Norwegian University of Science and Technology

TDT4520, Program and Information Systems, Specialization Project

iPad as a pedagogical device

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December 13, 2010

Abstract

This paper studies the use of an iPad in a classroom. What kind of pedagogical issues could potentially develop by using the iPad as a pedagogical device and does it enhance or decrease the learning experience. This research is performed through fact-finding and quotations from different sources. Because of the limited knowledge and experience with this platform and device from before, some best effort reasoning was used in order to come to conclusions.

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.

Preface

This report is a documentation of the project carried out throughout the fall of 2010 by Henrik Valstad in the subject TDT4520, Program and Information Systems, Specialization Project. The project is executed in the ninth semester of the Master of Technology education in Computer Science at The Norwegian University of Science and Technology, NTNU. The project was defined by supervisor Terje Rydland at the Department of Computer and Information Science. I would like to thank my supervisor for his feedback, guidance and encouragements during the project. I would also like to thank Alma Leora Culén and Frode Kyrkjebø. Special thanks are also given to Kjetil Aamodt and Bendik Solheim.

Trondheim, December 13, 2010

Henrik Valstad

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Nomenclature

3G Abbreviation for Third Generation: the generic term used for the next generation of mobile communications systems, providing enhanced capacity, quality and data rates and promising exciting new services in all of the areas of voice, text and data.

API Application program interface, is a set of routines, protocols, and tools for building software applications.

APN Apple Push Notification Service is a mobile service created by Apple Inc.It uses push technology through a constantly-open IP connection to forward notifications from the servers of third party applications to iOS devices.

GPS Global Positioning System: refers to satellite-based radio positioning systems that provide 24 hour three-dimensional position, velocity and time information.

iOS iOS is Apple's mobile operating system. Developed originally for the iPhone, it has since been shipped on the iPod Touch, iPad and Apple TV as well.

IPS In-plane switching technology in LCD monitors is applied to align the liquid crystals horizontally rather than vertically to the screen. This requires twice the transistors, and is more costly, but produces significant improvements to the screen viewing angle.

K-12 The expression is a shortening of Kindergarten (4-6-year-old) through 12th grade or grade 12 (16-19 years old), the first and last grades of free education.

LCD A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals

LED Light Emitting Diode: a display technology that uses a semiconductor diode that emits light when charged. LEDs are usually red. It was the first digital watch display, but was superseded by LCD, which uses less power.

Magic Trackpad A multi-touch trackpad produced by Apple Inc. Similar to the trackpad found on the current MacBook and MacBook Pro laptop models, albeit 80

MiFi MiFi is a line of compact wireless routers that act as mobile Wi-Fi hotspots. By backconnecting to a cellular data network and frontconnecting to local Wi-Fi devices a compact wireless router creates a local area of shared high-speed Internet connectivity.

USB Universal Serial Bus: Intel's standard for attaching peripherals to PCs.

VGA Video Graphics Array, a graphics display system for PCs developed by IBM.

VPN A virtual private network is a private data network that makes use of the public telecommunication infrastructure (typically the Internet), maintaining privacy through the use of a tunnelling protocol and security procedures.

Wi-Fi The name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections.

XML Extensible Markup Language, a specification developed by the W3C. Designed especially for Web documents.

Chapter 1

Introduction

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

After the introduction of Apple Inc's. iPhone and iPod Touch, Apple 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 of exploring and utilizing this new technology introduced, with more creative games and other sorts of applications that can push the user experience to new levels of interaction.

The iPad is built on the exact same platform as the iPhone and iPod Touch, so users can take their applications they know how to use from before and use them directly on the iPad. Lately, the educational sector has laid their eyes on the iPad and other tablets and experimented with these with educational purposes in mind. Through Apple's websites in the edu-

cational category, Apple touts the iPad as "the perfect learning companion" [Apple, 2010b]. The iPad offers an interesting alternative from textbooks and also offers other ways of learning and interacting with each other in a new way that challenges the old, traditional way of learning. How well does it perform in the classroom for note taking, reading, collaboration and all the other activities performed in the classroom. Does it become an alternative to textbooks or will they coexist? This topic is both very fresh and interesting as it provides a new look at learning, a way that has never really been possible until recently. However, there exists very little concrete research on how the iPad fares in the classroom and other pedagogical actitivies since the iPad is relatively new and experiences from pilot projects are just now beginning to surface.

This research paper will dwelve into what kind of experiences exists with using the iPad in an educational setting and what can be learned from these experiences and how the educational sector may benefit from bringing the iPad into the classroom.

Chapter 2 considers the iPad's technological features together with the iTunes App Store and its own educational app category. Then, Chapter 3 turns to the issue of app distribution among students and how to setup iPad configuration profiles. After this, Chapter 4 demonstrates the iPad's pedagogical potential with examples, lists samples of apps that can be used for note taking and educational purposes and important success factors which should be read carefully if the iPad is to be used as a pedagogical device in a classroom setting. Chapter 5 presents the conclusions and findings of this work.

1.1 Research Questions

In detail, I will try to answer the following problems:

- What kind of pedagogical potential does the iPad offer

- Strengths and weaknesses of using an iPad in a classroom compared to a normal text/notebook situation
- Investigate where the iPad has already been introduced in the classroom and what experiences and observations exists so far
- Will there be need for adjustments made in order to for iPad to function in a classroom filled with Norwegian students

1.2 Research Method

In order to solve the above problems, I will conduct the following background studies:

- Contact schools and research on how to find information on past and present experiences with iPad used a pedagogical device in a school situation
- Study reports and other material that is written about the iPad used for pedagogical purposes and
- If possible, use an iPad myself in the field and test the different applications focused on learning

Chapter 2

Prestudy

This chapter presents a introduction of the technological features of the iPad together with the iTunes App Store and its own educational app category.

2.1 Technological Features

The iPad features a 9.7-inch LED-back lit glossy wide screen Multi-Touch display with IPS technology. The display has a 1024x768 resolution with 132 pixels per inch. The iPad comes in 6 different variations; 16GB, 32GB and 64GB of storage capacity, where all models have optional 3G capabilities. The optional 3G capabilities requires a data plan, usually with a limit corresponding to the amount of data allowed to download. The 3G functionality can be used when a user is does not have Wi-Fi access, like field trips, or otherwise to much "on-the-go" for a Wi-Fi to work properly. The iPad has the same features otherwise as iPhone/iPod Touch, including Accelerometer, compass and GPS for location tracking.

Battery life is touted as one of the iPad's best strengths. With up to 10 hours of battery life of surfing on Wi-Fi, watching video, or listening to music indicates a good enough battery life to withstand a whole day filled with active use. With 3G enabled, the claimed battery life is 1 hour less.

Through the Dock Connector the iPad supports a resolution up to 1024x768 to VGA Adapter, for use with presenting on a presenter display. As of now, there is no support for full screen mirroring and only presenter view is available if the application supports it. Through a process called Jailbreaking, which includes installing non-supported applications people have circumvented this limitation and are able to mirror the whole screen on a presenter. The process of jailbreaking is further explained in Chapter 4.9.

Languages supported are English, French, German, Traditional Chinese, Simplified Chinese, Dutch, Italian, Spanish, Portuguese (Both Brazil and Portugal), Danish, Swedish, Norwegian, Korean, Japanese, Russian, Polish, Turkish, Ukrainian, Hungarian, Arabic, Thai, Czech, Greek, Hebrew, Indonesian, Malay, Romanian, Slovak, Croatian, Catalan and Vietnamese.

2.2 Touch Interface

The iPad uses only touch as input from the user, except from the Home button which serves as an all-purpose button, usually to bring the user back to the Home screen list of applications. There exists three different types of touches the iPad recognizes; taps, moves and gestures. Usually, the use of gestures is new to the average user as it consists of the user moves the fingers in a specific movement in order to perform a special action. They are usually affiliated with zooming in/out and are easily identifiable and repeatable. Apple has incorporated the same gestures into their portable computers with the use of the mouse pad, and latest with the Magic Trackpad, to create a known interface for the user with the same gestures across their product line.

There are some limitations with the iPad's touch capabilities, such as how many fingers you may use and the maximum number of simultaneous touches. The human being is only capable of controlling a certain amount of finger movements at the same time, as goes with the iPad with sensing multiple simultaneous touches. The number of maximum touches is not stated in

Apple development documents, but developers have through experimentation been able to allow 11 simultaneous touches[Gemmell, 2010].

2.3 Screen

The Amazon Kindle and other primary ebook readers, use a reflective screen with no backlighting - just like a paper book - while the iPad has an LED backlit display. Each has its advantages and disadvantages. The Kindle requires decent external lighting, which means in a dark lit room the screen is barely readable. The iPad has a bright screen, but does not fare well in direct sunlight. It is widely discussed whether reading on a LED backlit screen is not natural for the eyes and could potentially cause eye strain [Bilton, 2010]. As screens come closer to approximating (and in some instances, exceeding) the readability of the printed page, our eyes may strain less to overcome computer-specific annoyances such as glare, high contrast, and the like. The iPad and newer laptops automatically adjust their brightness to match ambient lighting.

2.4 Syncing and Backup

Syncing and backup are done by connecting it to the computer with an USB cable, and using the accompanied iTunes software. Music tracks, video, podcasts, photos, books can be selected from the iTunes library and transfered to the iPad. Mail accounts and calendar are also synced.

2.5 App Store

The iTunes App Store is where users can individually purchase and download applications, either from their computer or iOS device. iPad users have access to most of the App Store database which counts 250,000 third-party apps.

Apps specifically designed for the iPad, holds a count of above 10 000, where 864 was the count of applications in the education category as of June 11th. [Viticci, 2010]

The preloaded apps that come with the iPad will for most users already appear familiar, like Calendar, Notes, Maps, Mail, Safari. Some of the apps have been optimized to take full advantage of the bigger screen, which means making better use of the alternative viewing mode; landscape.

2.6 iTunes App Store Educational Purposes

Educational institutions can make application purchases with included discounts through the Volume Purchase Program. Volume vouchers can be purchases at the Apple Store in units of $100, $500, $1000, $5000 and $10,000. The Volume Purchase Program also allow app developers to offer special pricing for purchases offering a discount up to 50% on purchases of 20 or more of the same app. The Volume Purchase Program allows educational institutions to purchase multiple copies of the same app at the same time, which makes the whole process of bulk installing apps to iPads a lot easier for system administrators. After a purchase has been completed, a spreadsheet can be downloaded containing all the redeemable codes. Distribution is then decided by the administrator of the volume program. More specified, while schools with class sets would buy activation codes for each of their handhelds, only one code would be redeemed if all handhelds are synced to the same computer.

As of writing, the VPP is only open to eligible U.S educational institutes.

2.7 iBooks and Reading

iBooks, Apple's own eBook reader, is the most common app to use when it comes to reading. It features the iBookstore which has a vast selection

of books, including educational books covering calculus and history. Each book offer search functionality, look up words by tapping and accessing the iPad's built-in dictionary service, search for all occurrences of a word in a book together with the ability to jump to chapters and set bookmarks. Note taking is supported, and iBooks supports both the PDF and ePub file format. Notes are synchronized between devices along with last page read. Font size and style are customizable, and by double-tapping an image within a book the image is displayed ingreater detail. Books can include audio and video, which is terrific for a wide variety of learners from individuals just learning to read to experienced readers. The key component is the expanded interactive nature of digital books.

It should be noted that iBooks is not the only provider of eBooks on the iOS platform. Several competitors have launched their own app directing users to their ebook database, including Wattpad and Kindle. Both apps offer around the same functionality as iBooks, and user accounts can be transferred such that previously purchased books are available to read on the iPad for example.

Chapter 3

Implementation and setup

This chapter explains how the iPad can be distributed among students, how backup of data is handled, and further setup regarding app distribution and its limitations.

3.1 Backup

One of the first things worth considering, if the iPad is to be rolled out through a student program, is backup. Drops and breakages will occur at some point. Corruption, faulty hardware, all the normal computer trouble is bound to happen sooner or later. The iTunes backup system is very comprehensive; through a few clicks a user can have fully restored all of his/her data and apps looking identical to the old one on a totally new iPad should it need to be replaced. The whole process should finish within 30 minutes giving the student minimum down time. Everything that the user did not originally sync is backed up, which can be further detailed into: app binaries, movies, music and photos are not included. Everything else is synced meaning everything that is created on the iPad itself is backed up, Further explanation can be found at [Apple, 2010d]. Interestingly enough, paired BlueTooth devices and the keychain, which stores passwords etc, are only restored if the same

iPad device as created the backup is used, obviously from security reasons. In addition users can select to encrypt their backup for additional security.

3.2 Activation and Configuration

Using the iPhone Configuration Utility program configuration profiles can be created that can be installed on a device to provide more or less complete control over many aspects of the device's operation. The utility can create, maintain, encrypt, and install configuration profiles, track and install provisioning profiles and authorized apps, and capture device information including console logs [Apple, 2010e]. Configuration profiles are stored in XML files that contain security policies, VPN, Wi-Fi settings, APN settings, Microsoft Exchange and mail settings, and certificates that makes sure that all settings are stored and contains everything an iPad should need to be fully functional in an enterprise or school system.

A configuration profile provide control to aspects like installing applications, using Safari or YouTube can be locked out and content rating levels can be adjusted. This is useful if a user wish to be more in control of the information on the device and if there are minors using the device. It is similar to the parental controls available on the iPad, but more extensive.

Other settings and good examples of configurations that can be "forced" on the devices are :

- Separate passcodes for each device, with a customizable auto-lock time window.
- Predefined, as mentioned earlier, Wi-FI network SSID and password. Removes the process of handing out the Wi-Fi password to everyone.
- E-mail settings can be set up at once. The less the user has to deal with setup, the less trouble.

- Calendar subscription with class schedule, hand-in dates and other important information with optional reminders.

It is worth noticing that configuration profiles can be encrypted and signed, which allows the system administrator to restrict the profile to a specific device. A profile can also be locked, so once installed it cannot be removed without wiping the device of all data, except in the case where the user have the administrative passcode.

Profiles can be installed through USB with the iPhone Configuration Utility, on the web by visiting a website and downloading the profile from there, or by Email and downloading the profile as an attachment. Several profiles can be installed, for instance a "base profile" can be installed first and then the individual ones can be installed at a later stage.

3.3 App Distribution and Setup

App distribution can be a troublesome process, depending on the institution and the number of users. The App Store Volume Purchase Program, as previously mentioned in Section 2.6, can work as a great system for any organization that want to distribute copies of a third party app to a certain clientele. However, in a smaller setting with only a few classes and a smaller school, the Volume Purchase Program may not be the best way to solve app distribution. Often, in a university situation, the students own their iPad and manage it with their own iTunes Account. It would be rather backwards if college students were given iPads but was not allowed to use their own iTunes account. In this college situation the App Store VPP is a great way for a university to give students access to specific apps, and still let them use their own iTunes account.

Regarding smaller schools and if the schools have purchased the iPads, not the students, [Speirs, 2010a] describes these potential dilemmas :

1. If students manage their iPad through their own account, they are presumably syncing it at home and the school can not offer any backup facilities.

2. When a student leaves, they take their iTunes account with them and the school have to re-buy the application for the next student to use that iPad.

[Speirs, 2010c] decided to come up with his own solution at his school, where approximately 115+ students was handed out an iPad. Each classroom has one computer, one Mac OS X user account and one iTunes library. In his setup there are four classrooms and a "master" computer to use up the total of five authorized computers, which is the maximum allowed number of authorized computers per iTunes account.

These are the requirements listed:

- Any teacher can buy an app for their class without going to the IT Department

- Any app purchased will be available to all the primary classes without manual intervention from the IT Department

This is solved through the following setup:

- Five computers (A, B, C, D and E) authorised for the iTunes account

- Turn on Home Sharing on them all

- A is the "master" library

- B, C,D and E are set to automatically copy content from A

- A is set to automatically copy content from B, C, D and E

- B, C, D and E do not look at each others home shares

Say for instance, if a teacher purchases an app on computer A, the rest (B, C, D, and E) will see the app and copy it. Every machine in the Home Share group look at the libraries of every other machine in a fully-connected graph in order to stay updated. One can argue if the problem is the DRM from Apple is not flexible enough. This could be proposed to be an ethical dilemma, as the developer itself only gets a fraction of what he/she would normally get if 115 individual iPad users would purchase the app. See Appendix for further explanation of the App Store VPP app distribution process.

Together, this solution together with the App Store VPP are possibly the two best solutions to two very different scenarios when it comes to the number of users.

As a possible ideal solution to Frasier Speirs' implementation of using 5 different computers and Home Sharing to solve app distribution, [Speirs, 2010d] proposes something he refer to as a Mac OS X Server's Software Update Server. Instead of looking directly at the iTunes App Store, the system administrator could point (via a Configuration Profile already loaded on the iPads) the iPads to a iTunes library on the local network containing authorized apps. The App Store app on the device would then only display apps that are available in that library and everything would appear to be "free" and could be installed directly on the device. Updates would automatically appear if the master iTunes library had a newer version than the iPad.

This is a more "centralized" way of solving the problem of distributing apps to iPads, in an easy and rather uncomplicated way which requires little administration. Students/users could download apps from the local App Store "on-the-fly", and the rest of the App Store can be optionally hidden. If the student wish to purchase apps himself/herself, the student would need to type in the iTunes account password, preferably known only by the system administrator. Idealistically the iPad would support multiple iTunes accounts, such in a way that the student could fill the iPad with his/her own music and purchased apps, and still be able to connect to the local network

server and download the apps from there. This is currently a limitation that is very frustrating to many users; being locked to one iTunes library and the use of multiple computers with the "same" iTunes library. One other solution for smaller institutions, who choose to equip only a few selected students with iPads and wish to preload the devices with selected apps, but still let the users use their own iTunes account, is to purchase iTunes gift cards. This way it is easy to control the expenses, but there is no way to actually control that the student downloads the app the gift card was meant to be used for. The iTunes gift cards come in variants of $15, $25, $50 and $100.

Chapter 4

Pedagogical use

The iPad's pedagogical benefits and limitations are presented and discussed in this chapter. I present a brief overview of apps that can be used for note taking in class, in addition to this I list four scientific educational apps. Further are important success factors for the iPad to succeed as a pedagogical device presented and discussed.

4.1 Replacement and transformation

Technology adoption is usually performed in two different stages; replacement and transformation. Many schools have adopted the replacement stage, which entails taking 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/eBook form on for example an iPad. This is useful if the purpose is to "test" out new technology and measure how well it replaces the original resource.

Transformation is when a process, or a resource for that matter, is completely transformed in how it is used, taught or handled. In this field, it would be to completely overhaul the way of learning, through replacing every textbook and writing material and hand out an iPad instead. Obviously

more radical, but can also yield unexpected effects that no one would have thought of before the transformation process started.

These are also the two processes that most education sections face when a decision has to be made about which process they wish to enroll to their students. Most rational is the replacement process, as the iPad is only in its first product cycle and there exist little information about its pedagogical use. As we will uncover later in this paper, the transformation process may reveal new and unthought of ways that the replacement process may never uncover.

4.2 Pedagogical use of e-learning

Pedagogy can be defined as the art of teaching. It refers to the strategies, methods and styles of instruction. The adoption of technology adds another element in course design to consider. To produce, effective online learning and teaching requires a comprehension of the processes by which students learn and interact with technology. Before new courses are created it is recommended that teachers acquire an understanding of the pedagogy which will underpin their online environment.

The Joint Information Systems Committee (JISC) defines eLearning as: "Learning facilitated and supported through the use of information and communications technology (ICT) "[JISC, 2010].

eLearning includes:

- delivery of courses
- on-line assessment
- student to student and student to teacher communications
- use of Internet resources
- and other learning activities involving ICT and the Internet

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 called this the Modality principle. If verbal information is encoded auditorily it reduces the cognitive load of the leaner 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. [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 advantegous 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".

[Cutrim Schmid, 2008] equipped English language classrooms with interactive whiteboard technology, and pointed out that students argued that "a drawback of having easy access to resources is that it may encourage laziness towards the students, if the teacher "spoon-feeds" them." Some students 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 nega-

tive 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 find out about meanings 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. And in the end, could lead to students become "lazier". 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.

4.3 iPod Touch

If we compare the iPod Touch against the iPad, there are three major problems that separates it from the iPad:

- You can not connect a hardware keyboard.
- You can not connect it to a projector
- You can not do proper word processing

On the other hand, the iPod Touch is cheap, small, has tons of software available and easily distributable.

There are currently many test-projects in schools and universities where the iPad play the lead role. As these projects are still relatively fresh, there exists little information on how the iPad is used in the classroom and how it changes the experience of learning. However, there exists more information with the iPod Touch in a classroom setting, including from Apple's own websites.

At Central Elementary School in Escondido, California, students were equipped with the iPod Touch as a tool to use in their classes [Apple, 2010a].

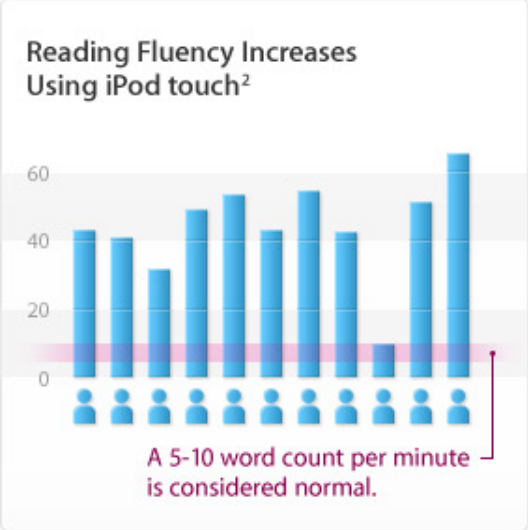

Figure 4.1 — Reading fluency increased using iPod Touch. Image courtesy of Apple Inc.

Escondido purchased one iPod touch cart per classroom, providing one device for each student. Each iPod touch would be each individual student's property to use at school for the entire year. To share ongoing insights, information, and student projects, participating teachers kept a blog. Students also had their own, individual blogs to share their writing and projects with their teachers and others. Through subscription, teachers were able to receive alerts when assignments were completed and posted. The assignments was delivered to where the teachers are located, not on the desk on the assignment deadline. This way gave the teachers the possibility to provide immediate feedback. As an another example of use, students used the built-in Voice Recorder application to record their pronunciation and rehearsed on their own, instead of the teacher having each student read aloud in class one at a time.

In a six-week period, students' reading fluency increased at six times the rate considered normal for that period of time. Students gained almost two years of reading comprehension after only six months.

4.4 Note taking

[Evenstuen et al., 2010] studied students annotation and note taking skills with the iPad. A typical concern from the students was: "The lecturer was moving too fast, and they did not have the time to do annotations on the iPad". Some of the students suggested the use of a stylus, as it resembles traditional pen and paper note taking. One important aspect regarding note taking is that to adapt from their former study methods into a new way takes time. Students have used pen and paper for note taking since they started school, and hence it is not considered easy to abolish pen and paper completely.

In this section I propose important requirements in order for note taking on the iPad to work efficiently as a substitute to pen and paper.

Depending on the situation (taking personal notes, meeting minutes, lecture notes, etc.) and the preferred method of note taking, students' choice of an app may differ, because there is a wide variation of approaches and functionality available.

Taking notes effectively with an iPad in a classroom, lectures or situations where pen and paper are the traditional tools, requires an app that support similar with equal or better functionality and some well-practiced skills:

- Position the iPad on a surface where the user can use both hands to type freely without making too many errors.
- Become experienced with the cut/copy/paste and select/replace functionality in iOS.
- Find a good note taking app the user can trust and be willing to put some time into learning its features and idiosyncrasies.
- Lectures tend to move in a quick pace. A good requires limited attention, making the user able to still participate and pay attention to what matters.

Primary considerations of a note taking app:

- Text entry and editing
  - Enter text quickly in the manner the user want it will often be the deciding factor on whether to use the iPad or a laptop, or force the user to switch back to pen and paper. Note taking apps are not word processors in the sense of novel writing, and hence should not be expected to take on that role. One text font, size and style per note are likely the most common features. If bulleting and auto-indent functionality are implemented then most note taking situations should be supported. The user should be able to make quick corrections and additions to notes effectively.
  - Ability to quickly draw a sketch, without the need to go through too many steps. Lectures are often held in a quick pace, so must the apps' functionality be in order for the user to keep up. Diagram drawing with the finger gives the user a much more versatile note taking option then a standard laptop based note taking experience.
- Organization
  - Over a semester the amount of notes can quickly become disorganized. A good note taking app offers good organization and makes it easy to find information once it is needed. The ability to separate notes by subject is a good first step, together with dates and titles of each note.
- Backup and Recovery
  - Systems crash, apps occasionally have bad updates and users make catastrophic errors like accidental deletion. Backup through auto-

sync to cloud is ideal (DropBox), manual in-app backup is acceptable, and iTunes manual file copy or export to pdf is better than nothing.

Secondary considerations:

- Audio recording and playback. Preferably with tap functionality so you can tap on a word and hear what was said when the note was taken.
- Bullets and indentation formatting
- Graphics/photo pasting and import pdf annotation
- Hyperlink and web browser integration
- Password protection, or other similar security features
- Sharing notes with others, and the ability to copy notes of others if shared
- To-Do lists
- Spell checking
- Print functionality

4.5 Basic Notetaking Apps

Apple's Notes is installed by default, and provides a notebook with separates pages of unlimited length. Syncing is done by e-mail or through Mail/Outlook via iTunes sync. Notes is an easy to use note taking app, with basic features but nothing out of the ordinary. Notes are timestamped, and phone numbers, emails and URLs are recognized. For the poweruser there is only one text fond and size, and limited note organization.

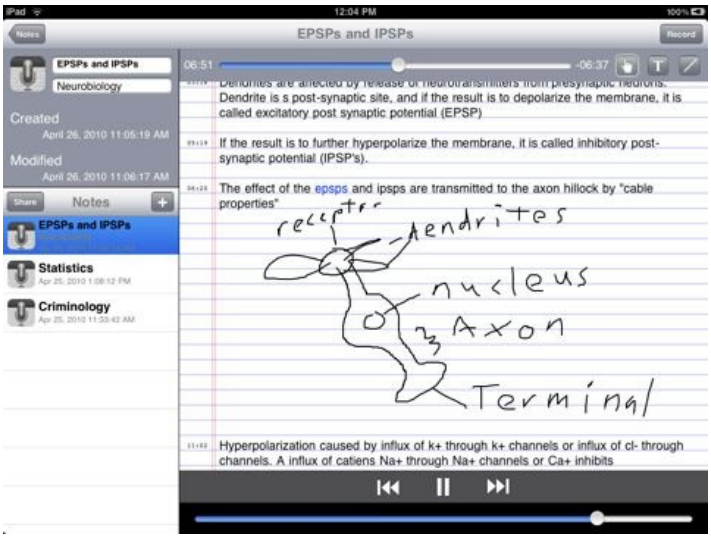

Figure 4.2 — AudioNote.
Image courtesy of Luminant Software

Below I list three apps that have their primary focus on note taking in lectures and school related work.

AudioNote in Figure 4.2 is a note taking app with voice recording. The user can sketch on the "paper", and audio is synced to the pen strokes. During playback the words are highlighted corresponding to the point during the audio when they were written. This way the user avoid searching for the notes that were written down while listening to the lecture. Some text features are missing, like bullets and there is only one font and size. Notes can not be organized into folders for various courses. Backup is done through iTunes and notes can be exported to PDF.

Complete Class Organizer in Figure 4.3 is a school class organizer, assignment tracker, calendar and note taker. It can synchronize notes with lecture recording, calculate grades, make to-do and homeworks lists and organize all information of each course in separate sessions. Notes can be taken either by typing or drawing. Bullets are supported, and it has a built in web browser and Wikipedia reference window.As of writing it only supports

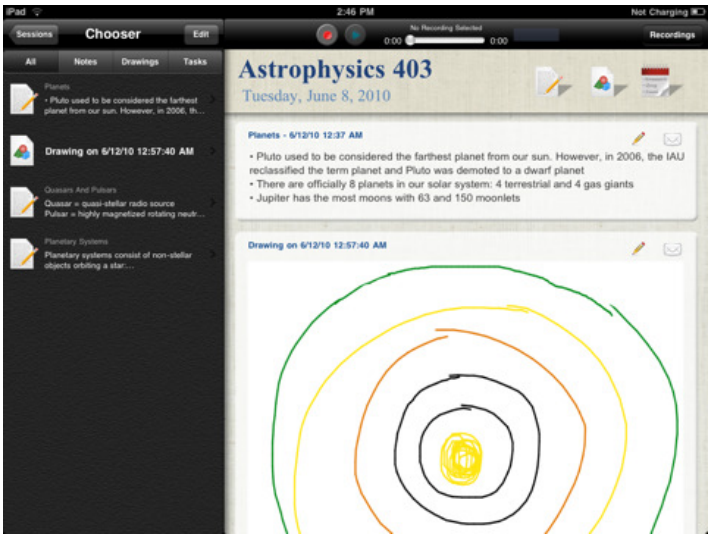

Figure 4.3 — Complete Class Organizer.
Image courtesy of Wil Lakow

backup through export to e-mail.

Note Taker HD in Figure 4.4 focuses on writing and organizing handwritten notes and diagrams. It shrinks the user's writing so it can easily fit a lot of text on one page. It reduces the size of the "ink" the user produces. Finger input or an iPad-compatible stylus is supported. Large drawings can be produced by drawing directly on the page, or the app can shrink the "ink" produced, which means the user does not have to try to make tiny motions like with a pencil. This app would unarguably offer the closest experience for users who wish to go paperless, but are afraid typing on the on-screen keyboard would be too drastic. Export notes in PDF format are supported and can be stored in the iBooks library.

This situation is not ideal. There is not one single app that fulfills all needs of an eager note taking student. Note Taker HD supports both hand writing and with a stylus, but does not support audio recording or proper note organization. For this Complete Class Organizer is needed. Each of the apps have its own area of expertise, so users would have to compromise if

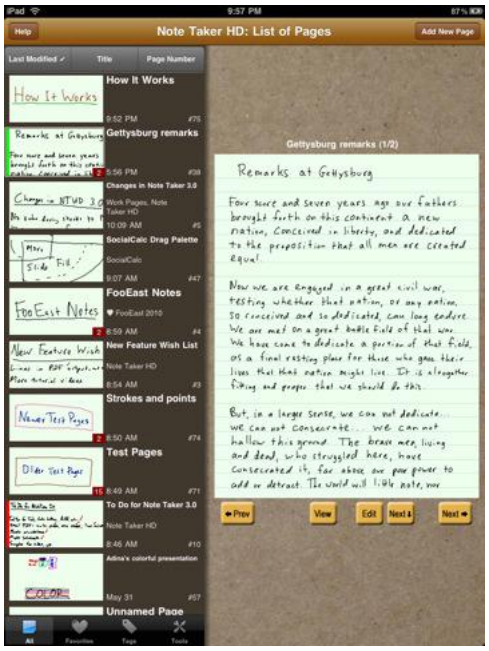

Figure 4.4 — Note Taker HD.
Image courtesy of Software Garden Inc.

they wish to stick to one application. However, a user could perfectly well use AudioNote for lectures, where the lecture is mainly focused on the lecturer's speech, and does not contain detailed drawings for example. Complete Class Organizer also includes recording with word sync so the user can tap on any word to play back what the instructor said the moment the note was written down. Overall, Complete Class Organizer looks like the best fit for students who wish for a fully, integrated way to keep track of their schoolwork and note taking. If a student wish to take notes using a finger or stylus, he/she can use Note Taker HD and then export the note to Complete Class Organizer at a later time in order to keep everything organized.

4.6 Saving and storing data

One problem that has been around since people started using computers, and especially emphasized in school, is how to store your data. 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 occasionally become corrupted, or the user would lose it resulting in important data lost forever.

Today, people use USB flash drives for the most part. Based on the same idea as floppy disks; rewriteable storage. The differences are increased storage, durability, and smaller size. The fact remains that when a user wishes to save a document, he/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 same the document, he/she has to go the same scenario only in reverse order.

The iPad does not use the above scenario for storing/opening files. When a user is inside an app and content is created, the data is automatically stored within the app. In an word processor, the normal procedure is to press something like “New” and the document is created without the user having to go through the process of selecting where it has to be stored. Some Word Processors features a file hierarchy similar to a hierarchy used on 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, just hit 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 way to store, access, create and edit files is with the third-party app Dropbox. Dropbox can sync files online and across multiple computers and other supported devices automatically. A free account gives 2GB of online storage, with up to 100GB available to paying customers. The beauty of Dropbox is that it syncs automatically when new files are created or changes are made. Files can be be opened in offline mode, and it syncs once Dropbox senses an internet connection. Dropbox can be used with any iOS device. Export file functionality to other applications is supported. This adds the functionality to open up a document created on a computer, download it on the Dropbox app, press "Open in" and Dropbox will automatically display a list of supported apps that can open the document and the user can continue working on it on the iPad.

A public folder to share files can be used with other teachers or students. Place a file to be shared in the public folder, right click on the file for a Dropbox URL, and email the URL and select which participants the file is to be shared with. A typical scenario can be that the teacher creates a Dropbox and has subfolders for each student in the main Dropbox folder. The teacher can share these subfolders with the appropriate students.

One problem yet to be solved in an elegant way, is how to export back to Dropbox from the iPad. Using the "Open in..." feature in Dropbox, all files can be opened in other applications that support the document type, but what usually happens is that it creates a local copy of the file from the Dropbox server on the iPad to edit. 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 uloaded to Dropbox. The developers of Dropbox have released an API that let developers incorporate Dropbox functionality in their own applications. This will eventually as more and more apps supports Dropbox, let users 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 end user.

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 is 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.

Yet ahead at one point during this decade, there will no longer be a billion folders and file icons floating in a virtual desktop. No more shortcuts to work around limitations and old conventions. These frustrating barriers—built during decades of evolution—are what make normal people dislike computers. The iPad is changing the way people store and share files, and where more people do not have to worry about the computers occasional absurd complexity. The apps store the data, instead of separate files, and turns the information flow between different devices into a more automatic experience. Instead of a file system with open and save panels, each app displays the files it knows about at launch for the user to navigate through directly. Apps on iPad save all their documents within their own installation directory. Delete the app and all of its related files are cleaned out. 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 a thing of the past and can be looked upon as "outdated", compared to the file storage design in iOS.

4.7 Presenting Using the iPad

The iPad supports video out through the Dock Connector to VGA Adapter. Developers can add video out capabilities to their app with the provided Apple APIs. The capabilities are somewhat limited, as it is not possible to project the Home Screen and the direct output of apps. Only certain apps such as Apple's own Keynote presentation app will send output to the VGA dongle. There exists apps (such as 2Screens) that supports a great amount of various file types to be presented on a display with "laser pointer" capabilities. To open presentations and PDFs the file has to saved to a Dropbox folder for instance, in order for 2Screens to be able to open the file. Some apps come with whiteboard capabilities with templates for chalk/blackboard so the presenter can solve equations or simply write on the screen for the whole class to see. At the moment, it is up to the programmer how he/she chooses to support and implement the functionality of the iPad VGA Adapter.

With the process of jailbreaking, as described earlier, true mirroring capabilities can be achieved. The app Display Out enables projecting from any iOS device. Anything that is displayed on the iPad's screen, such as a website, presentation, gameplay, or application can be broadcasted via Apple's VGA display adapter. This a huge advancement in iOS screen broadcasting, since the VGA cable is by default only enabled on the iPad and only functional in very limited instances (essentially it is restricted only to displaying a Keynote presentation). However, with Display Out, the VGA adapter works just as one would expect from any computer. When the adapter is plugged into a monitor, projector, or similar VGA device, whatever is happening on iPad is instantly displayed on the connected screen. This makes it fast and easy to share anything from the iPad with an audience larger than the two or three people who can gather around a device. Display Out is available from the Cydia store for $1.99 (a one-time purchase covers both iPhone and iPad).

The importance of projecting exactly what a teacher sees and does on the iPad on a screen in front of students is substantial. Not being limited to what an app can offer, but only by the teacher's own creativity to write on the "presenter" instead and to solve math equations on the iPad instead of using the chalkboard would complete the iPad as an educational tool even more. As of today the iPad is limited to present only what app itself can present, and it really boils down if the app supports external presenting. This could be a problem if a student want to present something particular from an app, but is unable since the iPad does not support true mirrroring of the display.

One example of use is if the teacher can pass the iPad around and students can together solve equations on the big screen / projector or draw images to what ever the problem may be. This could potentially be more overcoming for some students as chalk is not something students normally use and some typically have a fear of standing in front of the class, but they know exactly how to type and draw on the iPad. Plus, they can drag objects from a palette to make it even easier to visualize what they are thinking and draw more complex diagrams. This example of teaching has already been introduced by Smart Technologies and their product SMART board, which combines the simplicity of a whiteboard together with a computer.

The app Air Sketch can project PDF documents to a computer on the same local network, then a user can annotate them in real time from the iPad. This concept works great for presentations in the classroom, especially if there is a podium computer present. Open the specified URL from a web browser and display a selected document and write together with the class. For instance, in discussion hours the teacher can pass the iPad around the room for everyone to interact, mark up, and explain their understanding and to pose questions to others in class or directly to the teacher. A great way to go through material together, mark specific text, graphs or other material each student does not understand and share knowledge together without the need for each student to go in front of the class and "present" his/her findings,

which may be slightly intimidating for some people. Students do not have to overcome the hindrance of learning to manipulate another tool or implementation, rather they can use the natural tool they have been given and know how to use. Once taught the basic principles of a range of educational apps, they will achieve results in a short matter of time. Once they master a tool, they become more confident, and with confidence also grows the will to exemplify and try new things, and perhaps even teach other what they have learned themselves. The gained confidence could potentially increase their effort and enthusiasm. Presentation skills and communicating ideas to an audience is a skill that is already a clear competitive advantage for those able to do it effectively. We have all been the victims of poor presenters and experienced how great presenters can make almost anything sound interesting. Few skills demand the development of confidence like public presentations.

4.8 Effective Contributors

With iPad, the flow of documents to and from the iPad could as discussed in Section 4.6 transform the process of submitting homework as one example. When in class, students would collaborate together with their iPads and share their work. It can be handed between students, so for example if one complex problem surfaces, the one person in the gorup that knows "how to handle this" does it while the others are watching and then hand it back. Once done, connect the iPad to a projector and share it with the rest of the class. When 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. Better yet the experience 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. Consider a task where students are given the objective of setting up a small budget for purchasing school material for a year. One would use the web

looking up prices and the other would operate a spreadsheet app to catalogue what they were finding together. At the end they would upload the result to the Dropbox project folder, or email the teacher, and perhaps present their findings for the class.

Another point to be considered of great importance is that students and mostly kids and youth around are very efficient at consuming content. Searching for information becomes an increasingly all-pervasive activity for students and teachers alike. If a student is asked how he/she finds information today, the most common answer would sound something like "Google of course..". Google and Wikipedia are the two top choices of sources for information. YouTube and Facebook is a source of content where most people come to consume information, but less frequently contributes to. 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". Copyright protection and content thievery are topics that need to be further emphasized in school. Answers are not always just a Google search away, and students end up copying and pasting whatever they came over and did not really 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. Additionaly, letting the students take the iPad home after school, lets them pick up whenever they want at home. With its "always-on" functionality, the class or learning experience does not necessarily end at the chime of the bell, but gives the opportunity to the student to pick up right where he/she left off at any time of the day.

4.9 Jailbreaking Education

According to the Associated Press: "the decision to allow the practice commonly known as 'jailbreaking' is one of a handful of new exemptions from a federal law that prohibits the circumvention of technical measures that control access to copyrighted works. Every three years, the Library of Congress authorizes such exemptions to ensure that existing law does not prevent non-infringing use of copyrighted material. Another exemption will allow owners of used cell phones to break access controls on their phones in order to switch wireless carriers"[Panzarino, 2010]. All software or apps to be installed on an iPad/iPhone etc has to be verified and approved by the firmware that lies within the device. This approval process has its purpose to stop the owner of the device to install apps from 3rd-party developers who has not struck a deal with Apple about distribution of the software/app through Apple's App Store. The EFF (Electronic Frontier Foundation) claimed the purpose of jailbreaking was non-commercial, since the user only wished to open the phone to other types of apps than what Apple originally approved [EFF, 2010]. In short, the Library of Congress agreed.

This decision affects U.S citizens only, as in Norway there has not been an official ruling of the legality of the practice of jailbreaking. However, the Norwegian Consumer Ombudsman (Norwegian: Forbrukerombudet) is positive to the ruling [Bie, 2010].

The process today is that if a jailbroken device needs repair, Apple does not repair jailbroken devices as the company claims it voids warranty in doing so. The jailbreak process is totally reversible, meaning if the device needs repair one can easily restore to stock firmware using iTunes and thus the device is back under warranty. It is therefore, as of this ruling, believed that jailbreaking is also legal in both private and public sectors in Norway until proven otherwise. The copyright law can further be read in Åndsverksloven § 12 [Lovdata, 2010].

4.10 Podcasts and iTunes U

Excerpted from Apple's own websites : "Apple's iTunes U is home to more than 350,000 free lectures, videos, readings, and podcasts from learning institutions all over the world. Universities such as Yale, Stanford, UC Berkeley, Oxford, Cambridge, MIT, Beijing Open University and The University of Tokyo, as well as broadcasters such as PBS, offer free content on iTunes U. Content ranges from lectures and presentations to syllabi and campus maps. Accessing iTunes U is simple. Just tap the iTunes U icon and from there you can browse and download content directly to your iPad"[Apple, 2010b].

The most common source of Podcasts is the iTunes Store itself, which provides a catalog of thousands of audio and video podcasts. Unlike most iTunes Store content, podcasts are completely free. In fact the iTunes Store really only provides the directory of podcasts; the actual podcast episodes themselves are not stored or provided by the iTunes Store, but are rather downloaded directly from each podcast provider's server.

For the most part, Podcasts and iTunes U Collections are handled in a similar manner. However, unlike podcasts, iTunes U content is provided only through the iTunes Store itself. Also note that while most iTunes U content is freely available, there may be items that are restricted only to students and faculty of particular educational institutions. The iTunes U service allows campuses to host their own internal iTunes U sites exclusively for their own students. This content will generally not be visible to all iTunes users that are not part of those particular campuses.

Podcasts or iTunes U series can be subscribed to, and iTunes checks daily for new episodes and if subscribed downloadeds them automatically. Any older episodes that are available in the podcast series will appear below the most recent one but are not downloaded automatically.

Universities use iTunes U to spread their material to both their own students or to others that may have interest in watching their own lectures.

Especially MIT's computer science lectures have been known to be of great educational benefit and source of inspiration to students around the world. iTunes U also works as a marketing channel with great ways of distributing material which would be difficult to distribute through other channels.

Teachers and professors can distribute direct links with podcasts and video lectures on iTunes U to their students, and use it as homework for the next discussion session. By using iPads, students would only have to click on the link from the Mail app and it would automatically download, ready to be viewed in a few minutes (given the user has a respectable Wi-Fi connection). This offer a better, seamless workflow and less nuisance for the students, leaving out the process of accessing a computer. The podcast can be downloaded and stored as long as the student wishes, in case the student is going away and is unsure if internet access is available.

iTunes U furthermore works as an information portal, ex. giving students incentive to look up lectures from other courses and stimulate creativity. Incorporating further learning by only offering free material, in a new wrapping that is always available and could spike students' interests to all sorts of educational material that the student did not know exist, simply cause of lack of motivation or it was too dreadful going to the public library.

4.11 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 subjects for all learners, and create environments that can adjust invidiual learning differences [Anonymous, 2010].

The majority of the experimental studies are focused on the benefits of providing students with choices in the learning environment. Options in materials, tools, content, format, etc. have all revealed to increase student

motivation and engagement. 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." [Anonymous, 2010].

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 parallell 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.

The goals of learners are similar to the body builder than to the professional mover. UDL is established on that difference. Education aim to not just make information accessible to students, but to make learning accessible. As the body builder needs to know what kind of muscles that needs exercise, the teacher needs to know the instructional goal in order to find a suitable structure to teaching each subject or a to a specific problem. Let's say a teacher sets the goal of assisting a student to become more enthusiastic

about reading. Simply handing out the book in a digital format would undermine that goal rather than support it. But if the digital book the student was handed demanded interaction from the user, and perhaps 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 give 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 not be much difference in learning capabilities to a student with our without disabilities. The qualities 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 are using 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 langauge 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 discusses educational purposes of the iPad, it is a good fit together with these goals. 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 important in order to increase movitation and engagement. In addition to provide students with choices, one must also provide other possible alternatives for sustaining 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/she wishes to learn, could enhance the relevance of the goal, as long as it is completed in a controlled environment. If the content is available as text, audio, video or maybe even incorporates a way to interact with the student, gives 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 options, if available, teachers can easily make learning accessible, not

only provide information accessible through a textbook.

4.12 Conceptual Framework for Computer Supported Collaboration Learning

[Price et al., 2003] discussed how traditional computer-supported learning environments have demonstrated an example of how to promote collaboration, but only in largely constrained settings such as a classroom. With mobile computing 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 learning experience that were designed, did first take place outdoors where they used walkie-talkies for remote collaboration. PDAs was used for displaying information together with GPS for tracking purposes. The pedagogical goal was to support 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 consolidated together about what they just had experienced. Finally, the third phase was back out in the woods to experiment more and reflect on what they discussed during the classroom setting.

The primary focus of the study was to discover how different 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 quite different learning experiences from traditional ones. Different collaborations have different processes underlying them and trigger different kinds of externalizations from learners. It enabled them to identify the mechanisms that may engender particular externalizations

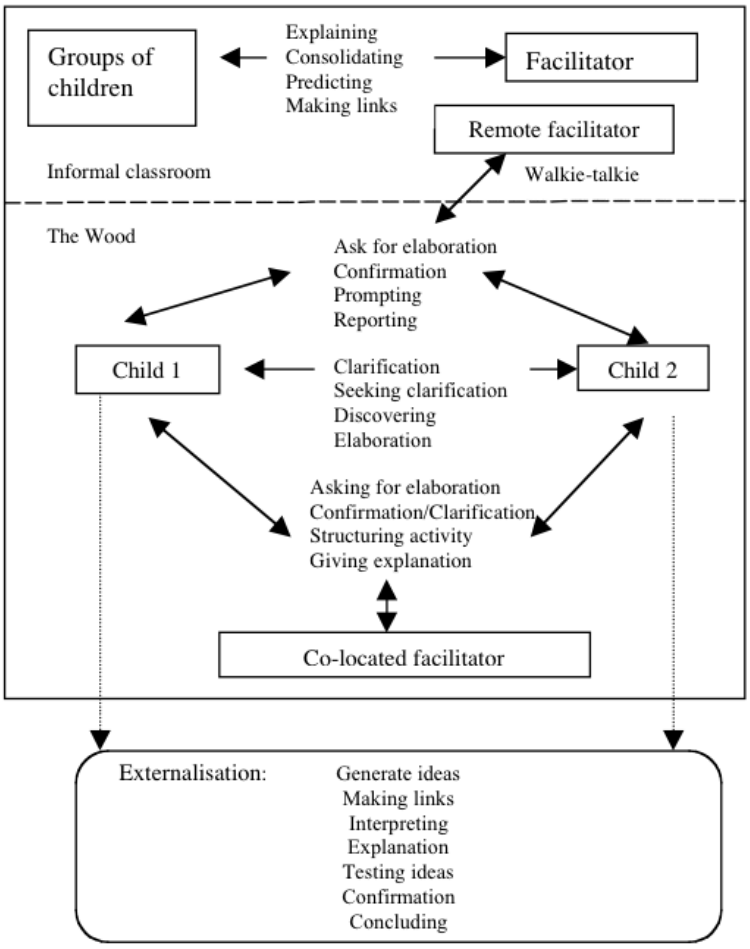

Figure 4.5 — Extended framework of collaboration.
Image courtesy of [Price et al., 2003]

that are an important part of reflection.

The iPad could fit very well into this framework, and it would be interesting to see this exercized 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 network setup.

One can argue that with the use of iPad in this framework, one can remove the phase of going back to the classroom. Since the students have access to the internet out in the woods, what is the pedagogical goal of them going back to a formal, static setting such as a classroom to go over their discoveries? One of the main benefit of moving back to a formal setting, is the potential to engender various forms of reflection [Boud et al., 1985, Ackermann, 1996, Scaife, 2002]. People often need some time to ponder on things, and to become better acquaint of the recently learned information and to make links. It is often recommended to take a step back from the physical action of exploring, such as in this example the woods, and have time to think more explicitly of the information recently gathered. By "self explaining" learners can become aware of their own discrepancies in understanding, enabling them to revise their model of understanding [Price et al., 2003]. This part is equally convenient for the teacher to provide feedback, so students do not become victims of the term group-think, or may have misunderstood or identified problems incorrectly and need assistance.

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.

4.13 Educational Game Design

In every kind of game there exists a possiblity that learning will occur, but it is necessary that the game provides challenges, several objectives and relevant content for the game to accomplish a teaching purpose. When games are made, the teaching component has to be clearly defined. Plan the objectives, contents and strategies for learning. What part of the learning process should the game aim for; at the beginning of a learning objective as a motivational element, during the lesson as another complement, or at the end as correction or remedial teaching. Studies have expressed that games enhance motivation and can increase students' interest in the subject matter, yet the extent to which this translates into more effective learning is less clear [Navarro, 2009].

Using multiple channels (visual and auditory) multimedia learning material can increase the amount of information that the brain can process [Sweller, 2005]. But, there is still the risk of cognitive overload. Too much information delivered in an ineffective manner can interfere with the brain's ability to successfully integrate information into long term memory[Anonymous, 2008]. Before information can be integrated into long term memory it must be received and processed by our working memory. Working memory is very limited, it can only handle small amounts of information before it has to be integrated into our long term memory otherwise it gets lost. The working memory is needed to do complex tasks such as reasoning, comprehension and learning.

Words and pictures are better than words alone [Anonymous, 2008]. The use of both words and pictures lets the brain process more information in

working memory [Sweller, 2008, Sweller, 2005]. Multimedia learning is more effective when learner attention is focused, not split. When learning content is presented together in time and visually, learning is more effective [Mayer, 2005]. If it is not presented together, the attention is split and the brain has to do more work to integrate the separate sources of information. Perhaps the most important part of multimedia learning, is that the presentation of multimedia content should exclude irrelevant and redundant information. Stick to the relevant, and keep the learning material focused on the objective instead of adding supplementary information. Research suggests to keep the additional information at the end, or separated in case the learner wish to explore more [Anonymous, 2008]. When learners are able to control the pace of the presentation they learn more [Anonymous, 2008]. If you put the learner in charge of his/her own learning, and offer the ability to choose the pace of the game/video/audio it can increase the efficiency of the learner. An important factor is how students transfer their experience and gained knowledge from educational games to daily life tasks such as complex problem solving. In math, for example, the debate must no longer be about whether to use calculators and computers – they are a part of the digital natives' world – but rather how to use them to instill the things that are useful to have internalized, from key skills and concepts to the multiplication tables [Prensky, 2001].

Figure 4.6 summarizes the multimedia learning principles [Anonymous, 2008].

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

- 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

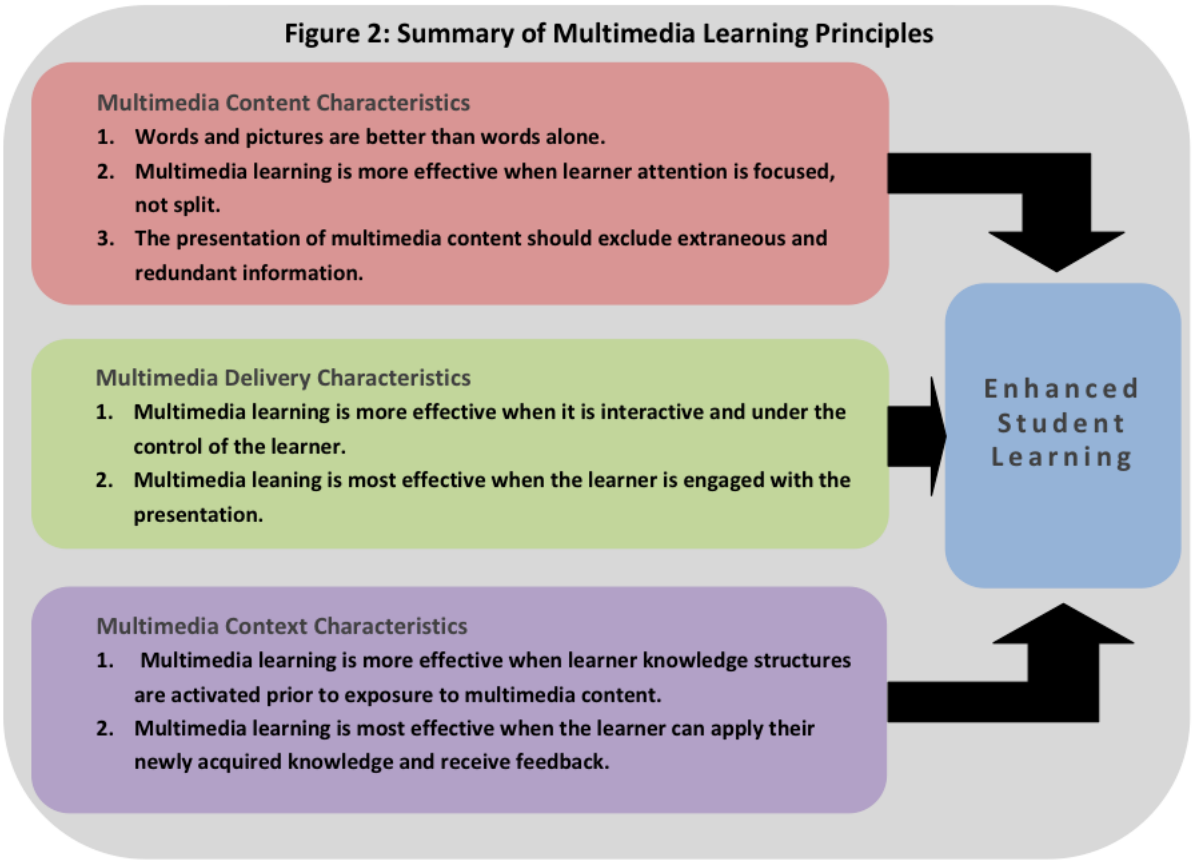

Figure 4.6 — Summary of multimedia learning principles.
Image courtesy of [Anonymous, 2008]

- developing self confidence and increased motivation
- allowing students time to reflect upon their practice

ICT and multimedia teaching is too often oriented to learning the tool itself rather than going deep in the necessary reflection on its application. So, the function of the button is taught but not the implication of using such a function. What happens if the learner chooses the wrong answer? Learners racing to the top of the scoreboard through remembrance and using try and fail is not the appropriate way of designing game based on learning. Games need to be as challenging as textbook quizzes. Students will feel frustrated at some time. When they do, encourage them to take a break. Do something else. Go back after a while and try again. In most cases, when they try again, success is usually accomplished. That is good. Frustration, and then getting past it, is probably necessary for learning [Aldrich, 2003]. While additional high quality research on the effects of gaming is needed, there exists significant reasons for educators to engage with digital games. Playing video games can result in the development of new cognitive abilities that translate into key skills for our transformed world [Facer, 2003]

- The ability to process information very quickly
- The ability to determine what is and is not of relevance to them;
- The ability to process information in parallel, at the same time and from a range of different sources;
- Familiarity with exploring information in a non-linear fashion;
- A tendency to access information in the first instance through imagery and then use text to clarify, ex- pand, and explore;
- Familiarity with non-geographically bounded networks of communication; and

- A relaxed approach to "play"—the capacity to experiment with one's surroundings as a form of problem- solving [Jenkins et al., 2006].

With the above multimedia design principles and the teaching difficulties technology 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.

4.14 Educational Science Apps

Given Section 4.13, I introduce 4 educational scientific apps that I consider highly relevant to students in higher education.

Apps from the science category would argueably be one of the easiest to incorporate in classrooms. Their ability to have both audio, video and through learning-by-doing, students can interact and play around with what normally is an antiquated periodic table. With increased functionality and features textbooks normally lack, these apps are most likely the least complicated starting point for students that have the desire to explore alternatives to textbooks.

The Elements is probably one of the most common known educational apps, with focus on chemistry and the periodic table. The app presents the periodic table as living table where every element is displayed with a rotating sample. Each element can be selected for further information. It offers facts and figures from Wolfram Alpha, and can also list the up-to-the-minute market price if available. More detailed pictures can be further examied to spark further interest. From the iTunes App Store, one user review describes the app to fail at describing how the properties of the elements are related to the electrons positions in the atomic orbitals. By understanding how

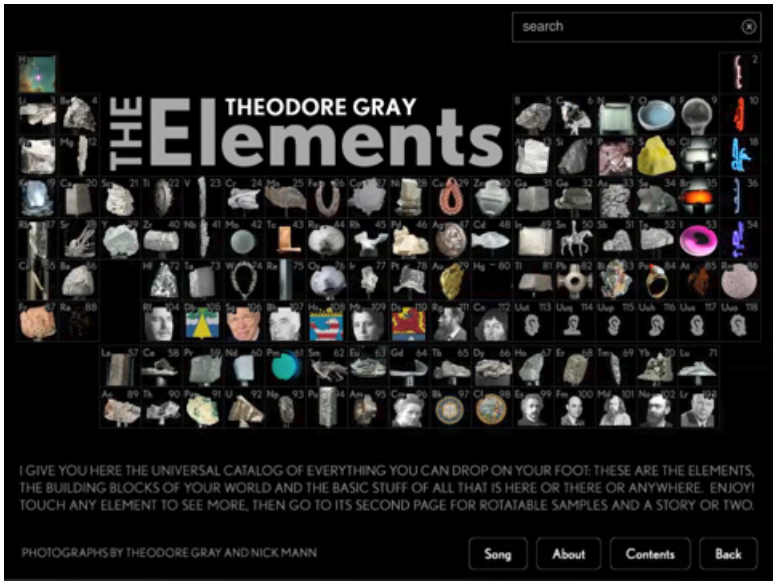

Figure 4.7 — The Elements.
Image courtesy of Touch Press

the electrons fill in a student should be able to predict the properties of an element and further gain a understanding of how the elements relate to each other [Apple, 2010c]. This detailed description of each element is missing in The Elements, but it arguably offers a visually stunning overview of the periodic table and each elements and its uses can lead to a more engaged chemistry student.

SpaceTime is a powerful mathematic solver and graph drawing app. It solves limits, derivatives and integrals and can graph 2D and 3D functions etc. Drawn graphs can be moved, pinched and rotated to give a thorough in-depth look in how the function is plotted. It supports matrix calculations, in addition to simpler math operations such as probability (nPR). The app closely resembles the Texas Instruments 89 graphic calculator. SpaceTime is without difficulty a great competitior to other graphic calculators traditionally used in mathematic courses. Priced at $20, the initial price seems steep, but compared to $80 for a TI-89 it offers great affordability.

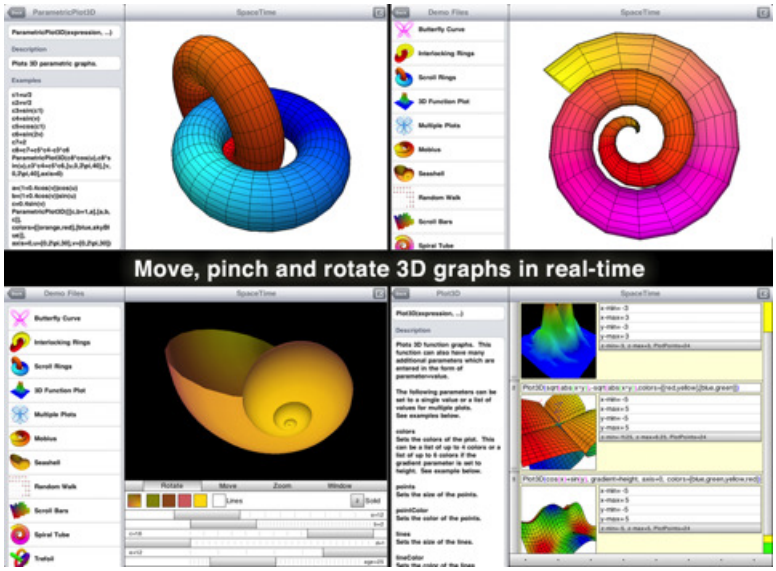

Figure 4.8 — SpaceTime.
Image courtesy of Pomegranate Software

iScience is a scientific reference app which contains all important mathematical and physical formulas and offers a interactive periodic system with all the chemical elements as well. Each category contains various topics featuring fairly basic formulae to the extremely advanced. There is a favorite system that allows the user to organize formulas into favorite groups. One suggested scenario is to collect all formulas related to an upcoming exam and assign them to a separate group to provide easy access. Full-screen view is supported, where formulas can be scaled up for a more detailed view. The function called "Share" offers export to print-ready PDF documents, which allows the user without difficulty to print out his/her favorite formulas.

Coaster Physics is a modernistic, innovative take on how to teach the laws of physics governing the motion of a roller coaster. The app explains how speed and acceleration is related, and how the g-force change at different points along the track. One of its features is the ability to design and ride a personal, realistic roller coaster, and see how quantities like speed, accelera-

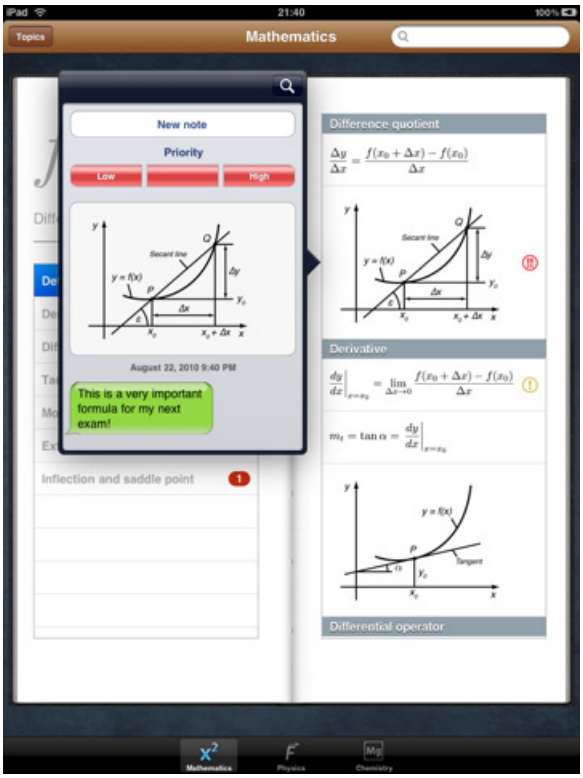

Figure 4.9 — iScience.
Image courtesy of Marc Burkhardt

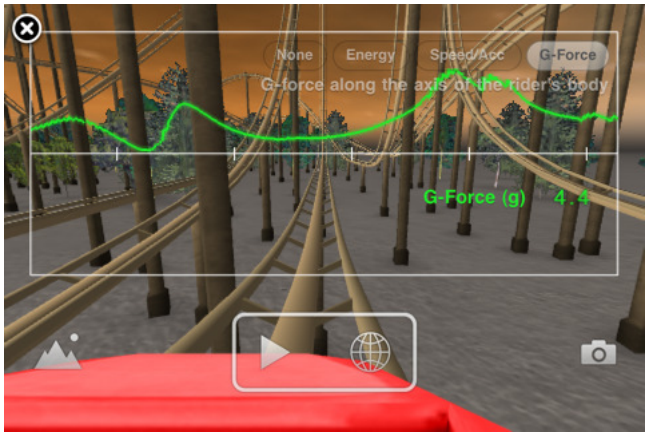

Figure 4.10 — Coaster Physics.
Image courtesy of Ziconic

tion, energy and g-force change as "you" ride along the track. The user can observe the build of potential energy until the coaster heads down hill and the potential energy converts to kinetic energy. The app enables students to view an application of basic physics concepts introduced in the classroom.

4.15 Curriculum Literature Available in Norway

One of the sought requirements for handing out iPads to practically any school class in Norway, would be that a high percentage of the curriculum literature is available in PDF/eBook format. Today most of the material handed out in public schools is copyright protected. Kopinor, the Norwegian organisation for writers, publishers and other licensees of texts and illustrations, handles the legality of copying of copyright material. The law today states that, for private use, you cannot produce digital copies of copyrighted material unless approved by the publisher/copyright owner. The publisher want to secure both that its expenses are covered and the writer still makes

money. There exists no standard for this today and thus it involves a comprehensive process of releasing curriculum material available on platforms such as the iPad. With the legal document "Kopinoravtalen" [Kopinor, 2010], between publishers and students and employees of educational institutations, people within this category can make copies of handouts such as books, newspapers, magazines etc. However numerous restrictions apply; it is only allowed to copy up to 15% of the entire book. This does not apply for books purchased at a campus book store; only handouts from lectures or provided by the teacher by other means. Digitalization of entire curriculums is up to each publisher to decide. The most critical and can prove to have the most impact on ebooks' success, is when publishers finally start producing ebooks in the true sense of the word ebook. In other words: interactivity, video, audio, not just "converted" printed text presented on a digital screen.

The majority of Norwegian publishers have hired the company "Den Norske Bokdatabasen", who is responsible for developing a database of all ebooks in Norwegian. The plan was to release a web-application where customers could log on and purchase ebooks protected with different versions of DRM, where each publisher would decide which DRM to implement. The database is already completed, but the project has yet to be launched, since the first solution was not compatible with iPad and Google's Android operating system. The latest developments is an April 2011 launch of the web-application, which will enable the publishers to open their own bookstore [NTB, 2010]. The publishers does not wish to follow through with launching titles through the iBookstore or Amazon Kindle, as they claim Apple/Amazon's commission is too high, and they fear Norwegian titles may drown in the enormous market of english literature [Eckblad, 2010]. One thing left to speculation would be how it would compete in functionality with Apple's iBooks app. Note taking, searchability, page memorizing and low-response time is crucial, and the importance of similar functionality and performance must not be belittled. iBooks supports the ePub-format, which

could mean the road towards an easy, accessible store that is supported by the iPad is not necessary that far away. Storing the ePub-books within the iBooks app is a trivial process, and with it note taking, searching and the above listed functions is supported.

The faster we can digitalize the curriculum, the faster the transition from textbooks to tablets will proceed. In the transition phase, we can consider to be in the beginning phase now, students will have to carry both the old and new standard, meaning textbooks will coexist with tablets and digital content. Carrying both could quickly lead to confusion and people would faster lose track of where they left off reading last time. Remember, the digital version of books offer searchability and an easier overview of chapters, not to mention it remembers the last visisted page. In addition to this, students do not have to wait for the book store to carry the required book, but can simply download it and start reading before class.

4.16 Important factors for success in the classroom

Based on the experiences gathered from eight mobile learning trials, this list describes several critical success factors for mobile learning to be successful [Cochrane, 2010]:

- The level of pedagogical integration of the technology into the course criteria and assessment
- The level of lecturer modeling of the pedagogical use of the tools
- The use of regular formative feedback from both lecturers and student peers.
- Appropriate choice of mobile devices and software.

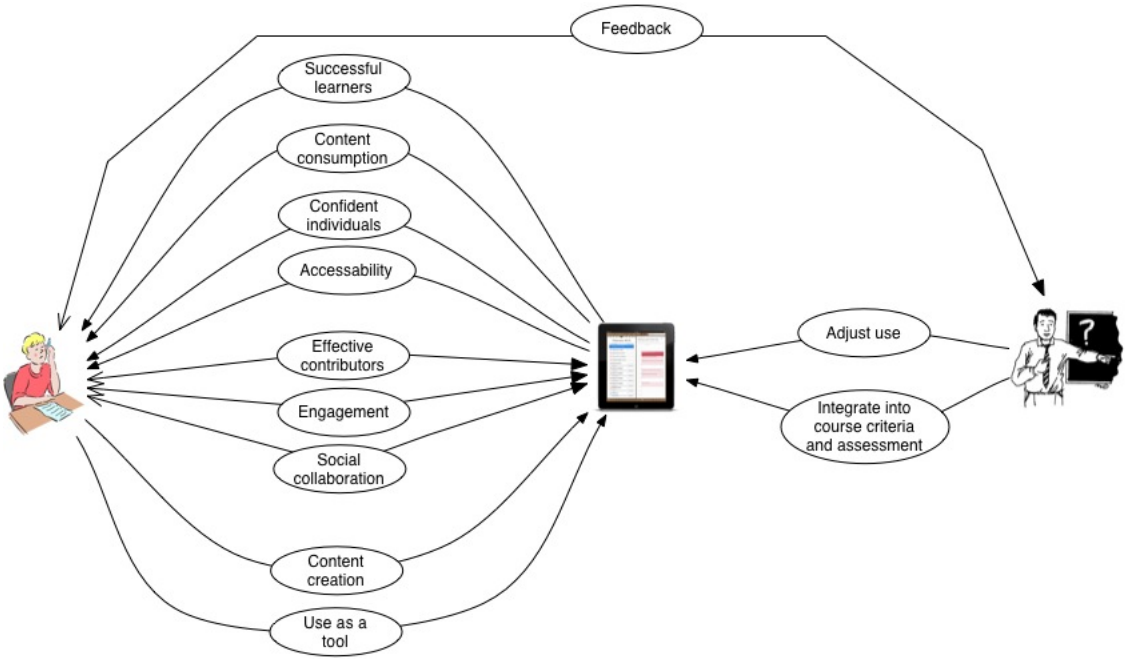

Figure 4.11 — How the iPad can help create and contribute in a classroom indicated by the direction of the arrows

- Technological and pedagogical support.

[Opheim et al., 2010] discussed traditional teaching techniques and evaluated them against more modern forms of teaching set in high schools and elementary schools in Norway. From their indications, they conclude that teacher controlled learning have proven to have a strong relevance with stable and positive influence towards each students performance. What is meant by teacher controlled learning is the use of blackboards, individual work, supervised class discussion and discussion between teacher and students. They continue with too much evaluation seems to have a negative influence on learning. The main challenge is to find the balance between teacher controlled learning and student activity on one side and between teaching and evaluation on the other side. Student cooperation offer great potential, but the teacher must be more involved and activated as a educational mentor and

as a professional authority, and at the same time reduce the intensity of evaluating each student's work the paper concludes. This research brings light to that new is not always better, but it is also important to take into consideration that the children and students that go to school today are "digital natives". [Prensky, 2001]. They need to learn and utilize proper computer skills. But define "proper", "computer", and "skills". A child starting school today will leave school in around 2023. How would these words be defined in 2023? Will they have the "exact" same meaning? Probably not. Students need to be nurtured technologically, or school would always be thought of "way behind" and something not relevant to how things are done in the business world. But there is also the dangers of educating students with specific tools and applications, and not the sense of why they are using these applications. Yes, students will have to use actual real software, but consider the difference between "teaching Microsoft Word" and "teaching word processing".

The sense of the iPad is that it will not create successful learners by itself. 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. The iPad is not to be dictated the specific uses for the device, but rather to let both students and teachers to identify the needs and uses for where the device will be useful in order to help and assist in each subject's unique requirements. It 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, and the term "'multi-purpose-tool" is not that far fetched for the iPad. The trends around students today is that both students and teachers do not wish to go a special classroom to use the computers. Students

certainly will not want to use a special "education device" when the market and the rest of the world is going elsewhere. Teachers does not wish to use complex devices that requires extensive training and continuous support.

The classical mistake is 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. This process of integration goes back to the earlier discussion about replacement and transformation. Do teachers 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? Detailed information and extensive education in the usage of the device is crucial, and the principles of UDL pinpoints several of these important goals.

Chapter 5

Conclusions and findings

What is good learning? It is definitely subjective, but we can still draw a few answers that should resemble what most people would answer:

- students collaborating, discovering, externalising, consolidating and concluding about educational material
- project-based learning and experimenting, that resembles real world contexts
- using multiple sources of information, and integrate technology into learning when applicable
- engage students in a learning experience that allows them to face a problem, gain higher-order thinking skills from pursuing the solution

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 were 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* [Levin and Arafeh, 2002]

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 by addressing several of the challenges presented earlier in this paper. The digital education revolution, a term that has taken far more time to implement would some say, reflect a necessary parallell path with society. Society is using new ways to communicate, share and collaberate, 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 education 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. They communicate with online teachers or tutors. They participate in online study groups. They even take online classes and develop sites or online educational experiences

for use by others [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, could 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), are struggling to teach a population that speaks an entirely new language [Prensky, 2001].

Since teenagers are particularly peer oriented it is no surprise that they make abundant use of social networking and other web applications that involve participation and collaboration. While young people make use of computers in school, apart from notable exceptions in classrooms here and there, the nature of teaching and learning in schools have been little affected. Success with regard to the integration of various technologies such as computers, whiteboards etc, has often been defined by how extensive or prominent the use of such equipment has been in schools, rather than whether such use was providing new, better, and more relevant learning experiences.

Integrating technologies into teaching and learning is seen by many educators as affording opportunities to shift from teacher-centered to student-centered learning[Moyle, 2006]. But it does not necessarily mean it have to be such a "shift". As mentioned earlier, traditional learning and teacher-centered techniques has proven benefitial for a lot of students in the sense of learning [Opheim et al., 2010]. Furthermore, several studies have now reported that students find the quality of their learning that includes technology to be poor and uninspiring [Farris-Berg, 2005, Levin and Arafeh, 2002, Valdez, 2005]. But this can also be spun around to that there has not been a "proper" educational device, perhaps not until now (iPad). Using computers and other

"special" educational devices have proven somewhat tedious and not relevant to what people use in their daily lives. 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 landline and mobile phones, text messaging, email, instant messaging and social networking sites to communicate with each other [Moyle and Owen, 2009]. In addition to this, as teaching and learning becomes increasingly possible in virtual environments, schools no longer have to be defined only by their physical attributes. There are now new opportunities for schools to create learning activities for students which blend physical attendance at school with online learning.

From Section 4.14, I list some of the apps that can be used as tools to assist students to visualize scientific problems and acquire further information. Continue their search online (looking up newspapers, viewing presentations from other universities, reading online books from Google Books) for more information regarding topics brought up in class. Students can take their notes from class, and prepare background papers by using more sophisticated word processor apps, and present their ideas with a presentation app. Suddenly, a person who claim to not be "creative" or "artistic enough", may find new ways of expressing himself/herself as he/she no longer need to draw or sketch on paper, but rather can use apps that provide figures and other helpful insights in order for he/her to express himself/herself in other ways. A challenge for teachers aiming to build students' innovation and creative capabilities with and through technologies, is to move students from being users and consumers of technologies to being creators and producers with

technologies. The constant switch between technologies and devices, where students may end up using one computer at the school and a different one at home, could potentially be one of the reasons why young people today is very efficient at consuming content, but may not be proficient enough to create content. The idea of having access to all of this using one device is intriguing and the concept of having everything stored in one place, and yet still backed up, would arguably ease the day for many students.

A challenge for schools will be to determine which information should be stored in the "cloud" and which information should be stored elsewhere, as these decisions will interface with questions about how much time students should attend school, and the nature of the learning they undertake while at school, compared to what they do in other locations. Using Dropbox, everything is stored in the "cloud", and the importance of attending lectures would need to be further emphasized. One thing is to skim through a presentation by flicking through slides at home, another is to be there when it is presented and class participation. Two very different scenarios, where the second one stimulates two or more senses instead of just one.

Students will carry their information with them and will be able to access school resources remotely, just as flash drives have made it possible for us to move flexibly between computers rather than being reliant on a single computer. Schools would need to set their own agendas around bridging home and school. This is not about trying to formalize the informal; rather it is about using this newly emerging third space in ways that stimulate students and enable them to transfer their skills. By sharing content, students can contact each other through various instant messaging apps and communicate and share thoughts together, and yet still write their own reflection paper. They can browse each others paper if they wish, and share ideas and thoughts about subjects they wish to further discuss in their own paper. Have your child ever collaborated with classmates when he/she is in the back of the car on his/her way up to the cabin for the weekend? The "instant-on" feature

can be thought of another incentive to bring it everywhere, since it does not need to boot up, or a power adapter has gone missing. The whole "dog ate my paper" - excuse can finally be put rest.

[Green and Hannon, 2007]suggests reverse IT lessons. We have all heard the phrase "the best way to learn something is to teach it to someone else." A large 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 give them the confidence with technology they are using. The confidence already exists at home, why not put it in use in the classroom as well. Approaching learning this way provides several advantages:

- A deeper understanding of the subject matter. The research you do will uncover the latest thinking and best practices in the field.
- Secondary knowledge. While researching the topic, you might uncover a new resource or source for future article ideas.
- Tangible evidence of your knowledge. When complete, you have a document that shows just how much you know about the topic.

The current model of ICT lessons often fails to acknowledge their expertise in the use of digital devices. Especially with the iOS, most students already know how to use and interact with it, and this can be put to further use in the classroom by letting students take more control in the explaining of the use of apps and other uses of the iPad. This is something both parts can benefit from and can bridge the gap between students and sometimes the "distant" teacher. By reverse IT lessons as proposed by [Green and Hannon, 2007], students can share their knowledge with other students and with their teacher, school leaders can pilot an approach that could see students taking ownership of their learning across the curriculum. Furthermore, the ubiquity of several technologies, and the robustness of young people's abilities to communicate and collaborate, presents challenges

for educators and stakeholders about how they conceive of schools. Indeed, it is time to reconsider what is a school and in what ways it can best fulfil its roles.

There exists a "soft" pedagogical side that has the student and student groups in the center. The students are to be taught in the different fields of study the teacher has been educated within. This side familiar to everyone. The other side is a "hard" technical side / line, that includes machines, and perhaps capacity of internet bandwidth, and is thought of by many as understood by the only ones that have special education within this field. When these two sides meet together to develop a fruitful relationship, there exists many factors that plays a role on the road to success. Attacking educators' current practices combined with the lack of acknowledgment of current best practices only hinders the growth of the education sector. There are countless educators who are masters at their craft, currently employing an array of exceptional instructional strategies. These are the ones that are best fit to continue to develop the education together with technology.

From Section 4.16 I discuss the important factors to achieve success with the iPad in the classroom. The iPad offers great pedagogical benefits, as discussed above, but there are a couple of factors that need to be further emphasized. First, the importance of using the iPad where it is useful and not to use it where it is not. To force students in an awkward usage pattern, where clearly pen and paper makes more sense is fundamentally wrong. Experiencing is key here, since the iPad is still a relatively fresh product, so its usage patterns are still developing. To let the students use the iPad where they feel it is most convenient, like for instance a field trip to take notes and perhaps search online for background material, is an example of where the iPad would be appropriate to use. Take a class with their iPads, a MiFi and the Camera Connection Kit and let them discover and see what they bring back. The iPad is versatile, it occupies the "agile space" among technology devices [Wilson, 2010]. Each app remakes the iPad into a different tool and

there are hundres of useful apps for education. The iPad becomes the app. Through a drawing app, it transforms the iPad into an artist's palette and canvas.

In some ways it more effectively helps pupils to develop confidence in their abilities and an enthusiasm to try than some traditional media. This is largely due to the immediacy of its set up, tidy up and effects, the security of an 'undo' button and that mark making is controlled directly by the finger itself.

Pupils do not have to overcome the hindrance of learning to manipulate another tool or implement, rather they can use the natural tool they have been developing dexterity in since birth. Once taught the basic principles of a range of art apps, pupils can achieve worthwhile results. They then begin to feel more confident and so become more willing to try – in the art classroom this is half the battle.

As a direct follow on from this pupils then do actually begin to achieve better results – their increased confidence increases their effort and enthusiasm and they feel less threatened and more relaxed. This confidence can then be extended and transferred into other art media. Jenny Oakley at Cedars School of Excellence in Scotland [Speirs, 2010b]

It can be argued how the iPad is meant to work as a substitute to or together with pen and paper in the classroom. It is preferably necessary to find out what situations than just the "obvious" ones, where the iPad could offer just as much or even more functionality compared to traditional methods. One is not necessarily better than the other: the two provide quite different experiences, triggering different forms of imagination, enjoyment and reflection. In turn, this can encourage or even enhance further exploration, discovery, reflection and collaboration [Rogers, 2006]. This is regarding Section 4.1, where the iPad is placed where one would normally sort to traditional methods, and watch was happens. Is it a success? Do people use it exactly as thought ahead, or do they develop a new usage pattern

that certainly was not expected? To use an iPad in education is a long-term institutional cultural change around technology. When people are allowed to figure out what technology is good for, the technology is often used better, more often and more effectively.

An idea of what could potentially happen when students are broad users of tablet devices like the iPad, is that together they make printing less frequently used. Printing in general is very expensive for schools, not to mention bad for the environment, and the amount of handouts in each course is substantial. Paper surrounds education, and if a lot of that traffic can be moved to email and digital handouts it opens up a lot of money meant to be spent for other things. [Evenstuen et al., 2010] reported less printed paper when they equipped students with iPads. The satisfying size of tablets also makes great sense for justifying why paper is going away. Paper is easily handed around, for instance used to as an example to parents what they are reading, but this has been the problem with computers. Computers are too much of a inconvenience to use with "show and tell", and it becomes troublesome for people to move where the computers are to come see what is going on.

The iPad incorporates some of the features of "micro mobility". It can with ease be handed around and it is effortless to share each others work. Working together with technology becomes the norm. The iPad brings the students closer to the teacher, since now the space previously occupied by a laptop is now free. There are less obstacles in the way from attaining important input and support from the teacher. The iPad is shareable in a way that a desktop computer can never be. Collaboration is suddenly more important as we let students take technology with them to do their work instead of setting tasks and separating students into silent communication with their desktop computers. Tomorrow's reading assignment can be delivered in PDF or ePub format through easy, accessible export functionality in for example Apple's Pages. Students take notes using the iBooks app, and then take turns to present what thoughts they induced when reading. New pervasive

technologies enables the design of transformed learning experiences from traditional ones. This provides an opportunity to explore new, different roles of collaborative student interaction. Collaboration in computer-supported learning contexts is more than sharing technologies, but is about different kinds of interactions that support multiple reflections [Price et al., 2003]. With such actitivies, battery time is severely important for the success of field trips and general collaborative work. The iPad's 10 hours of battery life, together with its "instant-on" feature, leaves out the common problem of low portability.

Undoubtedly, without these recent technologies (i.e. digital games, Web 2.0, etc.) in the classroom, strong lessons can still be achieved, but there is a sharp disconnect between the way students are taught in school and the way the outside world approaches socialization, meaning-making, and accomplishment. It is critical that education not only seek to mitigate this disconnect in order to make these two "worlds" more seamless, but of course also to leverage the power of these emerging technologies for instructional gain.

Students suggested that the ultimate digital textbook include [Moore, 2009]:

- The ability to personalize their book with electronic highlights and notes (63 percent).
- Quizzes and tests for self-evaluation (62 percent) or self-paced tutorials (46 percent).
- Access links to real-time data such as NASA, Google Earth (52 percent).
- Links to PowerPoints or class lectures that support textbook content (55 percent)
- Games (57 percent) or animations and simulations (55 percent)

- Links to videoconferences (30 percent) or podcasts from subject experts (34 percent).

Below I list the different activities and ways to use the iPad on the classroom:

1. Load iPads with eBooks and then select and assign reading groups for certain books. Have the different reading groups read the books together and then have them report back to the class.

2. Take advantage of the iPads collaborative intention, by selecting movies and other topics for the students to explore, and let them write to a class blog and start an open discussion about interesting findings.

3. Set up groups that take turns on finding new, educational material for the iPad. Podcasts and iTunes U are good examples of where to start.

4. Subscribe to newspapers and publications on the iPad and include daily reading and discussion period.

5. Teach students in better presentation skills, by using Keynote and other presentation apps.

6. Instruct students to use Google Docs/DropBox for collaborative writing, multimedia creation and brainstorming.

7. Closer integration with the teacher outside the classroom, by using instant messaging and audio conferencing. Encourage contact between students and faculty, especially those students who were unwilling to speak out in face-to-face classroom settings.

8. Assistive technologies support students with disabilities.They can be virtually any device that increases, maintains, or improves the functional capability of a student with a disability.

9. Explore iPads and have students list and critique them. New educational apps are launched every day, encourage exploring with new apps that can enhance learning.

10. Bring the iPads together on field trips, and let the students use them as they see fit. Note taking and online search are good examples to explore further while still out in the field. It gives them instant access to the information they need to succeed - either through apps, stored data, or the internet. It is far more dynamic than a laptop - it can be shared, passed around, propped up, gathered around - it quickly becomes a key tool for enabling group work.

11. Project problems on the whiteboard, and let students discuss problems and questions by highlighting text and project their drawings for the whole class to see. Get away from the front of the classroom and allow children to work live on the board for a more collaborative classroom dynamic.

12. Practice foreign languages by recording speech and pronounciation and let the teacher walk around and listen.

13. Explore and visualize physics and forces on objects by using apps like Coaster Physics.

Schools choosing iPad to assist teaching activities is not to catch the vogue of high technology, but to evaluate whether iPad is good for teaching and learning or not, whether iPad can improve students' learning and how iPad blends into students' daily life. At the same time, it is going to verify whether iPad can save the cost of textbook, whether students can blend into commercial society well after graduation. Of course, they are also testing the limitation of iPad in teaching. It is undoubtedly immensely tough to say or predict how the iPad will do in the education sector, as select schools are only a few months away in their evaluation projects. We need to be conceptualizing and

experimenting with new methods in education, so that we are better able to adapt to the dynamics of our changing world. As the reports keep coming in, things are looking good.

5.1 Uses of iPad in Norwegian schools

[Hatlevik et al., 2009] investigated students and teachers digital competence, by looking at the use of and general attitude towards use of ICT in elementary school and high schools in Norway.Typically, it is each teachers' own competence and workflow, together with unsystematic leadership in schools that is the bottleneck oinside schools in Norway today. Computers available 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 has support from the school board has far greater presumptions for using digital tools in teaching. Digital tools affect the student's performance in school and his/her own digital compentence 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 with less than an hour in teaching each week. This time frame limits the opportunity to vary teaching activities, and demands more planning from the teacher to use the computers 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 [**?**].

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 entails 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 presentation skills. tudents 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 PowerPoint students often learn by themselves or by others.
- Do not blame technology for poor pedagogy. If the students are not paying attention to you, in most cases it is not the technology that is the problem.
- ICT is not new technology, and today's solutions is not advanced. Computers, the internet and cell phones are not new technology. iPods and the iOS has been around since June 2007, and can hardly be looked upon as very "new" technology. ICT in school is about content and access to all of it, and the possible learning outcome by using it.
- Sharing is caring. Modern teaching technology today is blogging, Twitter, Skype, DropBox and Google Docs to name a few. It works on every platform and support teaching and collaboration.

The lack of goal setting is what is I personally believe is the greatest challenge in the debate of ICT in schools. What are the skills students should develop, what is meant to be learned, how to learn this the best possible way and how to use the learned skills and knowledge the best possible ways. And as a result of this the debate turns to which technology is best fit to serve the purpose, and less towards goal orientation. There are several other means

and reasons to this, but it is out of scope for this paper. From Section 4.11 I discuss UDL and its importance of creating a learning framework fit for everyone.

Going back to discussing institutional factors, such as dedicated computer classrooms, this is where the iPad truly shines. It does not alter the "way of teaching" in the same sense as what common ICT tools do. There is no need to move the class to the computer room, it is laying there next to the textbooks and it is instantly on. It is less disruptive, and can be used as another tool to the students in addition to solving math equations on paper. 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 to some extent end up with the same level of skill achievement.

Schools must create learning environments that encourage both teachers and students to experiment with ideas. Teaching students to be able to analyze and question information available to them across the disciplines is a capability that will be of value to students beyond schools [Sahlberg, 2009]. Inquiry-based, project-based and problem-based learning are approaches that use information processing to support students' learning about issues of meaning and relevance to them. These approaches fit well with technology-rich learning environments that focus on the learning experiences rather than the technologies. The focus of such learning environments is on the students' excitement about solving problems or investigating an issue that is of interest to them. In these environments the focus is on the learning and the inclusion of technologies in ways that support students to achieve their learning objectives.

If these characteristics of a technological infrastructure are met, then the technological infrastructure will be trusted by staff and students, and it will support their teaching and learning requirements. Furthermore, there will be commonly understood systems for sharing information among staff, students and the broader school community. Achieving the level of collaboration be-

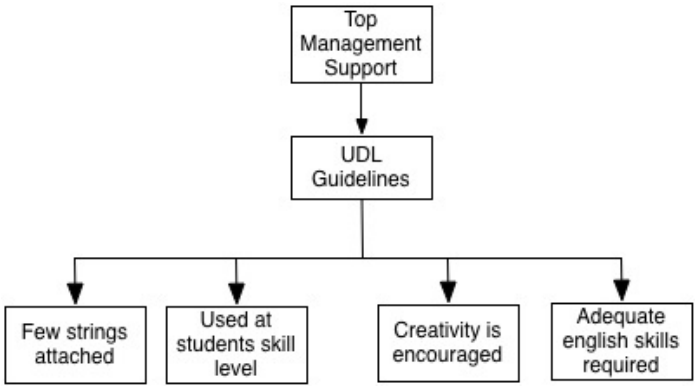

Figure 5.1 — How to incorporate iPad successfully

tween students and teachers that is hoped for within and across schools and school jurisdictions requires the respective technical systems to "talk" with each other.

From Figure 5.1 I list Top Management Support as the top pillar in order to incorporate iPad successfully to the school system in Norway. By this I mean school leaders have to ensure the whole school continuously support the use of technology in their education, and not to be referred as "that class is working on some random project organized by Lars; the tech guy." It is to be part of the school's mission, vision and strategic plan. An educational culture focused on using technology. With Top Management Support, it is often easier for the staff to see the benefits of including technologies in teaching and learning. There exists a base of motivated staff who are willing to change and learn at the same time. Most importantly, the teaching and learning conducted with technologies meets the needs of students and at the same time is consistent with the national learning goals.

Following with UDL principles, use the pedagogical principles such as:

- Provide the structures for students to actively explore learning
- Make sure students justify their claims and at the same time reflect upon what they discover [Laurillard, 2002].

- Promote and value students creatively experimenting in their learning
- Share information and create knowledge with others

Though left out in Figure 5.1, the importance of having digital versions of Norwegian curriculum material is substantial. Without a broad collection of education material in the primary language of students, the iPad will only be considered piloted in test projects and not to be broadly accepted into common school curriculum.

5.2 Summary and future directions

There is a significant revolution under way in approaches to pedagogy and student learning across education as a whole towards more individualized and learner focused approaches enabled by the innovative use of technologies. In particular, I feel it is safe to say there is growing realization of the limitations of traditional teaching with their emphasis often on the institutional delivery of curriculum content. Within this context, with the use of the iPad I believe in a more collaborative learning environment together with game-based learning technologies have the potential to enhance student learning, particularly enhance the development of skills as self-confidence and motivation, and to allow students to reflect upon what is taught. Further on to develop and apply transferable skills to be shared among students in a greater sense, and provide a complex real-world environment to apply to their theoretical knowledge, as well as equipping them with more technical know-how which is closer to their outside school environment. If eLearning and ICT have developed a reputation for being boring and mindless, games have developed the reputation for being engaging and challenging [Aldrich, 2003].

iPad based learning will and can not be the best suited learning device for every student and learner, and there is the potential issue surrounding deployment costs of such a broad installment. As more pilot projects of

using iPad as a pedagogical device are deployed, more data can be collected and thus induce a broader acceptance of it as a pedagogical device. Further work should be carried out on games-based learning and the use of digital devices instead of textbooks, and the impact and potential transformation and downsides of classroom and learning experiences. Students collaborate in online communities and share their work in a greater sense than ever before, and this is a way of collaboration students are eager to try, also in a formal learning environment.

Bibliography

[Ackermann, 1996] Ackermann, E. K. (1996). *Perspective-taking and object construction: Two keys to learning*. Erlbaum.

[Aldrich, 2003] Aldrich, C. (2003). *Simulations and the Future of Learning: An Innovative (and Perhaps Revolutionary) Approach to e-Learning*. Jossey-Bass Inc., Publishers.

[Anonymous, 2008] Anonymous (2008). Understanding multimedia learning: Integrating multimedia in the k-12 classroom. Technical report, SEG Research.

[Anonymous, 2010] Anonymous (2010 (accessed November 16, 2010)). *What is Universal Design for Learning | National Center On Universal Design for Learning*. `http://www.udlcenter.org/aboutudl/whatisudl/`.

[Apple, 2010d] Apple (2010 (accessed December 2, 2010)d). *iPad: About Backup*. `http://support.apple.com/kb/HT4079/`.

[Apple, 2010e] Apple (2010 (accessed December 2, 2010)e). *iPhone Configuration Utility 3.1 for Mac OS X*. `http://support.apple.com/kb/DL851/`.

[Apple, 2010c] Apple (2010 (accessed December 7, 2010)c). *The Elements: A Visual Exploration for iPad on the iTunes App Store*. `http://itunes.apple.com/us/app/the-elements-a-visual-exploration/id364147847?mt=8#/`.

[Apple, 2010a] Apple (2010 (accessed November 16, 2010)a). *Apple - Education - Central Elementary School Profile*. http://www.apple.com/education/profiles/escondido/#video-escondido/.

[Apple, 2010b] Apple (2010 (accessed September 23, 2010)b). *Apple iPad Education Site*. http://www.apple.com/education/ipad/.

[Bie, 2010] Bie, T. (2010 (accessed November 17, 2010)). *Jailbreak - Forbrukerombudet glade for jailbreak*. http://www.itavisen.no/847734/forbrukerombudet-glade-for-%ABjailbreak%BB/.

[Bilton, 2010] Bilton, N. (2010 (accessed December 3, 2010)). *Do E-Readers Cause Eye Strain?* http://bits.blogs.nytimes.com/2010/02/12/do-e-readers-cause-eye-strain/.

[Boud et al., 1985] Boud, D., Keogh, R., and Walker, D. (1985). Promoting reflection in learning: a model. pages 18–40.

[Buckingham et al., 1995] Buckingham, D., Grahame, D., and Sefton-Green, J. (1995). *Making Media: Practical Production in Media Education*. London: English and Media Centre.

[Cochrane, 2010] Cochrane, T. D. (2010). Exploring mobile learning success factors. *ALT-J: Research in Learning Technology*, pages 133–148.

[Connolly and Stansfield, 2006] Connolly, T. and Stansfield, M. (2006). M.: Using games-based elearning technologies in overcoming difficulties in teaching information systems. *Journal of Information Technology Education*, pages 459–476.

[Cutrim Schmid, 2008] Cutrim Schmid, E. (2008). Potential pedagogical benefits and drawbacks of multimedia use in the english language classroom equipped with interactive whiteboard technology. *Comput. Educ.*, pages 1553–1568.

[Dubois and Vial, 2000] Dubois, M. and Vial, I. (2000). Multimedia design: the effects of relating multimodal information. *Journal of Computer Assisted Learning*.

[Eckblad, 2010] Eckblad, B. (2010 (accessed December 7, 2010)). *Måbygge om ebokhandelen*. `http://www.dn.no/idn/article1999479.ece/`.

[EFF, 2010] EFF (2010 (accessed November 17, 2010)). *EFF Wins New Legal Protections for Video Artists, Cell Phone Jailbreakers, and Unlockers*. `http://www.eff.org/press/archives/2010/07/26/`.

[Evenstuen et al., 2010] Evenstuen, A., Dalen, J. T., and Midtbø, O. H. (2010). The use of ipad as a learning tool.

[Facer, 2003] Facer, K. (2003). Computer games and learning.

[Farris-Berg, 2005] Farris-Berg, K. (2005). Listening to student voices – on technology.

[Gemmell, 2010] Gemmell, M. (2010 (accessed September 16, 2010)). *iPad Multi Touch: Supports Eleven Simultaneous Touches*. `http://mattgemmell.com/2010/05/09/ipad-multi-touch/`.

[Green and Hannon, 2007] Green, H. and Hannon, C. (2007). Young people are spending their time in a space which adults find difficult to supervise or understand...

[Hatlevik et al., 2009] Hatlevik, O. E., Ottestad, G., Skaug, J. H., Kløvstad, V., and Berge, O. (2009). The digital state of affairs in norwegian schools 2009.

[Jenkins et al., 2006] Jenkins, H., Purushotma, R., Clinton, K., Weigel, M., and Robison, A. (2006). Confronting the challenges of participatory culture: Media education for the 21st century.

[JISC, 2010] JISC (2010 (accessed November 16, 2010)). e-learning : Jisc. http://www.jisc.ac.uk/whatwedo/themes/elearning.aspx/.

[Kopinor, 2010] Kopinor (2010 (accessed November 17, 2010)). *Universiteter og høgskoler*. http://www.kopinor.no/brukere/utdanning/universiteter-hogskoler/.

[Laurillard, 2002] Laurillard, D. (2002). *Rethinking university teaching: A conversational framework for the effective use of learning technologies*. Routledge, UK.

[Levin and Arafeh, 2002] Levin, D. and Arafeh, S. (2002). The digital disconnect - the widening gap between internet savvy students and their schools.

[Lovdata, 2010] Lovdata (2010 (accessed November 17, 2010)). *LOV 1961-05-12 nr 02: Lov om opphavsrett til åndsverk m.v. (åndsverksloven)*. http://www.lovdata.no/all/hl-19610512-002.html/.

[Mayer, 2001] Mayer, R. (2001). *Multimedia Learning*. Cambridge University Press.

[Mayer, 2005] Mayer, R. (2005). *Introduction to multimedia learning*. Cambridge University Press.

[Moore, 2009] Moore, A. (2009). Students say they have to power down when they enter schools education report signals weakness in u.s. global competitiveness.

[Moyle, 2006] Moyle, K. (2006). *Leadership and learning with ICT : voices from the profession*. www.teachingaustralia.edu.au.

[Moyle and Owen, 2009] Moyle, K. and Owen, S. (2009). Listening to students' and educators' voices.

[Navarro, 2009] Navarro, S. P. (2009). Pedagogical songs: learn by doing game based activities.

[NTB, 2010] NTB (2010 (accessed December 7, 2010)). *Satser på 000 norske e-boktitler*. http://www.vg.no/nyheter/innenriks/artikkel.php?artid=10012151/.

[Opheim et al., 2010] Opheim, V., GrÃžgaard, J. B., and NÃŠss, T. (2010). De gamle er eldst?

[Panzarino, 2010] Panzarino, M. (2010 (accessed November 17, 2010)). *iPhone Jailbreaking Now Legal Says Library of Congress*. http://www.theiphoneguru.net/2010/07/26/iphone-jailbreaking-now-legal-says-library-of-congress/.

[Prensky, 2001] Prensky, M. (2001). Digital natives, digital immigrants.

[Price et al., 2003] Price, S., Rogers, Y., Stanton, D., and Smith, H. (2003). A new conceptual framework for cscl: supporting diverse forms of reflection through multiple interactions.

[Rogers, 2006] Rogers, Y. (2006). *Moving on from Weisers vision of calm computing: Engaging ubicomp experiences*. Springer Verlag.

[Sahlberg, 2009] Sahlberg, P. (2009). Creativity and innovation through life-long learning.

[Scaife, 2002] Scaife, M. (2002). External cognition, innovative technologies and effective learning. *Expl Neurol.*, 51:78–109.

[Speirs, 2010c] Speirs, F. (2010 (accessed December 3, 2010)c). *Fraser Speirs - Blog - The iPad Project: Day Six - The Hamiltonian Cycle*. http://speirs.org/blog/2010/8/12/the-ipad-project-day-six-the-hamiltonian-cycle.html/.

[Speirs, 2010d] Speirs, F. (2010 (accessed December 3, 2010)d). *Fraser Speirs - Blog - The iPad Project: Day Three - End of an Era, and DRM Hell.* http://speirs.org/blog/2010/8/9/the-ipad-project-day-three-end-of-an-era-and-drm-hell.html/.

[Speirs, 2010a] Speirs, F. (2010 (accessed November 16, 2010)a). *Fraser Speirs - Blog.* http://speirs.org/.

[Speirs, 2010b] Speirs, F. (2010 (accessed September 23, 2010)b). *Fraser Speirs - Blog - iPads, Curriculum for Excellence and the Next Generation.* http://speirs.org/blog/2010/10/19/ipads-curriculum-for-excellence-and-the-next-generation.html/.

[Sweller, 2005] Sweller, J. (2005). Implications of cognitive load theory for multimedia learning.

[Sweller, 2008] Sweller, J. (2008). *Evolutionary bases of human cognitive architecture: implications for computing education.* ICER '08. ACM, New York, NY, USA.

[Valdez, 2005] Valdez, G. (2005). Critical issue: Technology: A catalyst for teaching and learning in the classroom.

[Vincent, 2010] Vincent, T. (2010 (accessed September 23, 2010)). *Tony Vincent's Learning in Hand - Blog - App Store Volume Purchase Program Explained.* http://learninginhand.com/blog/app-store-volume-purchase-program-explained.html/.

[Viticci, 2010] Viticci, F. (2010 (accessed September 23, 2010)). *The App Store Has Now Over 10.000 iPad Apps, 78 Percent Are Paid Apps.* http://www.macstories.net/ipad/the-app-store-has-now-over-10-000-ipad-apps-78-are-paid-apps/.

[Wilson, 2010] Wilson, I. (2010 (accessed December 3, 2010)). *the agile space*. http://ipadineducation.co.uk/iPad_in_Education/The_Agile_Space.html/.

Appendix A

App Store Volume Purchase Program

[Vincent, 2010] explains the VPP process :

1. A Program Facilitator creates a quote for a one or more Volume Vouchers for a set dollar amount in $100 increments.

2. This request is routed to the district Authorized Purchaser who approves the quote and places the order.

3. The voucher is sent to the Program Facilitator via mail.

4. The Authorized Purchaser receives the Voucher and send the voucher to the Program Facilitator via internal mail.

5. Using a New Apple ID created for this purpose, the Program Facilitator searches for and purchases apps in variable quantities, up to the dollar limit of the voucher amount and billed accordingly.

6. The Program Facilitator will receive an email with a link to a dashboard, now populated with app- -specific codes. These codes can be distributed to users for redemption at the App Store.

7. The Program Facilitator distributes the app specific codes to the individual that requested them.

8. The requestor redeems the codes in one of three ways (assume 30

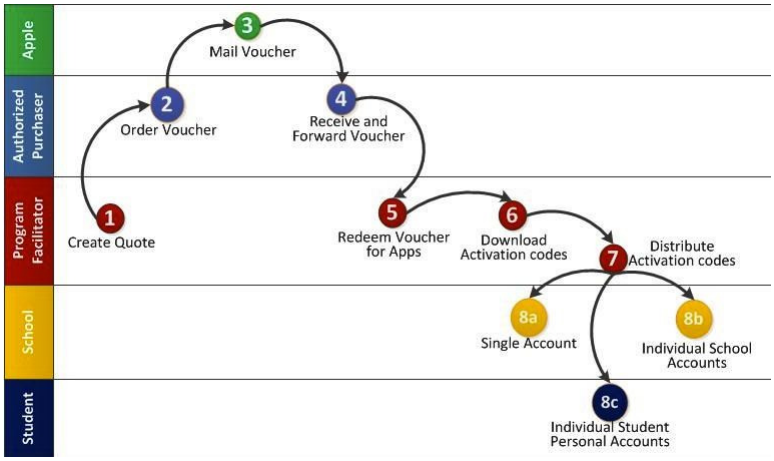

Figure A.1 — App Store Volume Purchase Program.
Image courtesy of Jim Siegl

iPads)

a. One code is redeemed to a single iTunes account, iTunes is activated with that account on up to five 5 computers. The 29 remaining codes are kept on file in the event of an audit.

b. 30 codes are distributed and redeemed against 30 school managed iTunes accounts.

c. 30 codes are distributed and redeemed against 30 student managed iTunes accounts. App becomes property of the student.

As explained above the whole process is fairly complicated. Teacher's cannot simply purchase an application in iTunes and sync. The teacher must instead work together with the school district's Volume Purchase Program Facilitator in order to make purchases. As previously mentioned, individual application developers have the option to offer up to 50% discounts on purchases of 20 or more of the same app. The discount is not displayed in the App Store, but rather through the App Store Volume Purchase Program page.

Take notice that this is only regarding paid applications, free applications can be downloaded without the need of the flowchart model.