies Program focused on health secretary was chosen to be the pilot group because of the relatively small size of the cohort and the broad course range of the program. The total number of students in the Vocational Studies Program is ten. Additional five students participating in Newer History was included in the project. Average age among the students was 18. The following academic courses was part of the project:

- Norwegian

- Newer History

- Communication and Interaction

- Health Promoting Work

- Professional Practice Theory

The broad range of academic courses and administrative roles represented in the pilot group, and the fact that staff and students had the iPads permanently, ensured that the iPads was tested extensively and in a variety of situations by twenty individuals. The interviews of participating students and staff resulted extensive material to be discussed later in this thesis.

3.2 FIRST AND SECOND MEETING WITH THE TEACHERS

The 5 teachers and IT operations manager from the school, which are participants from the administrative side of the project, was handed the iPads together with a gift card worth 500 NOK on January 19th. Right after everyone had received their own iPad, a brief introductory session was held and involved basics like how to connect it to the computer and how to create an iTunes account. It left much to be desired, but the idea was to simply hand out the iPads and aid in creating an iTunes account and not to bombard them with an intense and thorough introduction session as we had only just received the iPads ourselves. This it resulted in to let the teachers play with it first and wait a week to address further questions and to begin a more in-depth introduction.

The group of teachers is all females, varying in age and in technological know-how.

January 26th was the second meeting where everything came more into place and the teachers have had the time to explore on their own. To say the least, I was flooded with all sorts of questions.

To summarize the topics that was discussed:

- File storage

- App Store

- Basic navigation

The concept of transferring files to the iPad was confusing for many of the users at first. If one wishes to transfer something *directly* to the iPad without the primary computer nearby, there is no simple, ordinary strategy to tackle this. The process of transferring files through iTunes was explained, and how everything you wish to transfer to the iPad has to be transferred through either iTunes, Dropbox or by e-mail. Everything the other way around, that is created on the iPad is stored on the iPad, can easily be transferred to a computer if desired.

The concept of non-existent file system is confusing, and definitely will need to be repeated. It was explained that everything is stored inside every app, once you close the app it is automatically saved and stored inside the app. If you open it again, it will be right there. This created some nodding, but it was recognized that this would eventually require time to adjust to. Furthermore, how to delete files was explained. Deleting files demands user action as opposed to saving and storing files.

"How do I know what to search for? The number of apps are overwhelming" - Teacher

This is a known problem. Top Rated apps inside the App Store were demonstrated together with how you navigate the categories section. It was also suggested to search online for ideas, as the App Store is more or less focused on direct search and does not suggest apps that fit a "purpose" in any way. Questions like *"Do I search in Norwegian or English?"*, *"Should I only write one word or more in like a sentence?"*, were properly addressed in the means that App Store is mainly focused on English-based apps, and as previously mentioned the search function only works as a direct search and does not perform well with keywords.

"How do I get back to where I was earlier?" - Teacher

One interesting recurring behavior among the teachers, is when the user wanted to go back to start inside the App Store. The user did not use the back navigation button at first but rather pressed the Home button. The user would then be surprised when the App Store again was opened and found it to be at the exact same page as before the

Home button was pressed, which then lead to the user would either look for a back button or ask how it was possible to return to start.

Other noteworthy pieces of information from observation:

- Not all of the teachers' English skills are as proficient as one would expect. Simple popup notifications easily create confusion and basic tasks often demand more time spent than first expected.

- The lack of support and demand for mirroring the iPad screen to a projector has already revealed itself.

- One of the teachers had a slightly negative attitude towards the usability and kept expressing her frustration.

- The accustoming to a daily, frequent usage pattern could potentially be weeks with this rate of progress.

- In general, a positive atmosphere and excitement to what the iPad could potentially mean for their teaching.

3.3 PROJECT LAUNCH

Tuesday February 1st was the date when 15 students were given iPads for a whole semester. Everyone was instructed on beforehand to bring their laptops so setup would go as smooth as possible.

The initial introduction session of the iPad was given in a rough hour, and was focused on setting up AppleID accounts and performing their first sync together with their personal computer. Additionally a brief introduction of how to use the App Store, redeeming the gift cards, how the iPad store files and how to navigate around iOS. The introduction was very similar to how the iPad was first presented to the teachers. The necessity and imperativeness to project the whole iPad screen truly became apparent when you try to demonstrate how to navigate around the App Store in front of an audience of 15 people. My iPad has to be jailbroken in order to not waste unnecessary time running around demonstrating one-on-one.

The process of creating an AppleID through iTunes was confusing for some of the students, since the setup process

uses a mix of both Norwegian and English. The welcome message and terms and conditions are carefully displayed in Norwegian, but as soon as the user begins the AppleID creation process everything is in English. This lead to some confusion and different terms had to be explained.

Some of the students knew the basics of iOS from their iPhones or iPod Touches, and by the end of the introduction session the game Angry Birds was already downloaded on a handful of the devices. One student was curious if the iPad supported multi-touch gestures like four finger swipe like her Macintosh does, but was disappointed to hear that only the basic two-finger gestures like the pinch gesture was supported.

No major surprises presented themselves, as the students were busy exploring and somewhat overthrown by the media's attention.

3.3.1 *Launch aftermath*

The teachers and I met again the day after the launch to continue our discussion on basic troubleshooting and to further continue our quest to find interesting educational apps. Once the gift cards were activated, the group have really progressed in skills even by only one day. Observing how they discuss apps and miscellaneous problems displays a rapid incline in interest and skills developed. Two of the teachers had discovered Penultimate from the Top Paid list and found it easy to take notes with. The exploration of App Store is almost going by itself now, but some questions do occur but these are more leaned towards if I know if this is a good app or if I have any recommendations, and not regarding how they would search and find apps that fit their goal of purpose.

The majority of the teachers are aware of the multitasking bar, but have still not recognized it as feature worthy recognition. The normal behavior is to close an app and then look for the other app on the Home screen. As of right now, I choose to not "force" the use of the multitasking bar as it is not considered to be vital for their productivity or ease of use, and rather focus on answering questions, basic functionality of iOS and interesting apps to spike further interest. If one of them complained that switching between

apps is a time-consuming process at this stage, multitasking would have been introduced in more detail.

We needed to make a decision about a word processor, and it was narrowed down to two alternatives; Pages versus Quickoffice. Pages is the most popular word processor, and clearly is the best option if all you want to do is to write on the iPad itself. However, if you wish to present a presentation or constantly share files between people; Pages fails to meet these requirements. Dropbox integration was the frontmost reason why the decision landed on Quickoffice. One app, does Word processing, spreadsheets and presentations with Dropbox and Google Docs integration to name a few. The choice was straightforward.

An app for idea mapping has been requested, and both the requestee and I will look for a few alternatives and decide on one by next week.

A PDF version of the curriculum book for the history course will be available within the end of the week. As a secondary source for educative material in history I suggested Wikipanion, which is a free alternative for browsing Wikipedia with a better presentation than browsing the website and has the ability to bookmark articles.

The general consensus is that the iPad definitely have the potential to have a pedagogical and educational purpose, and they express their satisfaction of the iPad's battery life. This can be looked upon as a great start and there is an attitude towards to keep trying and explore further with the iPad.

3.3.2   *Overview of class observations after first week*

The first observations clearly pinpointed very different usage pattern among the students. Around a 1/3 of the students still keep their laptop open in the front of their desk, while the iPad is stationed closest. Some use it to play games, as while the lecture was ongoing the theme song from Angry Birds started playing from one of the iPads. One student demonstrated to me she had downloaded the NASA app and displayed interest in aerospace. Games are without a doubt the first stop for most of the students, as it is the most intriguing to begin with and use.

"It is easier for me to use the laptop, cause I have all my files on it". - Student

It is clearly a challenge to move all or to some extent the most important files to the students' iPad, but an introduction to Dropbox is planned in the forthcoming days.

An interesting observation is that most of the students was aware that the book for history course was now available as a PDF, unfortunately they had not realized the advantage and purpose of iBooks. The PDF was read straight inside Safari. The required tap to reveal the "Open in..." function had not been discovered. To read a substantially sized PDF file in Safari, is neither a pleasant experience nor the purpose of Safari. This was quickly corrected by instructing all the students to download iBooks and use the "Open in..."function.

Another observation is that the distance between teacher and student previously occupied by laptops, are now less apparent. It is easier for the teacher to catch the students' attention. One example was when the students were given a task to look up information about a previously viewed educational documentary. One student found an extensive and detailed article on Wikipedia, and in this situation the student handed the iPad over to the teacher, which then read the article out loud for the rest of the class.

Still, with only a week in it is evident that the students need more help and inspiration to exactly why the iPad can prove to be an aid in school, in addition to be a great device to surf the web and play games on.

3.4 SECOND WEEK AND LATER AND THE PROGRESS SO FAR

Presenting was brought up as one of the main topics during the weekly meeting among the teachers. One of teachers expressed her disappointment with presenting word documents. She thought it was only a matter of connecting the iPad with the VGA display adapter and the word document would be projected through Quickoffice. Presenting presentations through Quickoffice works fine, however a word document does not. I explained more in detail how the iPad projects very little from the start off, but there

are many apps you can use to present your documents. The app 2Screens was downloaded and we did a quick briefing. Another issue, with relevance to the previous one, discussed the procedure of constantly having to sending documents back and forth between apps. An example would be if a user would have to quickly make a small correction inside your document, and if the presentation app does not support Dropbox, it will require the user to go back to the app the document was produced in and then resend it back to the presentation appp, which results in two separate copies of the same document. One teacher asked me if I could jailbreak her iPad as well, as it would ease her work substantially. However, after I demonstrated 2Screens for her and illustrated how she could present her documents and even display web sites, jailbreaking was put on hold for the time being.

Quickoffice was brought up as it was some concern to the text editing features of the word processor. I explained the meaning of the name Quickoffice, as the first part of the app is called "Quick", and thus should be considered as so. I further explained the purpose of iPad as a word and text editor. The iPad is meant to be in the space between the computer and the phone, which entails it is not fit for serious word processing. Writing a draft, taking notes and similar tasks are solved very well on the iPad. However, creating a front page layout with table of contents, you might want to look elsewhere. It will most of the time only lead to finger fatigue and discomfort. This displays that iPad's area of use is to some extent still uncertain. The iPad is still a relatively fresh product, and new areas of use keeps appearing. This is a learning process.

Other notable subjects:

- iPad's always-on functionality highly appraised and there is a mutual agreement that it provides the internet one step closer. Many remarks on how they use it to surf the web on the couch during evenings.

- More cooperation among the teachers. Great willingness to present new skills and discoveries. They still need more suggestions of apps, some still have trouble finding relevant ones. *"There are so many apps out there, I don't know what to search for to find what I'm looking for". - Teacher*

- The free app neu.Annotate was introduced for PDF annotation and presentation with good results.

- The teacher that first displayed dissatisfaction with the iPad, did show more eagerness to learn this time, but still kept saying she needed a profound "reason" why she should use the iPad.

- It was agreed that in order to encourage increased use from the students, I and one of the teachers will do a more detailed walkthrough of the App Store, Quickoffice, PDF annotations and other tips and tricks for the class upcoming Friday.

3.4.1 *Thoughts After Two Weeks*

After over two weeks in it was time for a quick review session with the students to hear their thoughts and ideas of the project so far. This was done through a 5 minute review session after class and the teacher had left to let the students speak freely.

To summarize what was brought up during the 5 minutes:

- Things are progressing remarkably well I am told. The iPad is used for games, but also reading newspapers and preparation before class.

- The ones that also have their laptop open, use it only for Facebook and longer essay writing.

- Many of the students still find it awkward to write on the iPad. Mostly for short note taking.

- Fast app switching is cumbersome.

- In one class they have been told to write a complete essay, including a front page and table of contents. Students complain this cannot be done in Quickoffice, in which I agree and will bring it up in our next focus group session with the teachers. On a different note, it is positive that teachers make the students write on the iPad, as long as the task is within reach. Should produce interesting results.

- They keep exploring apps and filling up their Home screens.

- Mind Node is very welcomed for mind maps.

- I am increasingly worried the effect of zero e-mail access for the students and how it will affect the project.

Before the review session, I observed the class in the history lecture to take notes and finalize the questions I would ask for the review session.

Students' use of iPad has clearly increased to be the device to use while in class for most of the students. 1/3 of the class still have their laptop in the front of the desk solely for the purpose stated above. Annotating on the PDF is brought up, and the students demonstrate to each other how to use neu.Annotate since the majority of the students had already been introduced to this app last Friday. When addressed with the task of opening the history book PDF in neu.Annotate, the students faced a problem they were unsure how to handle. They already had stored the PDF inside iBooks, but iBooks does not have the functionality of sending PDFs to other apps. From the start of, they could have stored the PDF in their Dropbox folder, and then opened it from there. Problem is, Safari does not support the option to save to DropBox. Thus the inevitable question arose:

"But I have already downloaded it, do I have to do it again?! But it's already in iBooks! " -Student.

I instructed them to download it with Safari again, and then pick neu.Annotate in the "Open in..." menu, and was met with somewhat unenthusiastic silence.

When the students was instructed to work on a few assignments and use the iPad to write the answers on, a few interesting situations became apparent. The students found it demanding and disruptive to constantly switch between reading the book in iBooks, and then to go back and write in Quickoffice. Some still went back to the Home screen and then opened Quickoffice, which involved even another step back and forth. One student reported that Quickoffice had stopped working after switching back and forth between

iBooks several times, and I had to assist her to open the fast app switching bar and then close the app through there.

The mind maps app Mind Node is increasing in popularity. Some students chose to answer the presented assignments with mind maps instead of using Quickoffice.

Saving changes to files are still an uncertainty for some of the students, as some apps prompt the user to save their work. Mind Node saves everything inside the app, but I was regardless of this confronted with where they could save their mind maps and how to link it with Dropbox.

If access to Facebook would have been completely blocked on all Wi-Fi networks, I am confident, by students response and observation, that all of the students would not care to bring their laptops.

3.5 A MONTH LATER

After the above described first two weeks the project went into a more stable phase. The greatest hinders have been overcome, which resulted in less questions from both students and teachers and more exploration on their own. Below is an outline of the observed progress a month further into the project.

- Teachers report their excitement about some of the students are more active and prepared for class. The portrayed usefulness of iPad is more evident now.

- Mind Node (mind maps) works very well. Students find it easier to use it as a starting point in class and study aid.

- The use of Instapaper severely increased. In some classes the provided books does not supply enough information so both students and teachers look up scholarly articles and save them to Instapaper.

- Blocked content (YouTube, Mail) is problematic. Students are unsure if the iPad is the root of the problem or something else is to be blamed. Teachers frustrated and complaining this is nothing new and a common obstacle to their teaching even before the launch of the project.

- Presenting content is a continuous challenge.

- The use of laptops have decreased. I suggested to teachers to instruct students to only use laptops when necessary instead of it occupying desk space, as according to the action research plan.

- All of the curriculum books are now available in PDFs.

- Dropbox is widely used. Each student have their own folder and upload their assignments there, and the teachers correct and upload it back to Dropbox.

- Students are to spend two weeks working out in field at hospitals. Teachers came up with the idea of encouraging the students to take their iPads with them to report back to their teachers, and to use apps as scientific aids.

It is noteworthy of how the general consensus among the teachers is that overall class participation has slightly increased. Some teachers report more enthusiasm than others, and still are very cautious to the long-term effects as they also find that class participation varies from each time they have the class. They stay updated by reading online newspapers out loud in class.

"If you have access to information and educational material, the lower the threshold is to look up what you need to know for next class" - Teacher

Another matter brought up regarding class participation, is that a few of the students that before used to claim they was not technologically involved nor skilled, have found new interest in the iPad and demonstrates more will to explore.

Mind maps has grown very popular in use, and teachers explain that the students that choose to draw mind maps both are more engaged in class and in their work than before. One teacher claim the class is faster to begin working on assignments when they are provided with options in how to solve them. Students find it very easy and convenient to look up information off the internet, and then add it to the mind map. I was presented with a mind map that one student had created, and it was remarkably well detailed. Together with Instapaper, these are the two apps

that teachers find the most useful for class participation and engagement. In the course Professional Practice Theory, the curriculum book reportedly lacks or is short of detailed and comprehensive content, so they use internet to find articles and websites with additional information and then add them to Instapaper. Now that every course have the required books available as PDFs, this in addition to Instapaper gives the students access to all the required reading material straight on the iPad. Reportedly, the students no longer bring their textbooks to school, but choose to read on their iPad. They are actively doing more in class than before.

One teacher tries to explain the situation :
"This is an effect that both us and they are trying to figure out of this together. We share an experience, and this results in cohesion. We have a common denominator and that makes all of us more active".

The use of Dropbox is evolving as somewhat anticipated and hoped for, as student and teacher collaboration and file sharing are making progress. The teachers together made a quick walkthrough to how the students could create and share folders inside Dropbox, in order for them to easily grade and correct hand ins. This is apparently working very well, and they find it very hand to pick up delivered essays whenever desired.

The nuisance of blocked content is problematic. The students are unsure if the iPad is the heart of the problem, or if the problem lies elsewhere. This is both frustrating for the students and could create an attitude comparable to "this wouldn't have happened on my PC". Teachers claims this is nothing new and explains that they have always been troubled with network problems and inaccessible educational content.

"If they don't have access to all the functionalities, they won't comprehend all the advantages of using it. It is not always easy to continue schoolwork at home only because you have access to the functionality there. School is still school". - Teacher

Access to the learning management system Fronter has also proved troublesome. Limited or no access to published content is the foremost problem. Each course has its own

space within the students Fronter environment, and the teachers use this space to post lecture slides and notes and to update their students about recent changes.

Teachers are very involved in the project, as they keep exploring, interact together and find new uses for the iPad by themselves. When the students are to spend the two following weeks at a hospital as part of the vocational studies, teachers agreed they should bring their iPads with them to take notes and use medical apps to aid in their work. However, one teacher was somewhat hesitant to the extent the students would take advantage of the LabDx medical app, an app designed to assist with information to laboratory tests, as it is in English. Certain students have displayed insufficient English skills, but when confronted and asked to reflect on what the English word may translate to in Norwegian, they usually reason correctly. Further it has been problematic to find suitable anatomy apps that explain the body in a simple, illustrated manner. One teacher is somewhat surprised that she has been unable to find affordable apps that fulfill this need.

One teacher found the app ReelDirector, and demonstrated it in front of the focus group. It is a simple photo-to-movie app, where you add photos and make slideshow effects together with text captions. She thought it was a good idea that the students could use this app as a new creative approach to do presentations of their work and potentially result in more interest to work with school assignments.

3.6 APPS USED IN THE PROJECT

Which particular educational apps that was to be used broadly by everyone, was a continuous process nurtured by student and teacher demand and request. Presented here is the main four apps that was used by both teachers and students. While use may have varied from person to person, every student and teacher did try and use these apps from time to time. A list of the other apps that was downloaded and used can be found in Appendix A.

Writing, note taking and various office tasks was solved by Quickoffice and is pictured in Figure 5. Quickoffice is a 3-in-1 app, which features word processing, spreadsheets

and presentations. The reason why we chose Quickoffice instead of more popular Apple Pages, was explained in Section 3.3.1. In short, this was because of Dropbox support. Since we relied heavily on Dropbox support for assignment delivery and document sharing, especially since e-mail access is unfortunately blocked by the network administrators, we could not afford to pick an option that potentially could inhibit the users from sharing documents at all.

Quickoffice handled writing, note taking and word processing in general very well. The name Quickoffice is not to be mistaken; it is a quick, similar version of the very popular Microsoft Office suite. By this it does not support adding pictures, layout editing or advanced text formatting. Especially the lack of support for adding pictures, was not well received by some of the students that wanted to try to write extensive papers on their iPads.

QuickOffice's support for Dropbox proved successful, but not without a few shortcomings. Reportedly, copying files to other people's shared folders within Dropbox could results in various errors such as the file already existed. I myself was not able to reproduce this error.

One noted irregularity that I was able to reproduce was if the user would repeatedly switch between Quickoffice and another app, Quickoffice would at one time no longer open and only display a blank, black screen. In which case, a force quit of the app was the only solution.

In the history course we needed an app that made browsing Wikipedia more pleasurable and reader-friendly. We chose Wikipanion (free version) and it is pictured in Figure 6. It features a rich browser for display of Wikipedia entries. You can bookmark entries, but the most well-received feature was the table of contents browser features on the left side of the screen. This made it very easy to keep track of the reading, and effortless to skip forward to appealing sections.

"You can choose to read about his life and authorship. That's the app where everything comes at once and you pick what you want to read about" - Student

In one of the courses, Professional Practice Theory, the textbook had insufficient material concerning the course curriculum and consequently the teacher often used dif-
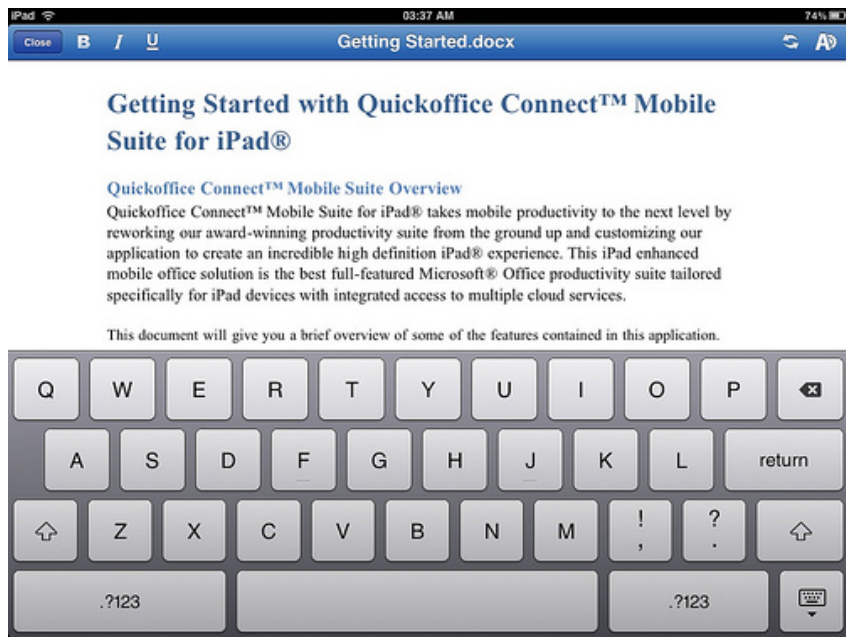
Figure 5: Quickoffice
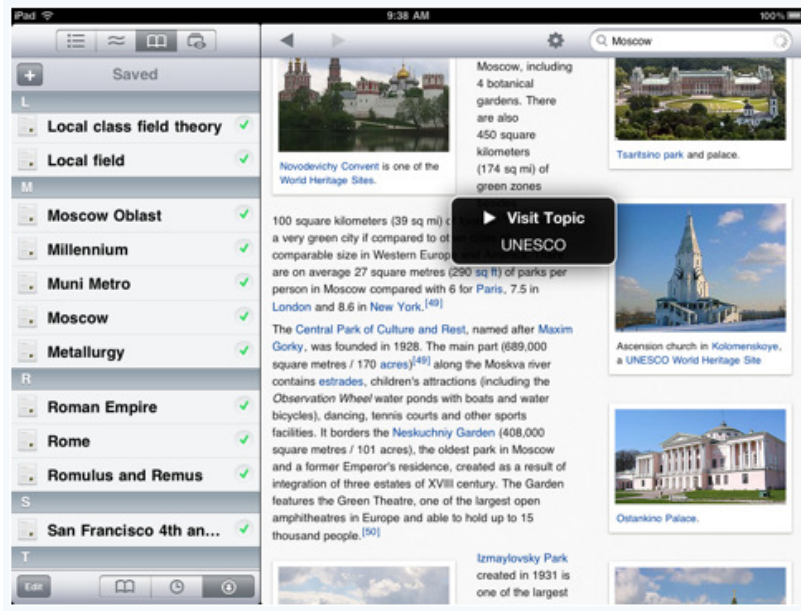Image Courtesy of Quickoffice Inc.

Figure 6: Wikipanion
Image Courtesy of Robert Chin

Figure 7: Instapaper
Image Courtesy of Instapaper, LLC

ferent websites and articles as extra material for course curriculum material. Because of this practice, Instapaper was suggested as a possible alternative in order for the students to always carry their articles and additional course material with them. This worked flawlessly, but the use varied greatly depending on how much additional material introduced in class. Instapaper is pictured in Figure 7.

Without exaggerating, the greatest success for class participation, engagement and overall satisfaction was MindNode. MindNode is a mind map drawing app, pictured in Figure 8, that enables the user to easily create and edit mind maps. Both new users to the concept of drawing mind maps and the ones who used to draw on paper preferred using MindNode. The ability to edit and move around on branches and to print out was said to be one of the key factors to why it was opted for instead of drawing on paper. Students found it to be a great alternative for taking notes, solving tasks that required ideas and thoughts and other creative assignments. Its Dropbox integration also made delivering assignments uncomplicated.
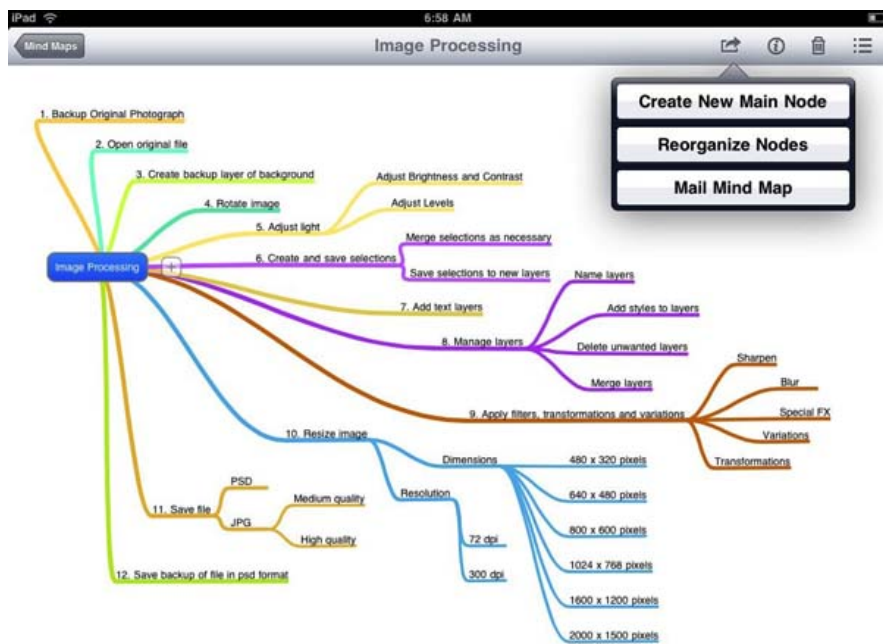
Figure 8: MindNode
Image Courtesy of Impressum

4

INTERVIEWS

This chapter describes the interviews conducted in the project. The interviews was conducted at the school with one student or teacher interviewed at a time.

4.1 INTERVIEWS WITH THE STUDENTS

The interviews focused on each students' experience with using the iPad in school. The purpose of the interviews was to see what kind of experiences, challenges, problems and other related thoughts and concerns the students faced with using the iPad in the classroom and at home. Each interview lasted on average 15 minutes.

A summary with the most thought relevant answers and quotations from the interviews are listed below.

- Compared to ordinary textbooks, what are the benefits of using an iPad?

    - Every single student preferred to bring the iPad to school to read from in class. However, it would change with each student if they preferred to read with the iPad when at home. Around 1/3 favored the iPad at all times, some preferred to mix depending if they would read for an extended period of time which in case some reported they would develop eye fatigue, and the rest opted for textbooks when at home.

    - The convenience of having all their books on the iPad made sure they could always pick up their reading whenever they felt like.

    - *"You don't need to bring your textbooks any longer. Very convenient. That's its greatest feature really". - Student*

- How do you feel the reading experience is on the iPad? For example for an extended period of time.

- – This question provided several mixed answers. Some preferred to read on the iPad and found no problems with the reading experience. Some complained that it required a lot of zooming back and forth, page numbers differed from the textbook and found it demanding if they wanted to swipe backwards, forwards and overall navigation was deemed confusing.

    - – *"You sit and skip pages, then all of a sudden the text gets big and small and back and forth"* - *Student*

    - – *"My eyes become tired, but then again it is probably just a matter of habit"* - *Student*

- How would you describe the access to learning content (books, wikipedia) is now, compared to before?

    - – Most of the students found it comparatively easy to access content in class. Opinions on whether the iPad provided the internet "closer" to the student was however divided.

    - – *" If you search for topics the teacher or yourself are unsure about, it works very fast. It's genius."* - *Student*

    - – *" I've used it but I prefer to use my laptop. It's faster"* - *Student*

    - – *" It much easier. It's very fast to look things up. Compared to my laptop. It's up and running at once"* - *Student*

    - – *" I use Wikipanion, it makes it very easy to find what you are looking for"* - *Student*

    - – *" It's very convenient. You're on the internet all the time. I really like that"* - *Student*

    - – As it can be readily confirmed by the quotations above, there exist several different conceptions to how accessing content is now than before. Additional content has undoubtedly been made more accessible, but students' opinion differ if the iPad is better for such tasks.

- Do you find yourself searching more actively for information regarding school topics than before?

- – This question proved difficult to answer for many of the students. Often when one search for information it is almost done subconsciously, and therefore it can be tough to tell if one do it more often or not.

  – *" You do, cause you have it right there. Otherwise you will have to go to the library and use a computer that takes 10 minutes. I don't normally bring my computer" -Student*

  – *" No, I usually bring my laptop anyways" - Student*

  – *" No, I find it easier to use my laptop. It get's too tedious [with the iPad]" - Student*

  – *" Yes, at school at least [as in more actively searching for information]" - Student*

  – *" Sometimes. I don't know. Yes, I think so.." - Student*

  – This was meant to try to analyze if the iPad enticed the students to explore more about topics in school, since apps like Wikipanion presents the information in a slightly different matter compared to textbooks. This came down to each student's own interest in the different courses and their willingness to investigate further. Apart from this, it does not appear that the iPad has noticeably made the students search more actively for information regarding topics introduced in school.

- Do you feel your motivation towards school work has changed since using the iPad? If yes, how? What is the factor that makes it more compelling to use?

  – Most of the students usually started with a slight hesitation and then concluded that their motivation had not changed. However, after a few questions later in the interview their opinion often changed once they realized how the different apps could make it easier for them to start working in class.

  – One student explained: *" Perhaps in Norwegian my work is a little better. Because you can look up things that isn't explained in the book. My teacher does this thing where he writes down a number of*

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keywords and then explains each one of them. If the rate of progress is too fast, or I was absent it is very easy for me to simply write down the keywords and then look them up and I find everything."

– *" Yes, or maybe only in the beginning. At first when we got it, it was all 'woo' and then it was a little motivating to be a school. But it quickly faded, at least that's what I think" - Student*

– One other student also at first claimed her motivation had not changed, but when asked if she used MindNode to make mind maps she responded yes and thought it was *"genius".* I then followed up with asking if mind maps had helped her to learn, or in a way increased her motivation since this was a different way of solving tasks than she had previously done and could have made it easier to take notes? She then responded *: " Yes, absolutely!"*

– *" Yes, it's easier to pick up than dealing with several books. You get everything in one device. I enjoy making mind maps. They are way more fun to create than on paper, since you can move them around and edit them thy way you like" - Student*

– Another student was also asked about MindNode in which she replied *" Yes, it's very clear. In such ways I have become more motivated to take notes during class".*

– *" Yes, it does. It makes it way easier. We had to write logs when we was in field placement. Then it was much easier to write your log on the iPad right at once, and turn it in at the same time. If I didn't have it, I would have had to write it on paper, then write it again on the computer once I got home. Then I would have ended up using 5 hours instead of only 2! " - Student*

– *" Yes, I like it very much [MindNode]. I don't know if my motivation has improved, but I like the fact that I have everything stored in one place. I gives me an overview of things.".* I then followed up with: When it comes to have more alternatives to solve tasks with, in respect to MindNode, may that

help contribute to that you in fact start working sooner and faster? Her answer : *"Yes"*.

– It is apparent that at first most of the students does not feel that the iPad has helped their motivation towards school and their class engagement. In spite of this, later in the interviews most of the students genuinely loved to make mind maps and explained how it has helped them to pick up note taking in a different matter than before. It simply did not occur to them that mind maps and in some cases the fact that they always carried their books with them, increased their motivation to take notes, solve tasks and made reading more accessible and a less demanding task to start with.

- How would you compare iPad versus a traditional laptop?

    – The answers here varied greatly depending on which tasks it entailed. For the most part all of the students said they preferred their laptop when it came to producing longer texts. This is as expected, because iPad is neither meant to be the device of choice for producing longer essays and other substantial material.

    – *" It's heavy to carry around [laptop]. At home I use it. Because it just sits there. But I think it's heavy and a little difficult to use. It's a lot easier with the iPad"* - *Student*

    – *" Yes, it's way easier to surf the web with. But I still think my laptop is more convenient. I also think it a lot faster to write on it. It is very easy to misspell on the iPad, because it keeps autocorrecting things here and there. "* - *Student*

    – *" It is easier to pick up if you want something done quickly. The laptop is better to write on. If I want to read something, then it's better [iPad]".* So if you want to produce anything, you use the laptop? *"Yes".* But if you want to consume anything, you use the iPad? *"Yes. To read with I think it's really great. Really great. But that's also it"* - *Student*

– *" I think it's better with a laptop. For instance, when I want to write something while I read I have to go back and forth between iBooks and Quickoffice. I don't need to do that with the laptop."* I then ask how it is concerning to pay attention in class. Do you think it is easier to just switch to something else? *" I believe I do pay more attention in class [with the iPad]".* So it's easier to not do several things at once as it is with a laptop? *" No".* Do you think that helps you to pay attention? *" Yes". - Student*

– *" Not sure. On my laptop I feel I have a more control. You have folders and such. Everything is stored in so many different places [iPad]."* When asked about multitasking and one app at a time: *" You don't have to worry about interruptions. That's very nice. But it's significantly more difficult to write an essay with it". - Student*

– This is the general consensus when the iPad is compared to a traditional laptop: iPad is for consumption, laptop is for writing. This is not unexpected. Very few prefer to take notes using Quickoffice or other notebook apps. Only two students preferred to take notes using the iPad. These was also the two that had invested the most time of using the iPad on general basis. It is noteworthy how many of the students that expressed they still missed a file system. They lacked "control", and found it confusing where their files was stored.

• Did you experience any problems? If yes, what kind of problems? Software or language difficulties?

– Very few reported any problems. There was only once incident of hardware failure, where the student's iPad suddenly stopped charging and had to be replaced. Luckily, she had recently backed up her iPad so she was quickly back working. 3 respondents claimed Quickoffice did not "like" continuous switching between apps, i.e. iBooks and Quickoffice. After a while, it would only open with a black screen and a manual close of the app was needed.

- Two students reported about intermittent shut-downs without any warning.

- Dropbox seemed to have caused both joy and frustration. A few responded they never really understood the concept, while others claimed they loved once they fully understood how to use it and had connected it to all of their other devices. A common denominator for the ones that enjoyed using Dropbox, was their more frequent use of the iPad than the others.

- Quickoffice with its Dropbox integration proved to be troublesome for a couple of the students. Supposedly, uploading files to the teachers' shared folders inside Quickoffice could result in an error stating the file already existed. This was solved by creating another folder and uploading to this instead.

- English was unanimously claimed to have not been the source of any problems. Except for one argued that English proved a little difficult when using medical apps, as terms and scientific words can differ.

- Did you encounter any problems with accessing content?

  - It was broad concurrence of both YouTube, e-mail and video content problems from the students. Seldom were they able to watch videos from news sites, though this could have been a combination of YouTube content being blocked and the absence of Flash player. E-mail was as expected one of the problems that left the students wanting more. Since external e-mail servers was blocked on the school network, it had proved tedious and uninspiring for the students to have to wait to get home before they could exhange documents with each other and the teachers.

  - Only two reported problems with the LMS Fronter and their failure to upload files. It can appear like the teachers did a good job of applying Dropbox and submitting files through it instead.

- Any suggestions to certain aspects that could have been done differently, which could have led it to be more appealing to use? Interactive books, better language support, accessing content etc.

    – The majority had trouble at first to think of suggestions that would make the iPad more appealing to use.

    – Two students missed the opportunity to write on a physical keyboard, and would desire one at a later time. Perhaps when they would purchase their own iPad's as I was told.

    – Once specifically asked if more interactive books, with audio and video used as an example, every single one except one responded that it would definitely help their motivation. Especially emphasized was when they would become tired of reading, they would be able to watch a movie instead. I was informed that in history, there exists a website that comes along with the curriculum book. The problem is that it required the students to "do the effort" of visiting the site of their own free will, and thus it was not "accessible" enough. Only when specifically told to watch selected videos on that website, they would visit it. I was evident to me that unless additional material was accessible within a few user steps, it simply would not be used.

    – As excerpted from the question where they compared the iPad versus the traditional laptop, the lack of a complete file system gave me the impression that the students requested more control. They felt like they did not always know where to look. This could be a consequence from lacking e-mail access, and documents would be "stuck" within one app.

    – One requested a video camera and camera for it to be used for school assignments, which would give her the ability to take pictures and include them in written assignments and presentations.

    – One expressed her frustration of the limitation of the PDF format. She felt it lacked logic by how

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PDFs was presented, and how she constantly had to zoom and pan around for her to be able to read pleasantly.

– More windows. One student requested the ability to have a website in one side of the screen, and Quickoffice in the other for her to be able to take notes and read at the same time. She felt the constant switching between apps was irksome at best.

• Did you purchase apps or music yourself? Perhaps you can give a few examples.

– Unsurprisingly, Angry Birds was brought up in every interview but one. It was obvious that in their spare time the students had focused on downloading games, whereas most of them was free. One student had purchased a few school apps, one named "Felleskatalogen" which is a pharmaceutical app which describes various drugs.

– One student claimed she did not care much about games that much, but rather enjoy reading magazines and had purchased magazines like Elle and Vogue. Both of them are written in English. She preferred reading them on her iPad in view of the fact that she found it easier to carry around and more affordable.

• Pros and cons in general? Any final thoughts on iPad?

– In its entirety, the most positive aspect or feature mentioned of the iPad mentioned throughout in every interview would be: portability. Everyone thought iPad's portability was its greatest strength on every level.

  * *"It's very easy to carry around" - Student*

  * *"You don't have to carry your books around, and you can bring it everywhere" - Student*

  * *"It's very practical, meaning if you go to a lecture it is very easy to take notes on it because you don't have the large screen in your way" - Student*

* *"I didn't picture it to be as easy as it was" - [Regarding using the iPad on a daily basis]. - Student*

– Besides its portability, other aspects arguing in its favor was MindNode, battery time and fewer opportunities to easily become distracted. One student also commented on how she enjoyed listening to music while working in case it was too much noise in the classroom.

– Flash support, awkward file system, multitasking and the time consuming app switching was mentioned as negative aspects.

• How do you feel about the project?

– Concerning the project's implementation, in the beginning of the project many of the students responded they desired more training in using the iPad and its apps. Many felt a lot of apps was "thrown" at them, and occasionally a week later a new app would come to replace the previous one and thus a lot of unnecessary time was used with a try and fail-approach. Though the class received training in basic iOS functionality, Quickoffice and Wikipanion they still felt it was insufficient. It was brought to my attention that if the project had been launched in the beginning of the school year (August), more time would have been allocated in training and they felt positive it could have stimulated in more use of the iPad.

* *"I think it would have been easier if we would have had it from the start. To begin with, I don't think I would have started using my laptop if so" - Student*

* *"We should have received more training in the beginning. Because I feel like it's almost been like we've downloaded apps and then had to learn it by ourselves" - Student*

* *"I don't know, in a way I feel like there isn't that much of a difference between it and the PC really. Except for the books." - Student*

– The notion about the teachers performance and encouragement throughout the project, was overall very positive. One teacher did excel in engagement and encouragement and it was apparent she had a positive influence on the students as well.

4.2 INTERVIEWS WITH THE TEACHERS

The interviews focused on each teacher's experience with using the iPad in school. The purpose of the interviews was to see what kind of experiences, challenges, problems and other related thoughts and concerns with using the iPad in the classroom and at home. Each interview lasted on average 15 minutes.

An summary of the most thought relevant answers and quotations from the interviews are listed below.

- Do you believe the integration of an e-reader was an enhancement or detraction to the academic experience?

    - This question focused on how the iPad functioned as a reading device, and in which case it was an advantage to have all the books stored in one device.

    - Altogether the teachers found reading on the iPad to be very positive. Its portability was highly appraised, together with its always-on functionality. The perceived usefulness of bringing the iPad to school was clearly noticed by most of the teachers, as especially in history the paper book is relatively heavy.

    - *"Students can no longer say they didn't bring their books!" - Teacher*

    - *"As a reading device I find it to be very good. It's a matter of practicality. You have everything in one place" - Teacher*

- How was the iPad used among students and faculty? How was specific apps used for academic purposes and what best practices emerged?

- Two apps was brought up in every interview; MindNode and Instapaper. Apparently students enjoyed having the curriculum "instantly" in front of them. According to one teacher, MindNode made it easier for the students to work with their notes in the way it was presented. It was referred to as another way of practice what was taught in class, and a good of number of students responded well to this.

- Dropbox was used to give instant feedback to turn ins. Compared to the learning management system Fronter, it did not require as many steps.

- Reportedly it worked very well to take absence with using the SkoleArena portal.

- *"We read newspapers aloud in the classroom. We have kept ourselves informed with what is going on in the Middle East. So it has made us more up to date than before" - Teacher*

- *"The curriculum book in Professional Practice Theory is not thorough enough. But we download articles using Instapaper. I think it is magnificent. You can organize the articles in folders and you get the chapters and different courses grouped together. I think it works very well" - Teacher*

- Was the integration of the iPad an enhancement to the academic experience? Do you believe the students felt the integration of the iPad caused them to put forth more effort and spend more time working on the course?

  - Most had trouble answering this. They could not right away explain if the iPad was a significant improvement to the students' academic performance. They all requested more time, and would have preferred if they were handed the iPad for the whole year instead of a semester.

  - *"It's a new way of acquiring information. Everything is instant and how you interact with it. I think many have thought it was easier than compared if they would have to do it on a normal computer" - Teacher*

  - *" I think maybe they've read more"- Teacher*

– In general the teachers was very cautious to identify the iPad as legitimate academic enhancement, and requested more time to explore apps and advantages.

- Did you notice any change among students in engagement, motivation or creativity? If yes, can you provide examples?

    – *"Students need to get to know the iPad as a tool. Before they got accustomed to it most of them didn't see it as an enhancement. But then many of them did learn how to use it and that is when you get to see the positive effects it can have"* - Teacher

    – *"Yes, I think I can tell there is more engagement in class. At least about half of the class I have noticed increased motivation in class. It makes communication with the students easier."*

    – *"MindNode made them very creative. I believe it helped them study"* - Teacher

    – *"I believe they are more motivated now. I cannot explicitly tell it is because of the iPad. It might because it is the end of the semester and I have to grade them. They have absolutely been more motivated, but it is hard to pinpoint the exact reason why"* - Teacher

    – The teachers did seem to believe the students had displayed increased motivation and engagement in class. Although only at a certain level. It is difficult to point out what and how the iPad has increased engagement in class. Many believed it was a combination of a lot of different aspects, and taken that they have only had the iPads for 5 months it is perfectly understandable it is difficult to explain exactly how the iPad has helped class participation.

- Do you believe apps like Wikipanion, Instapaper and MindNode, together with iPads portability can increase students motivation and stimulate creativity?

    – *"You have everything in one place and it doesn't get separated. I think that is a benefit. If they release a book made for the iPad, with pictures and interactivity*

in addition to the ability to annotate directly inside the book or take notes in the margin, then I think this can be really great" - Teacher

– *"Using Dropbox they could share their mind maps with the rest of the class and thus share their knowledge in particular courses" - Teacher*

– *"They did get very creative [MindNode]. I believe it has helped them. And that it is very easy to carry around" - Teacher*

– *"Yes, I think so. And if I as a teacher become better at using it myself" - Teacher*

– *"I believe it can yes. I heard about a school using Facebook. That sounds very interesting. To give feedback to each other. How your writing are for example. I haven't found an app for that [...] I would very much like a solution that enabled the students to talk more together In a way that permitted them to write things and others could comment on it. Kind of like Facebook. A collaboration tool. It doesn't have to be Facebook, but an app for something like this. They can share their mind maps and how they would solve problem" - Teacher*

– Especially the last quote here is interesting. Teachers want to reach out more to their students outside the classroom. They are not satisfied with the current solution provided by the LMS , as it requires too many user steps for each task and requires separate login. It is simple to disintegrated with everything else.

– All responded with a firm yes regarding increased motivation, although most of the teachers expressed that a few features lacked but was seemingly confident that these issues would be fixed in a matter of short time as they saw the iPad only was in its first product cycle.

• Other stories? Did you notice any change in their behavior? What do you think about the distance to each student?

– *"As a general rule you shouldn't have too many things on your desk that can steal your attention. You bring*

up the laptop when you will write larger essays. The apps designed for writing doesn't have all the features I want. But it doesn't replace the laptop as a tool when you want to produce things. But that's perhaps not what it's meant for either" - Teacher

– *"A lot of the students are very competent. I learn from the students. I think it's important that they are confident and can show off their skills to others" - Teacher*

– *"I think it's a lot better to enter the class now. They're not hiding behind their laptop screens any longer. It's easier to reach out" - Teacher*

– Two teachers thought it was less trouble to reach out to their students now. As explained by *"You don't have the screen that separates us any longer"* unquestionably does bring the student back closer to the teacher's attention.

• Was there any need for more training, or was the provided training adequate?

– It is evident more sophisticated training was required. As expressed by one teacher we *"paved the way as we walked it"* and it demonstrates that learning and problems were handled by request and at the spur-of-the-moment type.

– An introduction course in a more systematic fashion over a few days was suggested. In addition to this, guidelines to what is to be expected of each teacher's competence would need to be defined.

– One teacher felt she fell slightly behind the rest of the group in the matter of skills, and this hindered her from keeping up the pace with the rest.

• What problems did you encounter?

– This question was meant to signify and bright light to the teacher's frustration concerning the network restrictions.

– As one teacher plainly expressed her frustration with all the restrictions that laid a solid damper on the project like this: *"I don't know if I want to*

keep doing this next year if there is an equal amount of trouble. I can only wish the dream situation where there are no restrictions what so ever. There have been so many constrains to what we could have achieved. And then it takes such a long time before we even get an answer to why it is so. It is so much bureaucracy. If you wanted to go read at an online forum to see what other teachers discussed about using the iPad, you couldn't access it because it was blocked. So if they aren't interested in doing anything about this I don't really see the point of doing this. Students encounter problems and I'm unable to help them. I think it clearly has put a solid limitation to how great this project could have been" - Teacher

  – *"I still had to bring my laptop to class. To project things" - Teacher*

  – *"You cannot upload files from your iPad. To combine it with LMS such as Fronter, that doesn't work. Then it is very many websites that require flash. But even that has changed even from when we got it as more and more sites has started to work now" - Teacher*

  – The quotes above displays the frustration among the teachers. It is without any doubt that this is a situation that cannot continue on the same path. Furthermore, the lack of functionality to support uploading files does hinder both students and teachers from using the LMS. This was solved by Dropbox, but also here did network restrictions offer some occasional difficulties.

  – *"Fronter performs well at some aspects. But they [students] usually don't want to login, click on the specific course, and then click on one folder followed by another. It is kind of old fashioned. They don't bother" - Teacher*

- Did the amount of paper and hand outs change during the project?

  – Two of the teachers responded yes. By this they had began sending e-mails out instead. In history the teacher used to xerox news articles and hand them out, now they use the iPad and read the

articles together. This together with Instapaper reduced the amount of distributed paper.

– The rest responded the amount of paper had not changed. The reason for this was because most of the information was distributed through the LMS instead.

DISCUSSION

In this chapter we revisit the research questions posed at the beginning of the paper in Section 1.4 and summarize the answers based on the insight gained throughout the project.

5.1 INTRODUCTION

Before we examine how the iPad performed in the classroom, we will first look at certain other topics in the project and what kind of age we are in and thus revisit some of the previous sections.

5.1.1 *So, Replacement or Transformation?*

The importance of transforming a process, and especially the importance of ICT in school was carefully discussed in Section 2.1. Unfortunately in this project, it was not realizable to perform a complete transformation of the teaching and learning process. The state governed school system is relatively rigid and consequently change is typically not a familiar word. Therefore, we were forced to use the replacement process in this project. Replacement frequently comes with boundaries, restrains and old habits, and so did we realize in this project. So we adapted, worked around many quirks, and we believe we did to an extent transform several processes that can be read about in the following sections.

5.1.2 *The Digital Age*

Today's K-12 students are very different from even their recently graduated peers. These students are digital natives, a term attributed to futurist Prensky [2001] to distinguish between those who have grown up with technology and those who have adapted to it. They live in a world where digital technology is part of the texture of their daily lives. They

have never known a world without technology. Technology is their native language and they expect to use technology in school.

"I think the reason that we use the Internet so well and that we know so many things about it is because when it happened, we was there. So, it's not like it is some foreign language that we have to learn. It is something that we know, and we can apply what we know to find more things and then learn." - High School Boy from Levin and Arafeh [2002]

So how did the teachers in this project perform? Did they also fall into the trench as most of them are not digital natives? Not at all. They did their best. To the extent we expected them to. Some excelled in their ways of teaching, providing the others with apps and how to teach using the iPad.

In projects like these, where something new is introduced, skepticism will appear. Sapp [2011 (accessed June 13, 2011] claims skepticism can be a significant barrier to adoption. Sometimes prevents or significantly delays the adoption of presumably good innovations or brings about unnecessary punishment of an industry. How did we tackle skepticism? By lowering the technical difficulty in the focus group sessions, and though this can in turn hinder the more technically skilled individuals it was thought necessary in order for the group to move forward altogether.

"I've used it the simplest way possible. I'm the school's oldest teacher. To me it wasn't as intuitive as the youth wants it to be" - Teacher

"I'm against everything that is new. I like it old fashioned" - Teacher

When faced with such skepticism it does bring an extra challenge to projects like these. We are trying something new, and when certain individuals resist change from the beginning, how can we achieve change together? This is a well known challenge and it will undoubtedly appear again, and this was also briefly discussed in Section 2.5. There are, however, different levels of skepticism and vast amounts of contrasting attitudes and beliefs about new technology. Realizing your own limitations and potential, given the short amount of training, and consequently using it at the preferred skill level is perfectly acceptable. To try

and accept possible failure is still better than to not try at all. How can teachers resist learning to use new tools that enhance their teaching, when they at the same time have to instruct and teach students new things every day? How can you teach and yet still resist learning yourself?

Trinity School in Melbourne had this to say about training and being new to the iPad:

"I think there will be substantial resistance from some staff to using them. This will be very difficult to overcome and will require careful and timely training. This [training] should be both one on one and group based and should be hands on - not just demonstrations of what is possible. I like many others learn best by doing, not by being told or shown. Training should begin ASAP." Jennings et al. [2011]

Weimer [2011 (accessed June 5, 2011] tries to explain resistance in learning and her own experiences:

1. Poor self-image as learners—If students do not think they can learn, they often resist efforts that seek to make them learn. These are students who, at the first hint of trouble, abandon even fledgling efforts. Any negative feedback just confirms what they already believe: they aren't smart enough; they will never be able to figure it out. *"Developing a strong self-image as a learner—regarding oneself as someone able to acquire new skills, knowledge, behaviors, and insights—is a crucial psychological underpinning to learning."* Brookfield [1990]

2. Fear of the unknown—Some students resist learning because they are afraid. Students like doing what they already know. They hold on to beliefs that have served them well, especially those passed on from parents. *"People committed to eternal verities can withstand years of dissonant experiences and mountains of contradictory evidence that call these [beliefs] into question."* Brookfield [1990]. For many students, the comfort and security of where they are causes them to resist going to new places, especially places where beliefs might be held more tentatively.

3. Disjunction between learning and teaching styles—Most teachers have experienced this: bright, capable students who resist what is happening in class. Once a student in my class said, with some passion, "I hate discussion!" "Why?" "I can't figure out how to take notes off a discussion. What are you supposed to write down?" He was an engineering major and talked often about how clear and organized the content was in his engineering courses. Content is configured differently across disciplines. Sometimes students resist when their preferred approach to learning is at odds with how the information is organized or is being presented.

4. Apparent irrelevance of the learning activity—Students resist learning when they don't see how or what an activity contributes to their efforts to learn. If it looks like busywork or a waste of time, students resist. Brookfield [1990] points out that this is particularly true when learners are paying for their education themselves.

5. Inappropriate level of required learning—Students get frustrated and angry when they can not understand the content. They object to unfamiliar language and the fast-paced delivery of complicated material. The frustration quickly becomes resistance. Brookfield [1990] also uses the example of teachers who transfer too much of the responsibility for learning to students too quickly. Students resist. The teacher is asking them to do what he or she is being paid to do.

Weimer [2011 (accessed June 5, 2011] list contains more examples, but the above examples illustrate a variety of sources that can lead to resistance to learning. As pointed out in the list, these issues are not easy and should not be expected to be easy to overcome. These issues should be looked upon something to work towards to contain or mitigate its effects. For learners without confidence who are afraid of new knowledge, it helps to create learning situations in which they can taste some success early on.

In Chapter 4, one teacher explained her IT-skills was subpar to many of the students. By realizing this she decided to let the students teach her instead. She also suggested

the idea of allowing the students walk around in the city to take pictures of statues and to look up relevant information on Wikipedia, very similar to the approach by Price et al. [2003] explained in Section 2.6.

Green and Hannon [2007] suggests reverse IT lessons. A problem with learning in class is that shortly after class is over, much of the material is already forgotten. Students should be encouraged to act as facilitators or guides in ICT, and encourage them to gain more confidence with the technology they are already using. Given children's confidence with technology, incorporating reverse IT lessons would align the classroom to the outside world.

The current model of ICT lessons often fails to acknowledge students expertise in the use of digital devices. Especially with the iOS, most students already know how to use and interact with, and this can be put to further use in the classroom by letting students take more control in explaining the use of apps and miscellaneous IT topics.

5.1.3 *Revisiting Mental Models*

In Section 2.5 the theory of mental models was explained and how it can help us understand why people act the way they do, and to pinpoint issues and to use these to suggest steps to how the user experience can be enhanced. During our testing we witnessed many accidental touches; many users was lost within an app because they touched something that they did not mean to. Low discoverability, with active areas that did not look touchable was a hindrance in the beginning of the project, before more of the users became accustomed to overall design layout of the iPad.

Budiu and Nielsen [2010] did a usability review of many popular apps, mostly magazines, and found many repeated user mistakes or misunderstandings of the user interface. Below are excerpts from the article together with our own experiences noted during the project:

- Lack of Affordances: Where Can I Tap?

    - Many applications assume that users will know where they can tap and do not take the trouble to build perceived affordances for the target areas. In many situations, however, they have to touch the screen repeatedly in order to initiate an action.

In other cases, the controls are invisible and users need to discover them by first tapping the screen or a specific part of the screen.

– This is a problem we also recognized. In the beginning of the project, students did not know how to transfer PDFs from Safari to iBooks, and did not discover the at first invisible menu, which enables the user to use the "Open in" function, that only appears after a tap inside Safari when viewing PDF documents.

• Getting Lost in an Application

– It is easy to tap something accidentally on the iPad, and how confused users are when it happens. Many apps do not have a Back button to allow users to recover reliably from a mistake. Besides the Back button, though, there are other navigation tools that people miss from the Web.

– This became clear to us that many users failed to register back buttons usually placed in the upper left corner. At first teachers had trouble locating in when browsing the App Store, and instead chose to press the Home button when the intention was to go back to start. When opening the App Store again, the user, which is the teacher in this case, would be surprised that the app was still in the same place. This required the user to look around until the back button was discovered.

– Other apps use pop-up menus when for example are adjusting settings. When delving deeper into the menus, which is normally displayed as you move further to the right inside the menu, buttons are used that only resembles a Back button. However, they do not explicitly say Back but often have the name of the previous menu the user came from. As many users do not automatically remember where they navigated from, and only wish to "go back" this creates some inconsistency.

• Gestures That Are Too Complex and Memory for Gestures

– The gestures that most people use naturally on the iPad are tapping and dragging. Flicking through pages seems to be easily discovered in a display that has a good horizontal scrolling affordance. But other single-finger gestures such as double tapping, or touching and holding are less familiar. In addition to this, using many gestures can confuse people: they are likely to forget which gesture they are supposed to use for what feature, and memories for different gestures often end up interfering with each other.

– For instance some apps, like Mail, rely on the swipe gesture to delete e-mails displayed in a list. Other apps, in this case Instapaper, requires the user to first select which article to delete, then tap the Trash can icon. Surprisingly, after pressing the Trash can icon it says Archive instead of Delete. After selecting Archive, it requires the user to perform another step by opening the Archive folder and delete the article from there.

The above listed examples are important reasons why most people will need practice and training in both using iOS' basic functions and navigation inside apps. People's mental models are used to focus their attention on what they will select or click, as the situation is in computer programs, but in many cases with the iPad the users does not even know where to tap or push the screen. This can prove challenging for many at first and will require training in order to understand this new way of interaction.

5.2 USE OF EDUCATIONAL APPS AND HOW IT AFFECTED WORK

MindNode, Instapaper, iBooks, Wikipanion was the apps used during the project that initially focused on learning and educational content. The amount of use among the students varied greatly, as also indicated by the individual interviews in Chapter 4. The amount of time each student spent with the iPad, greatly influenced each student's claim in relevance to what extent the iPad had assisted in the studies. An introduction of the apps was presented in Section 3.6.

5.2.1 *Mind Maps with MindNode*

The use of mind maps and its effect on learning was described in Section 5.2.1. In this project we did not perform any tests regarding the students memory recall, before and after using mind maps. This is outside the scope for this paper. Instead, we tried to analyze if mind maps did have a positive effect on students' motivation and the general advantages of introducing it as a study aid. Below we will describe various quotes and opinions concerning the use of mind maps, and how it was implemented by using the app MindNode.

Experiences and thoughts from the teachers, as can be read from interviews in Chapter 4, did in an although general way conclude that mind maps had helped some of the students to more eagerly take notes and pay attention in class.

" [Student] made an excellent mind map. She read things on the internet and quickly entered it into the mind map. I see that they do things more actively now. Their learning is slightly more systematic" - Teacher

"Can we make mind maps or do we have to write?" - Student

"It is much easier. If you are drawing mind maps on paper you can't edit much, but with the iPad you can" - Student

"They're easy to make. It's done in noe time, instead of drawing it on paper because it takes so much longer" - Student

In Communication, two assignments were to be answered in mind maps and delivered through MindNode's integration with Dropbox shared folders. This is an example to how apps with Dropbox integration can both ease the delivery and correcting of assignments.

As it can be determined, both above and from the interviews, many students found mind maps to help their motivation and often preferred it as the new way of taking notes in class. The editing functionality in MindNode also helped students that earlier thought it was too tedious to draw mind maps on paper, and enjoyed the ability to move around and reorganize words or ideas.

It should be noted that this is not representative for all of the students. Mind maps was used by 2/3 of the students, which would equal to 8 students from time to time. Among the rest that did not use mind maps, and rather chose to use conventional study and note taking techniques, the reasons why mind maps was not used was often described as they did not see the point or dissatisfaction of using it. Furthermore, we did note a correlation between the use of mind maps and overall satisfaction with the iPad. A possible explanation for this could be from Section 1.6, and in what stage each student was in the domestication model. As Wyatt [2003] further explains, non-use of technology is a strategic decision. Some may see it as not beneficial or in some cases actively resist the adoption of new technology. This was not unanimous among all the students, but it can be perceived that this is plausible theory to why some of the students did not use mind maps and somewhat disinterested in the iPad.

As it can be verified, mind maps is not for everyone's liking. One can argue if higher levels of motivation might have been obtained if more training in producing good mind maps were provided. This is mere speculation, and outside the scope of the paper.

Mind maps is anything but exclusive to the iPad, as there are numerous alternatives available for PCs. I believe that the tactile feedback offered by the iPad gives a distinct difference compared to what PCs offer with the mouse and keyboard. Dragging "bubbles" and keywords around with your finger does give a new way of feedback and unlike to what people are normally used to. This is one significant difference to why we have confidence in that creating mind maps on the iPad contrasts creating mind maps on the PC, regarding both playfulness and a more tangible interface.

5.2.2   *Instapaper and Wikipanion*

In Section 2.4 UDL is explained and the distinction between access to information and access to learning. While Instapaper and Wikipanion does make the access to information on the surface as straightforward as possible, it can in some circumstances also provide access to learning. Yes, Instapaper and Wikipanion make curriculum and additional learning

material more accessible, closer and at the students fingertips. Nonetheless, it furthermore does make access to information less challenging. But this is negligible in this context, as Instapaper did extend the curriculum book in Professional Practice Theory and provides access to articles they normally would have printed. As one student explains it:

"If I'm going somewhere I know there's no internet, I usually download the articles to Instapaper"

This is according to Principle 1 in UDL: Multiple means of representation to provide learners various ways of acquiring information and knowledge.

Multiple means of representation can also tap into learners' interests and motivate them to learn, as according to Principle 3. In greater articles Wikipanion continuously present further topics and other links of interest to the user, in order to make more content available and to provide further explanation. This way access to content can entice further interest, but only if the learner wishes to do so. This was not the case,however, for every student in the project. Those who chose to remain with the laptop, or use the iPad only for the bare essentials did not or would not have benefited from this.

"It's very easy to use it to look up things. You get it organized in chapters. In case I wasn't in class I could just look it up and everything's there"

"If you search for topics the teacher is unsure of or yourself, while in class, it comes up very fast and perfect"

This are quotes from two students who benefited of Instapaper and Wikipanion. But it is important to also take notice of other aspects of this:

"It's not that often. It's not like everyday there is new things you need to look up"

This is a detail worth noticing. It is not the case that handing students iPad provided with the right apps will not "automagically" make students Google everything or read

further explanations on Wikipedia. It is more of a process to make access to information easier and in a more enjoyable format, that can as already documented make students more motivated to look up more detailed information about what is presented in class. Those who do, will certainly benefit from it but it is not expected that every student will bother or develop new interest in the course by bridging the gap between student and available information.

5.2.3 *iBooks and The Road Ahead*

iBooks, together with the curriculum books, was the iPad greatest strength during the project. As explained earlier, every student thought that having every book on the iPad brought great aid in portability, effectiveness and accessibility. Half of the students preferred to read from the textbook when preparing for tests, or during extended reading sessions. This was somewhat expected, but it is curious to consider that the same amount of students did not experience any eye fatigue during extended reading sessions on the iPad.

"It is much faster to read on it. I think it's too much work to read normal books" - Student

It can be determined that iBooks did help the students with their reading, but to which extent it helped students learm more, is rather uncertain. Making the books more available, does not necessarily equal that students read more. However, teachers praised it as students no longer could excuse themselves by saying their books had been misplaced. Using PDF as the document format did only "convert" the textbooks to a digital format, and not provide any additional features. A few students complained about constantly having to zoom back and forth, and thought it occasionally was rudimentary to use. It is apparent that better document formats than PDF is required, as PDFs in iBooks will not increase students' learning, other than a slight increase in motivation from having the book always accessible as we experienced in this project.

In Section 2.8.1 the digital book called Our Choice was presented. Our Choice lacks important functionality such as

Figure 9: Inkling
Image Courtesy of Inkling

text selection, but it is the concept that this book embraces that is important. During the interviews 2/3 of the students, when asked, requested more added content. Specifically designed websites with additional helper content, was not visited as it often demanded to many steps and was not thought to provide much that was already explained in the textbooks. The students wanted the content "at their fingertips", otherwise it was not considered relevant. Therefore, books with added content integrated *inside* the book is needed. Anyone can convert textbooks to digital format, and if new solutions does not come up within the educational sector, the relevance of iPad as an educational device will fade. This was also requested by one of the teachers, towards a more united experience where readings would be discussed, uncertainties would be annotated and the teacher could then enter further explanations within the

text. A more thorough collaboration tool, that provided students the ability to share their thoughts around school topics and post feedback to each other's written material. Inkling introduced their app which is based on many of the previous mentioned ideas and is pictured in Figure 9. They provide learning books in a different format, in a way that resembles Our Choice from Section 2.8.1. The social media functionality is one of the features most touted, as users can note in the margin and see others notes and comments alongside their own, and help each other. Professors and teachers are also welcome to answer questions in the margin. This together with multimedia features such as audio and video, creates a flexible, interactive publishing platform where users actively can explore the learning content in a less streamlined fashion and thus trigger different kinds of externalizations Price et al. [2003]. This type of multimedia learning is something we lacked in our project, and is recommended for future work in Section 6.3.

5.3 LESSONS LEARNED

Presented below is an summary of unexpected problems, or unthought-of difficulties that occured during the project. As discussed in Section 2.2, iOS does not have a hierarchical file system. As many might see this as a blessing, where files no longer can become lost within folders inside folders, it gave mixed results in this project from both students and teachers. As school is very much concerned about turning in various assignments, files need to transferred and shared continuously between student and teacher.

5.3.1 *File System*

Though not completely unexpected, the lack of a file system did become troublesome and slightly unmanageable for some of the users involved in the project. iPad's file system was introduced in Section 2.2. Many teachers explained they lacked "control" and found it difficult to manage their files.

"Everything is stored in so many different places" -Student

Since the user has no access to a common file system, students was unable to deliver assignments through the LMS Fronter. Though Dropbox solved many of these tasks, it did still create some difficulties if an app did not have Dropbox functionality built in, and so the student had to use e-mail and then deliver it with a laptop.

"There's no logic in it to me. It's stored inside the app and within some hidden structure. It has to be somewhere" - Teacher

Consider an example we experienced in our project:

We had students who enjoyed reading using iBooks, but also would like to annotate directly on the PDFs. Once the students had downloaded an app that supported annotating inside PDFs, they thought they were all done. But the problem arose when they wanted to transfer the PDF from iBooks to the new app. There is no send to-feature in iBooks, so the students was unable to "right-click" the file in iBooks and open it in another app. This was solved by downloading the PDF through Safari once again, then selected the new app with the "Open in..." function. Many students found this very awkward. Since Safari does not support a save-to functionality, which could have enabled the students to save the PDF in their Dropbox and quickly find it there instead of downloading two copies of the same PDF. This naturally is not intuitive for many new users, and difficult to explain why this process is of such complex matter.

We believe that many of the users in this project were confused by the sudden lack of a general file system, and then some of the apps did have their own file system inside the app. Since apps automatically save their documents, and everything is stored inside the app most apps does not require the user to name files or use the "Save as..." function as is common on normal computers. Consider MindNode, which does not require the user to save the mind maps, but displays the many mind maps the user has created in a selectable list. Quickoffice features its own file manager, and each time the user has created a new document he or she is prompted with "Save as..", where it is required that the newly created file is named and stored. This was confusing for many of the users. Apple does not want a file system on the iPad, but many users are still

clinging to it and thus it is revealed that many developers still implement it in their apps. In many ways, a limited file manager makes sense, but the constant switch between apps that does and does not have a file manager can be confusing. Consequently, students repeatedly asked if it was required of them to send their files to Dropbox in order to save it, and hence this is an example of two possible concepts of a file system who is in conflict.

5.3.2 *Projecting*

Let us consider the following scenario:

If a user is ready to present a document, but minutes before he or she notices for example an embarrassing typo. The user now has to go back to the original app, correct the typo, then export the file back to the presenter app and locate it there. Many apps does not have Dropbox functionality implemented, which means the user often have to fiddle with different user interfaces within each app, in order to locate the file and export it back to the presenter app after correcting the typo.

Switching between three different apps in order to view, edit and present a document cannot be classified as user friendly for a typical, average user. One get confused between the different user interfaces and file manager views and have to transfer files between apps to present it. If one want to edit instantly while presenting a document, you normally cannot. This creates a possible dilemma and frustration to a teacher who is dependable on equipment working as planned and are used to a certain workflow.

This was the case for the teachers with the first generation of iPad. On March 3rd 2011 Apple released the iPad 2, and with it comes full screen mirroring. This added functionality makes many screen presentation apps obsolete, and the above scenario in most cases is no longer relevant. However, this was the situation we had to deal with during the project and it demanded serious workarounds and inconvenience for the teachers who commonly presented web pages, documents and other material on a screen. Additionally, attempting to teach 15 students or 5 teachers basic iOS or app functionality without the ability to project the iPad's

screen, made it necessary for me to jailbreak my own iPad in order to project the screen.

5.3.3 *Training*

Due to Apple's policy of not revealing launch dates, we were forced to wait until the iPad was officially released in Norway before we could begin the project. Given the circumstances and the tight schedule we were forced to launch the project to both teachers and students with only a week in between. It was a simple matter of receiving the iPads and then quickly handing out the iPads before more time was wasted. This provided with us with little time to provide training, and so training was handled in a close to explorative fashion. While this is definitely not the best approach for rolling out iPads in a school, full with inexperienced teachers and students it gave us valuable experience in to what extent people need training in iPad. This is a abbreviated version of the many challenges regarding training that we faced, and a more in-depth report can be found back in Chapter 3.

First, many of the teachers and students had trouble transferring their files onto the iPad. There is no easy way to directly transfer all of people's files in various formats onto the iPad. It requires time and effort.

Second, the App Store is an enormous database of apps and requires time and effort put in to find good educational apps. If apps lack reviews, there was often only one option which was to purchase and test the apps for ourselves. Fortunately, a lot of time can be saved if one look up educational forums where the are often several recommendations from teachers who are in the same position.

Finally, apps are the main challenge. If other schools deploy iPads to their teachers and students they may have already decided on apps to use, and thus exploring the App Store is not of the same importance. Many apps implement various gestures and a separate approach for displaying the user's files and accomplishing elementary operations. This is confusing to many users, and often not learned without training and experience. After our experiences with the amount of time that was required for the teachers in our project to become comfortable with the iPad and reach the

conversion stage from the domestication model in Section 1.6, we recommend an extensive workshop spanning over 3 days in order to learn iOS basics and app functionality. This is a challenge not to be underestimated or belittled. After the workshop is completed, it is not to be said the teacher is fully trained and consequently the teacher is able to use the iPad to its fullest potential in class. Follow up is strongly recommended and to let the information and training develop and to let the individual play with the device for him or herself. Take notice this is a bare minimum requirement of training necessary in order for teachers to match students' generally rapid IT learning rate, but not enough to transform the complete learning experience. That is accomplished through continuous experimentation and cannot be achieved in a matter of 3 days.

One teacher explains the learning process :
"The students are just like us. In the beginning you're sitting there with both [iPad and laptop]. One of them you're used to use so you use both of them. That wasn't so great. The students needed the period of getting to know it. Get to know the iPad as a tool. How you do things technically and so on. Before they got accustomed to it they didn't think it was much of an advantage. But once they cross that boundary then you get to see the positive effects of this".
This is very relevant to the domestication theory from Section 1.6, and where those who accepted the iPad and integrated it into their domestic time, undoubtedly learned and benefited the most from this project.

But first and foremost, the will to explore has to be present. The curiousness to figure out why things are so, and thinking "shouldn't there be a way to do this", and then go online to look for answers. We observed students with virtually all the 8 possible pages of apps filled up, and then someone with bare minimum of the required apps downloaded.

5.3.4 *Bridging the Gap*

Wilson [2011 (accessed February 14, 2011] invented the term "agile" space created by the iPad and other tablets. It adds a level of flexibility which has been absent until now. Wilson explains *"conversely, the iPad offers the screen size of a small*

laptop which is significantly larger than a handheld device, whilst avoiding the traditional form factor of a hinged-screen laptop. The importance here is that the laptop format is relatively clumsy when a small group is sharing the device and need to pass it from one learner to another. Furthermore, the fact that the iPad has only one plane, as opposed to the two planes (horizontal & vertical) of the laptop form factor, means that there is no physical barrier between the teacher and learner or between learners when working together in groups. " During the project we witnessed repeatedly this behavior as described by Wilson [2011 (accessed February 14, 2011]. The teachers' also welcomed the change as an increasing number of the students chose the iPad throughout the project.

"I think it's much better to enter the class now, compared to when they were all sitting behind a screen" - Teacher

"It has eased my communication with the students" - Teacher

While some appreciated this more than other teachers, we believe that the "agile" space occupied by the iPad is considerably less for both teacher and student, and bridges the gap normally occupied by a sizable laptop computer. Computers or tablets, are here to stay in education. With an iPad on students' desks, we return back to a less occupied desk which resembles the time when there was only textbooks and notebooks.

5.3.5   *Multitasking. Friend or Foe?*

Throughout the interviews many of the students claimed the frequent switching between apps using the multitasking bar was both tedious and limited their opportunity to both note and read at the same time. Reading in iBooks and taking notes in i.e Quickoffice is not the most suitable fit. Many students requested the possibility to have several apps open at the same, in order to read and take notes in a proper writing program. Other examples was to read websites either through Safari or Instapaper. We agree that this is not possible to a certain extent in today's version of iOS. Numerous PDF reading apps have the capability to mark text, annotate and draw figures, but this is typically

only on the same PDF itself, rather than in a separate document. Splitting the screen in a horizontal view with two apps open at the same time is not likely to produce good enough results due to size of the iPad's screen. Thereby, it is a necessity to create better apps for reading, with a more appropriate note taking functionality than those who exist today. Inkling as introduced in Section 5.2.3 is definitely a step in the right direction, with social media sharing of notes and questions and where notes are kept together in a notebook.

While 1/3 of the students thought the constant switching between apps was cumbersome, in some cases it was also preferred as it was increasingly difficult to become disturbed or focused on other things.

"I don't become tempted to access other sites. It's complicated to do so. It's easier to switch between Facebook and Word on a computer than on a iPad. You don't get distracted as easily." -Student

Multitasking is believed to enable users to be more productive by allowing the user to do several tasks at once, however research may differ as *Buser and Peter [2011]* explains in their research that *"multitasking significantly lowers performance in cognitive tasks compared to a sequential execution."*

ICT in school is here to stay. It is not possible to make a student keep his or her attention all the time, no matter how great the teacher is at presenting or how perfect the iPad may be as a educational device. One student explains it as :
"You do what you want to do. If you want to pay attention you do, and if you don't play Angry Birds".
This can be excerpted as either the student wants to pay attention or not, and the iPad makes doing both at the same considerably worse. Therefore, we believe that when students work with the iPad it is in many ways viewed as a tool on an equal basis as a laptop. Students prefer to write longer texts on a laptop, mainly because of the keyboard, but each app makes itself completely in focus on the iPad and as a result students do not find themselves as easily distracted from other disturbances who may influence their school work. What Wagler [2011 (accessed June 3, 2011] tries to explain with Figure 10 , is that iOS is
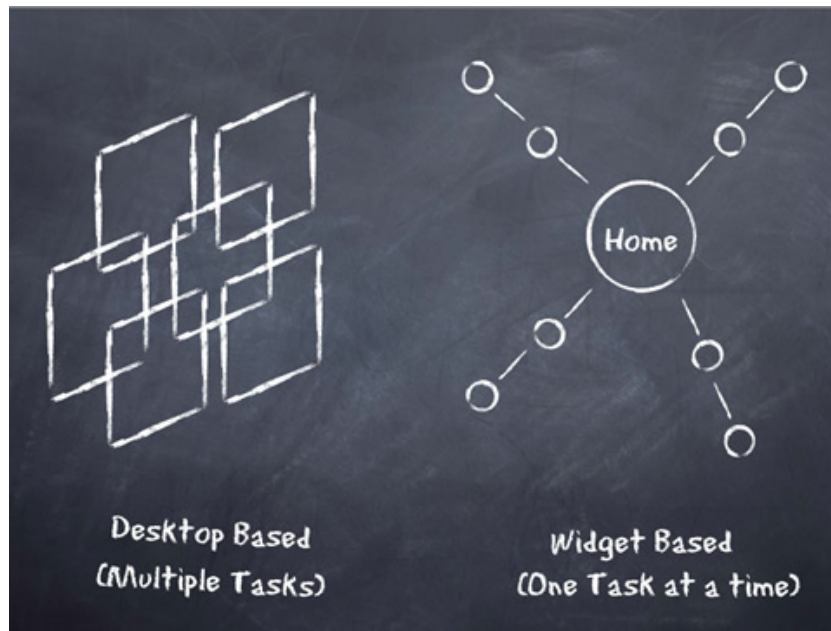
Figure 10: Multitasking and Widgets
Image Courtesy of Wagler [2011 (accessed June 3, 2011]

represented by the right widget based model. In this model apps are stacked on top of each other, typically within the same category or type of task. We consider this to be the model to increase concentration and productivity among students, as long as better and more integrated apps will be available on the market, in this context a combined reader and note taker. To quote Fraser Speirs in his Future Shock article: *"If the iPad and its successor devices free these people to focus on what they do best, it will dramatically change people's perceptions of computing from something to fear to something to engage enthusiastically with. I find it hard to believe that the loss of background processing isn't a price worth paying to have a computer that isn't frightening anymore."* Speirs [2011 (accessed February 1, 2011]

5.3.6 *The Dilemma of Introducing New Technology in Norwegian Schools*

Let us revisit the discussion of institutional factors from Section 2.10. We experienced many of the same troubles as described in Hatlevik et al. [2009]. No support for e-mail servers except for Sør-Trøndelag County Authority own

service, hence leaving out access to students' own e-mail. YouTube and several websites, normally within discussion forums, were blocked from access. As Section 2.10 explains, unsystematic leadership in schools is the bottleneck within schools in Norway. The general norm seems to be that the County Authority pushes increased use of ICT within the education sector. This is great, but we are under the impression that this is only at a concept and idea level. The infrastructure to support increased use of ICT is not available, and it appears to be a distinct separation between what the politicians aim for and what the IT department decides to allow or not. In the bottom end, it is the IT department that decides if a project is to be realized or not. If the County Mayor wish to accelerate further ICT projects and development, but the IT department itself does not wish to further increase network congestion, then project's like these receives a limited amount of network traffic available with heavy restrictions. If the IT department claims there the network infrastructure cannot handle increased traffic, then these are the issues that need to be dealt with before introducing new digital tools in schools that only increase network traffic. Hatlevik et al. [2009] reported that a motivated and competent teacher that also has support from the school board has far greater presumptions for using digital tools in teaching. Why is it that projects that are sought to look for increased learning and motivation in school, are only provided with limited amount of resources? Equipping teachers and students with iPads that involves strict network restrictions like the ones mentioned above, greatly limits both the research and potential success of projects like these.

From the interviews in Chapter 4, one teacher describes the situation in detail and how it has hindered her ways of teaching. It can seem like only through continuous requests to the IT department, new previously blocked content can potentially be accessed for everyone to view. Callister and Burbules [1990] asks the important question, *"How can students learn to be responsible, to make social and intellectual choices, if those choices are made for them by filtering the information they access?".* This is another discussion outside the scope of this paper, but it must be noted that each school must carefully investigate to what extent and how their current network infrastructure will allow and

support iPad's high demand for network bandwidth and port access. Restricting network ports and blocking other content will in return leave the iPad severely handicapped.

5.3.7 *Learning Management System and iPad*

Schools in Norway rely heavily on the use of Learning Management Systems (LMS) for assignment delivery, information exchange and other course and school related content. The problem with these platforms are that they are barely supported on the iPad, due to the fact that uploading files are normally done through the use of Java technology which is not supported by iOS.

Additionally, the lack of support for Java and access to a file system makes the use of an LMS severely incapacitated. This required workarounds during the project, and resulted in very little information were distributed through Fronter, but rather through e-mail and assignment delivery was either done through e-mail or Dropbox. This worked fairly well, but Dropbox lack many features that LMS currently possesses, such as plagiarism control and many other characteristics that schools is heavily dependent of. Fronter recently released an app on the App Store, but only with a limited set of features such as messages, calendar and news Fronter A/S [2011 (accessed June 13, 2011].

Hence, LMSs' need to incorporate the "Send to…" functionality, such in a way that users can select files in Dropbox and send them to the LMS app to deliver assignments. As millions of NOK has been invested in LMS throughout schools in Norway, this is a system that cannot be replaced in a simple matter due to the fact of vendor lock in.

5.4 MOTIVATION AND ENGAGEMENT

In this section we will present how the overall academic motivation and engagement changed together with a summary of other notable factors the iPad changed during the project, and compare it to a similar project to ours.

5.4.1 *iPad Pilot Summary and Course Summary*

The Oklahoma State University launched a similar iPad pilot project to ours during the Fall 2010 semester Handy et al. [2011 (accessed June 5, 2011]. Students and faculty from the School of Media and Strategic Communications and Spears School of Business participated in the pilot. The executive summary from their the pilot project will be compared below to our own experiences and opinions.

The goal of the Oklahoma project was to evaluate the overall impact on the participating students' academic experience and performance, and is similar to our goals. Our focus was the advantages and disadvantages of using and iPad in a classroom, and to investigate if overall academic motivation and engagement would become different. The students in the Oklahoma project are of higher academic experience, and sotheir motivation can be potentially higher as their courses and area of study are selected of students' free will compared to our class where most of the courses are mandatory.

How was the iPad used among students and faculty? How were specific applications used for academic purposes and what best practices emerged?

- Of particular note is the quote *"Dropbox, "It is the simplest way to safely store all of your work. Also, professors should realize it's a great way to communicate back and forth as far as grading.".* This is very corresponding to our experiences. Both students and teachers enjoyed using Dropbox for simple file storage, and teachers found it easy to access and read students' deliveries. Yet we noted a few students expressing some frustration with Dropbox, mostly related to the integration with Quickoffice and how it not always worked the way they expected, and occurrences where files would not upload. We believe this is mainly because of the previously explained network problems and restrictions from Chapter 3, but we can not rule out software bugs and other inconsistencies.

- *"There was also a high usage of social media applications such as Facebook and Twitter which were used for both academic and personal reasons."* Unfortunately, this was

not possible for us because of the network restrictions. It is not explained in detail to what extent the social media applications served an academic purpose. We imagine it was used for class discussion and other related topics. One of our teachers explained that she was eager to use Facebook and social media more, as could provide *"exciting results"* and where feedback would be available more instantly both from her as a teacher and other students.

- *"Some students expressed a desire for some kind of introduction course or tutorial for the iPad. Online tutorials were shared at the beginning of the semester but time in class was not devoted to fully exploring the device. The most common frustrations students expressed included not knowing what other kinds of applications they might want to download (one student suggested Apple should include a Facebook "like" button so they would know what their peers were using) or lack of knowledge to fix problems that occurred with specific applications.".* This is also reported by us in Section 5.3.3. Both students and teachers requested more training, and as it can be confirmed by the Oklahoma project this is not limited to our project.

Was the integration of an E-Reader an enhancement or detraction to the academic experience?

- *"Qualitative and quantitative responses were mixed regarding the iPad as an e-Reader. Qualitative response indicated students liked using the iPad to house their textbooks. In some cases, the ability to read textbooks on the device resulted in increased reading by the students."* We experienced similar opinions and results. Students strongly appreciated what the iPad provided in terms of availability of their textbooks. Availability and the quick access to the reading material, led to that the iPad was favored over textbooks. The class was divided whether extended reading on the iPad would result in eye fatigue. Of other problems, iBooks presentation of PDF documents required the use of zooming and panning around, which many students felt was awkward. In the Oklahoma project CourseSmart was used for reading textbooks. It is unknown whether Cours-

eSmart provided a better or lesser reading experience than PDFs in iBooks.

- We believe that further enhancements to the capabilities of e-reader apps on the iPad, as discussed in Section 5.2.3 will promote the academic experience to greater heights.

Was the integration of the iPad an enhancement to the academic experience?

- Following is a quote from a student that participated in the Oklahoma project: *"This program not only helped me in this class but I was able to incorporate my iPad in all my classes. I was able to Google things instantly when I didn't understand a word or phrase in my other classes. Also, it was nice to have my textbook on it."* We had many similar thoughts from students. From Chapter 4, quotes from students confirm that iPad aided students that sought to look for more information introduced in class. We do not claim this to be typical behavior, as the task of searching for more information and investigating further details about class topics were considered only to be performed by the top dedicated students and those who reached the conversion stage from the domestication theory model in Table 1.

- *"Consensus is the iPad was an enhancement to a student's academic experience also has positive implications to faculty usage. The most important consideration is the device must be truly integrated into the course. Simply distributing the device to students without evaluation of how the course might be modified for its use limits the impact."* The Oklahoma project further reports greater depth to classroom discussions, and reportedly the students felt the iPad enhanced their academic experience. To an extent, we observed the same. Though we cannot conclude or claim that the iPad alone enhanced each student's academic experience, we believe that iPads portability and apps did influence the majority of the students and increased motivation and engagement in class. Although we suspect one or two students in the beginning felt increased motivation because of increased attention due to the study, but this motivation

fell shortly thereafter. In general, the majority of the teachers felt that to a certain extent they could tell the class had greater motivation towards each course, but many failed to identify the iPad as the only cause to the increased motivation.

5.5 RESEARCH

In this section we revisit the research questions posed in Section 1.4, and summarize the answers based on the insight we have gained throughout the project. An individual subsection has been allocated to each of the research questions.

5.5.1 *RQ1: What are the strengths and weaknesses of using an iPad in an educational setting?*

To investigate this research question we looked at similar research with emphasis of use in ICT in the educational sector and different learning methods in Chapter 2. The iPad, with its tactile feedback, facilitates constructivist teaching methods, multimedia learning and incorporates many of the goals from UDL in which many learners can benefit from. The iPad possesses strong e-reader capabilities appraised by students as documented in Chapter 4, which can evolve even further with better apps built for reading that includes multimedia learning capabilities as discussed in Sections 2.8 and 5.2.3.

Teachers and students benefited from iPad's small size and portability, and the ability to have all course curriculum books were well received. Paper consumption went down in a few courses, due to use of Instapaper and online news portals. Teachers reportedly, while not unanimous, claimed the iPad made it easier to talk and reach out to the students compared to when the laptops occupied their desks. The use of apps presented in Section 3.6, provided the students who reached the conversion stage as explained in Section 1.6 better access to learning content. Instapaper filled in the gaps from obsolete textbooks and made added curriculum material easy accessible.

The iPad requires user training, somewhat more than anticipated, if it is to change and alter the way of teaching

and learning as discussed in Section 5.1.1. As we experienced the laptop holds a strong position with both teachers and students, and challenging its territory is demanding. iPad's lack of a visible file system to the user, no file upload through Safari, and zero Flash support can make the transition for many users burdensome because they are used to things at it is, and the many fundamental changes iPad bring can only be explained as "unexpected" to many users. Thus we refer back to training again in Section 5.3.3.

One of the main concerns and drawbacks is that the iPad is highly integrated into its own and Apple's services. This is regarding schools' heavy investment in Learning Management Systems, such as it's Learning and Fronter. Whether these LMSs bring any favorable aspects and opportunities to the educational sector is another discussion, but the situation today is that every school in Norway to a certain extent use some variant of LMS. The iPad cannot directly upload files due to the design of iOS and how each LMSs is designed to handle file exchange. This is a serious obstacle for many schools, and while there are no complete solutions available Dropbox handled very well many of the assignment deliveries in this project.

There is confusion to how and to which areas the iPad will replace the laptop. The iPad is not a device to write a thesis on. We observed many occasions where the iPad was believed to exhibit the same attributes and capabilities as a laptop or PC, and hence some confusion and disappointment came along once it was revealed the iPad did not behave as expected. The iPad is not the same tool as a laptop, and consequently will not behave or handle tasks the same way. There are both advantages and drawbacks to this. This can be referred back to Sections 5.3.3 and 2.1.

We faced many troubles with network restrictions, as the iPad and iOS is tightly integrated with its own services such as e-mail support. This gave us many challenges as external e-mail servers, which mainly concerned the students, were blocked and thus gave the students one less incentive to use the iPad. We believe the success of the project had been even greater, had the school network been less restricted and gave each individual the ability to use the internet to its fullest potential for both personal and educational use. The heavy network restrictions that schools around in Norway face, is a serious concern and can bring a solid damper on

the further rollout and educational benefits of future iPad projects.

5.5.2 *RQ2: Can the iPad produce increased motivation for learning?*

The iPad will not create successful learners by itself. It is not a magical device to instantly "revolutionize" the educational system single handedly. The relevance of iPad-based teaching is to produce increased levels of engagement in both class and homework assignments. To achieve success, engagement is one of the fundamental bricks, but not sufficient enough alone. It is a tool to be used with one underlying directive; to be used where it is useful and nowhere where it is not. This is a important factor that many do not take into consideration when the words iPad and learning are mentioned in the same sentence.

It is laying there next to the textbooks and it is instantly on. It is less disruptive, and can be used as another tool for the students where the teacher or textbooks come short. The main purpose is students can pick between two or more ways of learning new material, as long as the learning goals are the same and the learners end up with the equal degree of acquired knowledge.

From the interviews in Chapter 4, and from every focus group meeting in which the majority is documented in Chapter 3, it can be concluded that the iPad produced a certain degree of increased motivation and engagement in class participation among the students.

The inclusion of mind maps provided the students with a new tool to use for their note taking, and to solve other various tasks and assignments. Mind maps is not exclusive to the iPad, but students enjoyed the tactile feedback from the iPad and the ability to move around and edit the different branches with a single touch as documented in Chapter 4. Wikipanion gave those who sought to involve themselves in supplementary curriculum material the opportunity to do so. It made access to information easy and available, and a few select students explained they found it easier to look up information related to educational content. iPad's portability and always-on functionality, made it easier for students to pick up their readings, thus they felt slightly

more motivated to read. Another example is that a student formerly claiming her IT skills were insufficient and lacked motivation, developed new interest with the iPad and produced very comprehensive mind maps. It is to our understanding the iPad gave the students added ways to read, learn and take notes with. This is not representative of every student that participated in the project.

The iPad need better multimedia learning content, especially in textbooks, as discussed in Sections 5.2.3, 2.8.1 and Chapter 4. Students claimed their motivation to read and interest for using the iPad would further increase had their books included multimedia content, as it was revealed in the interviews the students did not visit complementary websites due to lack of interest and the effort it required.

CONCLUSION AND FURTHER WORK

In this final chapter, the conclusions drawn from the project are presented together with the contributions and prospects of future research.

6.1 CONCLUSION

The goal of this project was to evaluate the iPad as an educational device, in which the advantages and drawbacks of using it in a classroom setting would be discussed and if the iPad could create increased motivation and engagement in both class and course participation. This was achieved by equipping 15 students and 5 teachers with iPads in 6 months. The research questions from Section 1.4 would be answered by observation, interviews and focus group meetings. Handing out iPads to students and teachers abroad in many courses made this project the first of its kind in Norway.

Steps required to make sure the project would be executed to its fullest potential, by observing and from focus group sessions and then changes were made according to the method of action research Kemmis and McTaggart [1988]. Issues that affected the project's success was network restrictions, and little help was provided to resolve these problems, and in consequence the iPad was unfortunately not tested to its fullest potential. Time constraints before project launch due to undisclosed delivery estimates of the iPad, resulted in very little staff and student training and hence training and problems were solved in a more day-to-day basis and problems were dealt with upon request.

The advantages and drawbacks of using iPad in school are many, and it is to our understanding that iPad's mobile and convenient size, e-books, multiple means of content representation and providing the user with possible multiple ways of expression are deemed as valuable advantages. The main disadvantages are extensive training in order to provide any transformation of the educational practices,

incompatibility with LMSs and insufficient educational content that make use of multimedia learning. Motivation among many of the students moderately increased, mostly because the use of mind maps, iPad's playfulness and tactile feedback, and the required reading was easier accessible. A few remaining students did not deem the iPad as particularly helpful, besides having the textbooks in digital and increased portability, and while it is difficult to conclude exactly why, it is believed that network restrictions that hindered use of all of the iPads functionality, relatively little amount of multimedia learning content and the lack of overall school motivation is the cause of this.

The greatest constrain is that new devices are used in the same way as the devices that preceded them. The iPad was put in the "booth" as laptops and thus was constrained and not used to its fullest potential. This is the educational sector's biggest obstacle to transforming education, and this came somewhat unexpected that the limitations was at such fundamental levels.

The iPad is thought to be one of the many resources and tools students use to find answers and create content with. The key concept is diversity, there is no tool that fits for all and every purpose, but we keep discovering new ways of using tools and utilizing resources together. Although further research and development of apps for use in learning is essential to further growth of multimedia and digital learning, we can already see that this form of learning has a lot of advantages compared to the traditional way of learning, and we can foresee that this form of learning will develop at a even greater pace in the years to come.

6.2 CONTRIBUTIONS

- The advantages and disadvantages of using an iPad in a Norwegian High School.

- To what extent iPad can increase motivation in school among students.

- The amount of training required to use iPad efficient by both students and teachers in a classroom has been described.

- What level of bureaucracy to expect within certain school districts in Norway, regards change and possible restraints to expect.

6.3 FURTHER WORK

As we encountered, it is apparent that today's school in many ways do not encourage the increased culture of sharing knowledge as the rest of the society is moving towards. Students around the world report regularly they would like to be assigned more complex and engaging activities that involve technologies, and that such activities should be relevant to their lives Green and Hannon [2007]. Indeed, many students in these studies assert that such uses of technologies would significantly improve their attitude toward school and learning. Young people's lives are fundamentally collaborative in nature. One of the characteristics of students using a range of technologies is the amount of communication and social interaction this involves. Students use mobile phones, text messaging, e-mail, instant messaging and social networking sites to communicate with each other Moyle and Owen [2009]. During observation, Facebook was excessively used by the students. There are now new opportunities for schools to create learning activities for students which blend physical attendance at school with online learning. This was uncovered in Chapter 4, where a teacher requested a online, social collaboration solution where students could share ideas, questions and collaborate outside the classroom together with the teacher's expertise. Further research of this concept are possible implementations, or pilot projects that extend the previous examples of Our Choice in Section 2.8.1 and Inkling in Section 5.2.3 is recommended.

- What potential benefits of using collaborative, multimedia learning software exists and does increased collaboration among students and teachers outside the classroom increase motivation and learning?

Another path is to try the iPad in a educational setting with no boundaries or limitations. This project was restricted within certain predefined limitations, and the next step in any case would be to further investigate the use of the

iPad in a less restricted environment, together with more collaborative tools as described above.

- Conduct a pilot study, but at a broader level. An example would be for a complete grade or school. No network restrictions and preferably better digital textbooks and iPad-student ratio 1:1. This would span over 1 year and reveal how the iPad effects learning at more in-depth.

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LIST OF ALL APPS USED IN THE PROJECT

Below is the complete list of all apps that were tested by teachers and then distributed to the students.

Apps purchased by teachers:

- Quickoffice

- Mindnode

- Felleskatalogen

- Medisinsk ordbok

- Wikipanion

- Instapaper

- neu.Annotate

- 2screens

- Penulitmate

- Prezi

- BodyBooks

- Dropbox

- Pdf-reader

- Pages

- iBooks

- Keynote

- VGA browser

- Expedition

- abcNotes HD

- System Digestive

- Forty weeks of pregnancy

- Vuvuzela Man

- Labtests

Apps purchased by students:

- Quickoffice

- Mindnote

- Felleskatalogen

- Medisinsk ordbok

- Wikipanion

- Instapaper

- neu.Annotate

- Penulitmate

- Dropbox

- iBooks

- Labtests