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From digitized to digital

FROM PRINT REPLICA TO HYBRID: THE QUEST FOR TEXTBOOK 2.0

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Preface

From digitized to digital is a research project examining the digitization of educational teaching materials, focusing on e-textbooks.

The research originated from two sources: my ongoing doctoral thesis *This is not a book* (due 2017) and my work on the *Next Media* project. [Next Media](#) (2010–2014) was a major project in which companies and research institutes cooperated to accelerate the media transition to a new digital era, in which e-readers, tablets and smartphones have gone mainstream. The project was large in Finnish terms: nearly 300 work years. I was responsible for new publishing techniques and user experience in e-reader work packages. One good example of cooperation in practice is the streaming-based e-book lending service created for the Helsinki metropolitan area libraries. I developed the [user interface](#) for this service and was also responsible for the research component – together with the *VTT (Technical Research Centre of Finland)*. In this context, we also examined social reading in e-books. The aim was to further pursue the matter in a follow-up project called *Nordic Next Media*. In the very end the funding was not picked up by *Tekes (Finnish Funding Agency for Innovation)*, however parts of the project [went ahead](#), including the presented eTextbook research project. The project is now funded by the *The Media Industry Research Foundation of Finland*. This publication is available in Finnish as an [extended version](#).

This research is not restricted to the possibilities of social reading in textbooks, but also examines other educational potentials of digital books, how e-learning can be integrated into the learning environment and the obstacles to mainstreaming it. It is important to state here that I am not exploring the move to electronic format in general or all possible materials: my focus here is on e-textbooks. More specifically, I am interested in the relation between e-textbooks and virtual learning environments.

For this purpose, the research seeks to conceptualize the existing e-book formats in terms of their essential functionalities used in teaching and learning. The aim is to spark a debate about the relationship between e-books and learning environments by sharing information about the formats on the market and the existing and potential functions of e-textbooks. This study also identifies and proposes solutions to the problems of digitalization.

This is not a guide for choosing e-textbooks. Instead, the aim is to bring new knowledge into the sector and launch a debate on possible future e-textbook models and opportunities, and to act as a kind of cookbook for textbooks in a new era.

Many experts have been consulted for this work. I wish to thank all my interlocutors; the aim was to listen to a variety of different stakeholders. Thank you to *Annu Ahonen* of *Aalto ARTS Books*, *Miikka Salavuo* of *Tabletkoulu*, *Johannes Perna* and *Simo Veistola* of *e-Oppi*, *Jari Harvio* of the *City of Hämeenlinna*, *Liisa Keltikangas-Järvinen* and *Liisa Ilomäki* of the *University of Helsinki*, *Risto Korhonen* of *Ilona IT*, *Eija Weck* of *Kirjaväily*, *Kristiina Markkula* of the *Finnish Book Publishers Association*, *Marko Karppinen* of *Ritchie*, *Valtteri Halla* of *LeiaMedia*, *Achille Conchrecht* of *Aquafadas*, *Enrico Gazzana* of *PubCoder* and many others. The interviews were conducted as background research and are not cited directly. If someone who was interviewed is cited, this refers to a published work.

I would like to point out that the conclusions of this research are my own and I take sole responsibility for them. The people interviewed may have held a different view.

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The aim is to bring new knowledge into the sector and launch a debate on possible future e-textbook models and opportunities, to act a cookbook for textbooks in a new era

1

Where are we now?

Many previous studies describe how teaching materials are becoming more diverse in the process of digitalization. Usually, the perspective to date has been the virtual learning environment as a whole. The main teaching instrument – the book – has received much less research attention. It has been passed over as part of the traditional learning environment, and in electronic format it has been seen as a ‘closed material resource’ (cf. Jaakkola et al. 2012, 21), forgotten in one corner of the large virtual learning environment.

The term virtual learning environment (VLE) refers to the whole that is made up of different learning platforms (e.g. Moodle, Optima, or Fronter), individual web pages, search engines, and open-access material resources (such as iTunesU and MOOCs). In contrast, the term learning environment refers to the school, equipment, tasks and all traditional learning materials.

The name of the study, ‘From digitized to digital’, refers to the ongoing development of the electronic textbook, movement from multimedia and electronic copies of the printed book towards something new: that is, a more open and networked, form of genuine digitalization which plays a more active role in the virtual learning environment.

This development also reflects the overall development of e-books. The old 1990s view, of the future of the book as a sort of enriched multimedia product (Stein 2010), has been replaced by the idea that, one way or another, books will develop in line with the internet. (Cordón-García et al. 2012.)

We are in the midst of the transition from digitized to digital. The basic version of the digitized book is a simple print replica of the print book, published, for example, as a PDF. The other traditional format is its predecessor, the multimedia book, which started as CD-ROM. A slightly more advanced version of the print replica includes links to video, audio and animation. Besides this enriched print replica, various hypertext book formats have become available with the advent of internet. Right now these models appear to seek integration not only with each

*Printed
textbook*



*Multimedia
CD-ROM
Digitized
textbook
Print replica,
enriched
print replica*



*Digital
textbook*

other, but also with virtual learning environments and learning management systems (LMS).

This study will consider not only how the move to electronic format has influenced the textbook but also the way it could do so in future, so that e-textbooks would become more mainstream. The subject is a complex one since an e-textbook is no longer a ‘book’. It is also part of the software technology sphere. An e-book is not only type of a content, it is also a system.

Although information technology has gone mainstream, the printed book is still the most important source of information in society and the backbone of educational programmes. E-books did not develop quite as expected. According to the market forecasts at the turn of the 21st century, the vast majority of books today should be electronic. The most optimistic forecasts predicted 90% of the market share (Guardian 2002). Beyond the Anglo-Saxon world, however, you can today count the percentages on the fingers of one hand. In the 2015, the book is the last bastion of analogue media, while music, film, television, radio and magazines are all well into the digital age. As the front line of the information society advances, the book seems to be lagging behind.

On the one hand, the book is seen as a Gutenbergian product that is going out of date. On the other, the advantages of printed books are recognized, as is the fact that books will continue to be printed in the foreseeable future.

What role will the book play in schools at the dawn of the next decade? Will it be relegated to complementing digital technology, or instead, will digital technology be viewed as reference material and books used even more than they are now? Or is digitalization inevitable for books too? Will the pace of digitization increase? And if so, how? Will we continue to read electronic print replicas in future, or will digital technology change the whole concept of the book, so that what used to be a delimited entity is replaced by a variety of electronic teaching materials? Is the book as we know it disappearing?

A number of possible scenarios are emerging. In this research, the e-textbook is seen as innovation with the



potential to develop in a variety of directions, according to the feedback from the book market. Although the state is involved in choosing the path ahead on a national and municipal level, teachers and students are the most important actors, since they are the ones who ultimately accept or reject a particular technology.

The teacher's role is not easy, as she or he has to consider entirely new things when choosing an e-book: what is included in the product, how does it work, how usable is it, and what interactive features does it have? What about digital rights management (DRM)? It is a lot to ask of a teacher: to figure out the advantages and disadvantages of a solution when this means more than simply choosing a textbook. Technological solutions range from ecosystems and user management software to device level, and may require new ways of teaching.

Publishers produce textbooks based on requirements and demand. But publishers face a difficult situation when they do not know what the demand is and how to meet end-user needs.

It is therefore important that all stakeholders understand better what to expect from digital textbooks. Thus, the aim of this research is to classify existing formats and to list educationally significant features that are already in use – or could be implemented in e-books.

Another goal is to shed light on the current debate and concepts. For this research, I have followed the discussion forums and debates in trade magazines. The discus-

An early example of the supposed death of the printed book in the face of new technology is Octave Uzanne's work, *The End of the Book* (*La Fin des livres*, 1895). Uzanne was convinced that the recent invention of the phonograph made books obsolete: Why read anymore, when you can listen? The image shows an evil spirit holding a phonograph appearing to Gutenberg. Artwork by Albert Robida.

sion about e-books seems rather conflicted. When we talk about e-books, do we really know what we mean? A large proportion of the debate seems to concern electronic texts which are not in the category of the book, the use of information technology in general, or virtual learning environments – but ends in an argument about whether iPads or Android tablets are better.

When there is no information available about what digital textbooks are and could be, more than often teachers get an idea of digital textbooks by looking at a web pages.

1.1 The ultimate goal: an e-textbook roadmap

The aim of this research is to conceptualize existing models for e-textbooks and their relevant functionalities for teaching and learning. This will provide new information about the use and potential of e-textbooks for both users and producers, including educationalists, experts, content creators, publishers and technical enablers. The goal is to make it easier to choose the right e-book and to promote product development and mainstreaming.

The source material consists of various concepts of e-textbooks implemented in the largest and most advanced market, the United States, but Finnish and European examples are also included. This is set in the context of technological change: an e-book is software – or a file which runs on software – which works on a computer, tablet or mobile phone, and is thus an integral part of the world of technology which is in constant flux. It is dependent on developments in the technological environment. I will show that our technological and educational approaches also affect how we view the role of the e-book.

Then I will move on to the existing formats and classify their features. Finally, I will propose a few possible solutions to the problems identified.

The study aims to be critical and to learn from how e-textbooks have failed to enter the mainstream. It even lists these failures at length. This should not be interpreted as technological pessimism, but as a technological constructivist framework (Klein & Kleinman 2002; Bijker et al. 2012) where innovation is seen shaping according feedback and as a step toward developing much-needed dialogue. The basic idea of this discussion is that the technology does not deterministically control its own development – the real acid test is user approval (Atkinson 2008, 23) and market feedback, which steer development. Technology does not develop in a vacuum – not even the e-book (Hillsesund 2001).

This research claims that a good e-textbook is a possible and important component of networked digital content, but concepts, methods and forms of implementing it are still developing. It is possible to influence these, but this requires identifying the right problems, and solving them.

1.2 Technology changes faster than content

Electronic textbooks and learning materials have been widely available for nearly a decade. Yet it cannot be said that they have gone mainstream, sales have generally been no more than a few percent of the total school book market (Allen 2013). E-textbooks have been lagging behind the overall e-book market, which has exceeded twenty percent of the market share in the United States. Kindle has been the main source of this success in the Anglo-Saxon world, mostly in fiction sales. Elsewhere in the world, the e-book market is still much smaller (cf. Bonfanti et al. 2013). The latest development is a move away from the black and white e-paper devices which were once so popular. Only 19% of Americans own a device solely for reading e-books, a drop in 13 percentage points in one year (Anderson, 2015, 5).

The touch screen revolution has had a particular impact on the technical environment. For the first time (2015), sales of PCs or personal computers are expected to be overtaken by sales of even more personal computers: tablets. These were already outstripped by the even more personal computer, the smartphone, years ago. Well over five times more smartphones than tablets are sold (Gartner 2014). Increasingly fewer young Americans own a traditional computer (Anderson 2015, 5).

The smartphone has become a hand-held computer in recent years. Its screen has grown bigger year by year, and it is roughly as powerful as the average computer was 10 years ago. Smartphones are nearly always equipped with internet access and serve as a general social networking tool. In a very short period of time, they have become the device for not just everyone, but especially for every young person.

This change is completed by the development that almost all (99%) of the school students in the Nordic countries have a computer with internet access at home. They started using computers at a young age and this takes up a large proportion of their waking hours. In Scandinavia,

about 40% of primary school pupils spend more than four hours a day online (OECD 2015, 18–40).

1.3 The digital native as a model student

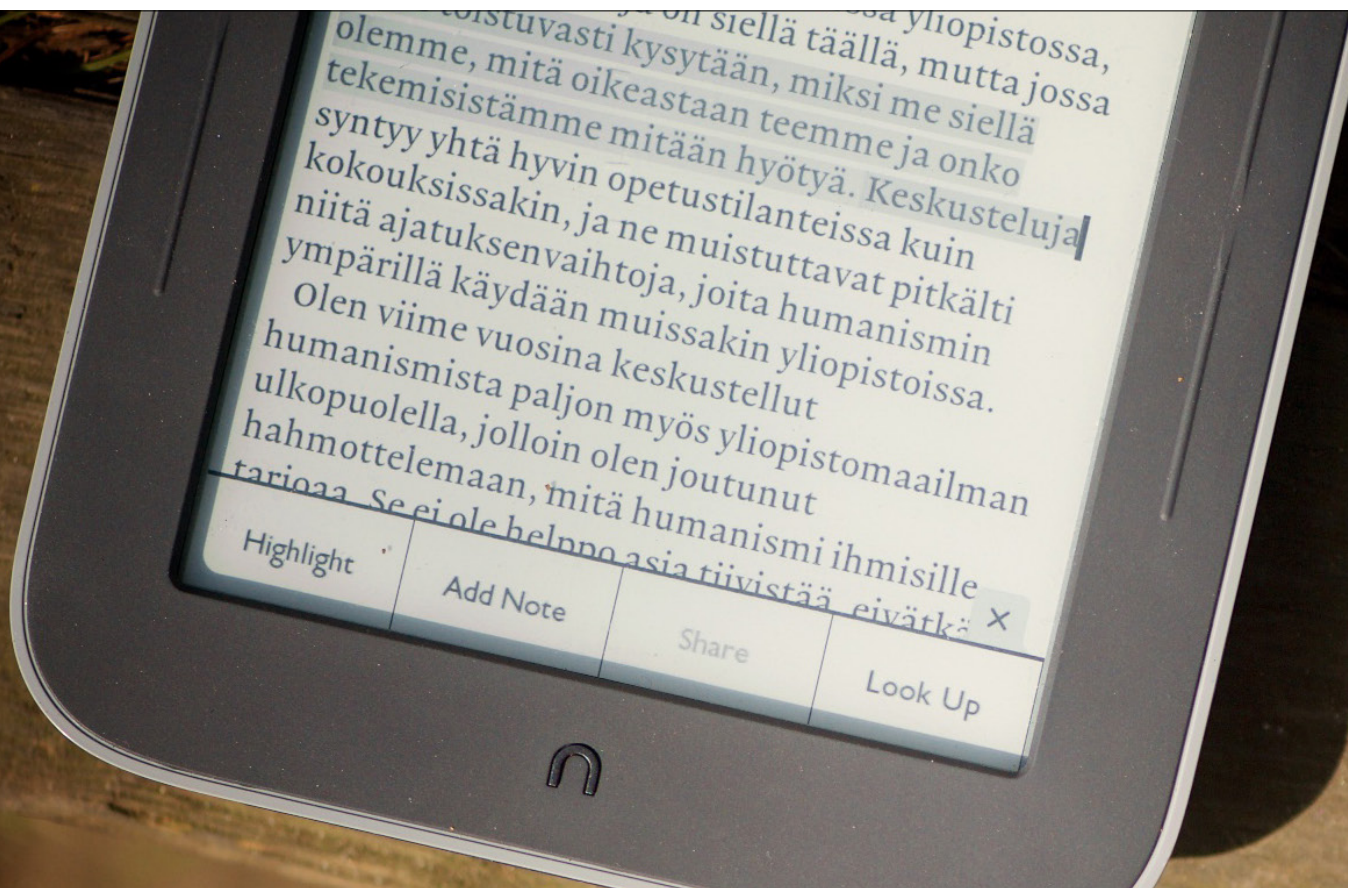
Such vast change cannot leave schools unaffected. Some see this as such a great cultural shift that it requires a change in the entire teaching paradigm, and this is highly significant for books. *Sanghyun Jang*, who researches the move toward e-learning, writes that the emergence of the 'digital native' generation requires as radical a change in education as the transition to a modern agricultural society (Jang 2014, 73).

Digital native is a term coined by educational consultant *Marc Prensky* at the turn of the twenty-first century. He used it to describe the differences between those born in the digital world and 'digital immigrants', who learned the language of digital technology later in life. School administrators and teachers are 'outsiders' who do not understand the new 'insider' digital social practices. Prensky argues that appropriate education for digital natives should use 'native idioms'. He cites games as the most common of these (Prensky 2001, 4). In this view, the diversity and interactivity of electronic media imply a qualitatively new literacy which requires a response, otherwise children's learning experiences may even alienate them from school (Korkeamäki et al. 2011). A new kind of learner who needs new teaching methods is assumed from this perspective.

This new approach emphasizes self-directed learning: the student is no longer to be the recipient, but the producer. The teacher is no longer a director, but more of an educational facilitator or mentor. The teaching must be adaptive, that is, personalized to the student's needs. Teaching should also use multimedia and provide access to a wide range of internet resources (Jang 2014, 74–75). Jang's summary is a good illustration of the symbiosis between a structuralist educational approach and an



Black and white e-paper devices designed for reading only, like Kindle, started the e-book revolution, but sales of these fell sharply last year. Above: Letto e-reader by AdLibris, Sweden, introduced in Finland in 2015, based on the CyBook Muse by Bookeen, France. Below: Nook e-reader by Barnes & Noble, USA.



emphasis on computer technology. It is clear that the traditional textbook type of product plays rather minor role in this environment.

Yet not everyone even agrees on whether or not new types of learner exist. Dutch learning psychologist *Paul Kirschner* and his colleagues have summarized criticism of a tailored educational approach for digital natives as ‘urban legends in education’ (Kirschner & Merrienboer 2013, 170–177):

1) The legend of digital natives

The idea that there is a new generation who naturally knows how information technology can be used for learning and how to construct meaningful audiovisual information from the deluge of data. For example, digital natives learn by playing, and they have developed the ability to do several things at the same time.

2) The legend of learning styles

The theory that tailoring individual learning and customizing information technology to specific learning styles (e.g. visual, analytic, or holistic learners) will supersede traditional teaching has no scientific basis.

3) The legend of learners as self-educators

Students are seen as self-educators, so they should be given maximum control over both their own learning and assessment of what they have learnt.

Kirschner’s article considers all these points in the light of the existing research, concluding that there is no evidence to support the effectiveness of a minimally directed and constructivist approach to learning. The fact that the structures of the human brain change very slowly appears to have been ignored. He argues that our understanding of learning ability, and in particular the key importance of long-term memory in learning, has increased in the last few years. If long-term memory is not developing, learning does not happen. Kirschner argues that problem-based learning, where the student gains knowledge by trying to solve problems, relies on short-term memory and does not lead to effective acquisition of knowledge and skills. Poor and mediocre students suffer from this, while gifted students do well regardless of the situation. (Kirschner et al. 2006, 76–77, 80.)

Many other learning psychology researchers argue along the same lines: our way of learning has not changed, and the assumptions about digital native and multi-tasking learners are somewhat questionable. Professor *Liisa Keltinkangas-Järvinen* emphasizes that the problem is not the use of information technology in and of itself, but rather the fashionable concepts of learning that go hand-in-hand with it, which not only lack any scientific basis but have even been shown to be incorrect. (Keltinkangas-Järvinen 2015.)

Similar concerns have been raised elsewhere. The fear is that digital teaching will break up the learning experience. Learning paths and learning objects may leave students with no more than a Spotify-style subject menu of data streams to pick and choose from (MindCet 2012).

The basis of learning has not changed: the assumptions that students are digital natives and multi-taskers are controversial.

The e-textbook is at the heart of this debate. Some are of the opinion that a suitable textbook for digital natives is no more than a series of various digital objects, while others emphasize that the experience of reading quietly is essential to developing long-term memory.

The concern is that the fascination with technology is having a negative impact on learning outcomes.

The e-textbook is at the heart of this debate. Some are of the opinion that a suitable textbook for digital natives is no more than a series of various digital objects, while others emphasize that the experience of reading quietly is essential to developing long-term memory.

The Canadian reading researcher *Christian Vandendorpe* (2013) identifies three categories of reading: *browsing*, *searching* and *grazing*. Browsing is what we do when we move from page to page on the internet without a clear goal. Searching is when we are doing a targeted search for specific information. Grazing is a traditional way of reading, going through a complete text systematically.

There is much debate about the gains of digital technology, but the losses are also worth discussing (Ross 2015). Combining the ideas of Vandendorpe and Kirschner, one might conclude that the digital revolution has made the experience of reading quietly for a long time a rarer one. This idea is also supported by Naomi S. Baron (2015) who claims that digital reading might not be the best solution for all types of reading. Perhaps e-books are not a substitute, but a complement to printed matter, offering us the best of both worlds. Cory Doctorow (2015), who has written a great deal about digital books, also came to this conclusion.

Perhaps the focus should be on considering how future digital books and educational content could also support grazing as a reading experience?

1.4 Conflicting results from large digitization projects

Regardless of the favoured educational concept, it is worth examining previous digitalization projects to avoid repeating the same problems. Digital books have played a key role in several ambitious projects recently, with little success. The basic idea of successful iterative development is that if one approach does not work, another variation is attempted.

SMARTeducation was a South Korean project (2008–2015), which aimed to digitize the learning environment completely at primary and secondary level. Digital textbooks and support resources were introduced at all levels in the pilot schools. Since then, Korea has given up on its plan and brought books back alongside the digital materials (Harlan 2012). The experiment with full digitalization was abandoned as it was seen to have had a negative impact on learning. For example, it was feared that digital textbooks only increase internet addiction and screen time. The premise of the project was weak, as digitalization in itself was thought to lead to a better outcome than an analogue approach. (Nam-Joong 2011.)

The major digital project in Los Angeles Unified School District, LA Unified (LAUSD), was shelved this year (2015). The original intention was to spend over a billion

dollars on purchasing tablets with packages of English language and mathematics materials. In the first part of the project 36,000 pupils received iPads with educational materials by Pearson. Due to a series of usability problems with the materials – including access (less than five per cent of the students were able to log in online without any problems), the fact that the material did not meet educational requirements (Lucas 2015), the devices were used inappropriately and a surprisingly large proportion of them disappeared (Margolin et al. 2014) – the agreement with Apple and Pearson was cancelled and the project, which had targeted 650,000 students, was suspended.

Michel Horn views LAUUSD as a cautionary tale. Digitizing teaching is not impossible, but projects can be extremely challenging. Projects should not be technology-driven, but first clarify the problem which needs solving and only then look for a suitable technology (Horn 2015, 97–98). Horn states that ‘No one wants to be the next LA Unified. I think that’s healthy, and it will get people to pause and learn the bigger lesson’ (Lapowsky 2015). The LAUUSD was not driven by learning objectives and the learning experience. There was no pilot phase, the devices and ready-packaged content were simply purchased.

A large Canadian study by Karsenti & Fievez (2013) investigated the use of iPads in schools. The final report praised improved student motivation and access to sources of information, as well as increased team work, but criticized the decline in learning outcomes. The latter was attributed to the increase in distractions during class caused by the iPads, which were not only used for studying and thus reduced concentration levels. It was a challenge for teachers to manage multiple programming platforms simultaneously, and many teachers experienced that planning took several times longer. Other researchers also cited distraction and increased workload (Jöns-son 2015, 13). Karsenti also found new reward systems: teachers gave students playing time on the devices at the end of class if it had gone well. Unexpected problems arose around using e-books. Firstly, many books require a constant internet connection. The actual use of tablets for reading e-books also fell far short of expectations. Less than three percent of the students who participated in the trial said that they had read a textbook on a tablet (Karsenti & Fievez 2013, 39).

Similarly, the University of Washington pilot study of student e-textbook use found that there were major difficulties with using e-books on mobile devices and outside the university network. Logging on was perceived as particularly cumbersome. The analysis showed that less than one percent of all pages were read in offline mode. A quarter of the students ended up buying a paper copy of the book themselves, even though they had received the same book in electronic format free of charge for the study. The newspaper headline was ‘digital natives prefer printed books’ (Giacomini et al. 2013, 8). This observation recurs in other studies. Students prefer printed books and complain that it is difficult to stay focused on e-books for a longer period of time (Baron 2015, 75–76).

The move toward e-learning has been criticized for focusing too much on technological capacity, often by acquiring the equipment first, and only then thinking about the content and how to use it.

The user experience of e-books is compared to paper books, which is a demanding standard. Parents involved in the study also reinforced this impression: if the connection is slow or breaks up, it is quicker to dig out a paper book (Vernon 2006). Using e-books has to go smoothly, or they will not be used at all. A properly functioning high-speed wireless connection and effortless signing-in are basic requirements.

For Horn, the LAUUSD is a case of techno-hype. The latest OECD report also cautions against excessive enthusiasm for all things digital. Understanding and learning requires an intensive teacher-student relationship, which technology can damage in some cases (OECD 2015, 3). The OECD emphasizes that acquiring the technology never leads directly to better learning – it is far from being an automatic process.

The conclusion is that more extensive use of information technology in schools does not seem to improve learning outcomes. On the contrary, more intensive average use is to be associated with ‘significantly lower learning outcomes’ (OECD 2015, 16). In its report, the OECD criticizes the naïve application of technology, poor quality of teaching programmes, and overestimation of teachers’ and students’ digital skills, stressing that there are lessons to be learned. Technology allows students and teachers to work together, enables material enrichment, improves cooperation, sharing and updatability, and places the teacher in a key position. The teacher has to be active in the change process, not only implementing it but also participating in creating it (OECD 2015, 3–4).

The move toward e-learning has also been criticized in Finland for focusing too much on the technological side, often by acquiring the equipment first, and only then thinking about the content and how to use it. Nevertheless, technology-driven 100% digitalization projects are in the pipeline. The municipality of Vantaa’s decision to purchase 16,000 tablets in 2014 could be a case in point. Expectations are high: according to the deputy mayor Vantaa is the first Finnish city where studying is being completely digitized’. According to the local newspaper, Vantaan Sanomat, this is an internationally unique leap into the digital age, which means replacing printed textbooks with tablets. This turns students into knowledge creators (Salonen 2014).

In reality, acquiring the devices is only the first stage of development. The lack of high-quality Finnish material, integrating learning objects into various teaching plans, teacher and student engagement, user management, usability, and the diversity of ecosystems are some of the many issues which will crop up next.

There is a risk that the large investment will not be exploited fully due to a lack of appropriate content. As yet, only a small amount of educational content is available digitally. Information technology is underused from a resource perspective (Norrena & Fabric Beach 2010). Only a small proportion of teachers can use the technology with ease (Ilomäki 2012, 7). Teachers cannot be expected to shoulder the burden of creating new materials.

The situation in Sweden is quite similar. Svenska Dagbladet writes that Sweden is ‘The world’s best equipment dealer – and the world’s worst user’ (Sundén-Jelmini 2014). This newspaper headline summarizes the Swedish Digitalisation Commission’s assessment, which rates the country’s schools as poor in four out of seven categories. Sweden is doing well in only one category: the number of computers assessed is good, the best of all the reference countries.

The newspaper article refers to Professor Berner Lindström’s research at the University of Gothenburg. Lindström also emphasizes that teachers are the key to digitalization and that currently digital learning materials are far too complex for some teachers to use. Some teachers ‘are marginalized’ and experience the technology as disrupting their teaching, while others are excited by the opportunities the technology presents. Lindström found this polarization recurring in study after study.

On the other hand, Lindström argues it is wrong to criticize the information technology from a traditional educational perspective. The teacher should not see information technology as a tool to replace, enhance or improve their teaching, but as an aid that will help them to determine what skills are needed in the information society. ICT is not going to replace old methods, but add to them; it should be naturally integrated into the teaching of all subjects, according to Lindström (Arpi 2012).

Major procurement and large-scale projects have been justified from an employment, democracy and learning perspective (Jönsson 2015, 9). Supposedly, students will prepare for a digital society and working environment, a device-per-student procurement policy will reduce the digital divide between those who can and cannot afford a computer, and ICT will improve learning. These arguments were also made in the Vantaa decision. (Salonen 2014.)

In contrast, it seems that the lack of devices with internet access is not the main problem, because so much time is already spent online or in front of computers that this cannot really be increased (OECD 2015, 18–40).

The same report argues that equal access to devices and the internet does not increase equality in ICT, but in fact, the reverse is true. The better the basic skill level (good literacy and mathematical skills), the greater the equality in terms of ICT. (OECD 2015, 16.)

Digital technology is not the solution, but a tool.

The chasm between early adopter and early majority is hard to cross – these groups have different needs and preferences.

1.5 Towards implementing the technology

The above section raises the question as to why digitalization projects are so technology-driven and always seems to run into the same problems.

One explanation may lie in Geoffrey A. Moore’s (2014) technology mainstreaming model. It is based on Everett Rogers’ diffusion-of-innovation curve, which dates from the early 1960s. It classifies technology users according to the different stages of mainstreaming: technology moves first from the developers to a small group of early adopters, from which it reaches the larger majority, which Rogers divides into two subgroups, the early and the late. The majority is followed by the late adopters, who are about as numerous as the early adopters, but suspicious of technology.

Moore’s key point is that the main problem with mainstreaming is not what we generally focus on, that is, getting the early adopters to use the technology. Instead, the chasm between early adopters and early majority is really difficult to cross, because – and this is key – these groups have different needs and preferences.

Early adopters like to experiment and approach the technology as valuable and interesting in itself, which is reason enough for them to try it out. The early majority is more pragmatic. Its relationship to technology is instrumental. People in this category want solutions to the problems of everyday life and value ease of use. The majority does not want technological revolution, but evolution. These people want to minimize the discontinuity between old and new. Early adopters may accept products with problems, but the early majority will not. It does not want to be a test user for an unfinished product. (Moore 2014.)

If e-books are to reach the mainstream in schools, it could be argued, based on Moore, that the target group should be the majority rather than early adopters. This means increasing usability and the user experience until it approaches the level of printed products. In addition, problems and educational objectives should be defined by subject first, and only then should the search for the appropriate technical solutions begin. This also means that the technology is understood as a whole, which will continue to develop. A tablet is not an e-book. An e-book is content on a tablet, and integral part of a software / hardware framework somewhere within an ecosystem.

The type of e-textbook which Moore’s majority can accept is still under construction.



How was the research conducted?

The first problem for this research was what qualifies as material at all. This problem describes the change in the sector as a whole. It used to be clear what a publication, publisher, publishing platform and release technology were, but the boundaries between these are blurring. We could think of an e-book as a content, but also as a standard file which is read by a certain reader which creates a reading experience. So what is the e-book? The file or the app or even the reading platform?

Many publication types, such as [Inkling](#), are software developers and proprietary publishing platforms, but, at the same time, also publishers. There is also a type of application which only reads other publications, but enriches them so much that it is more appropriate to call it a data-processing app than a simple reading program. For example, applications like [SubText](#) – which is discussed below – are created for emphasizing interactivity in reading, but [LiquidText](#) (see image below) is closer to something new, which does not yet have a name.

[Liquid text](#) is an iOS programme that allows you to read, manage and organize your text in a new, active way. Liquid text is an example of a programme that is difficult to place in any previous context, but its approach may prove highly significant in terms of e-textbooks.

I came to the conclusion that, even if it is possible to distinguish between the e-book and e-text or e-materials, the exact delineation was not justified in terms of the research questions. It is worth including the whole range, as there are no clear exclusion criteria. More than 30 e-textbooks and reading applications were reviewed for this research to identify their features, and I used this data to construct a model of e-textbook formats and functionalities. The crucial factor was whether these products were used as study material and the target group saw them as e-textbooks or not.

The works were selected based on popularity, size and levels of recognition, with an emphasis on the US market. The USA was chosen for the case study because e-textbooks have developed further there – after all, the aim is to understand how they are evolving. Material from Finland's edSTORE, and French and Italian solutions, were also included for comparison.

Listings of popular e-textbook services were also used. Mobile material was largely collected from Apple/

jokaisella" (Saikkonen, 2015 #898)

Tämä muutos täydentää kehitystä, jossa lähes kaikilla (>99 %) koulukäytävistä pohjoismaalaisista on tietokone ja internetiä kotona, ja jossa tietokoneiden käyttö aloitetaan nuorena ja se vie suuren osan vapaa-aikasta. Skandinaviassa koululaisista n. 40 % viettää netissä jo yli neljä tuntia päivässä (OECD, 2015 #892@18-40).

Digitaaliset natiivit

Näin suuri muutos ei voi olla vaikuttamatta kouluun. Jotkut näkevät tämän kulttuurisen muutoksen niin suurena, että sen nähdään vaativan paradigman vaihdosta koko opetuksessa, ja sillä on merkitystä myös kirjan kannalta. Pedagogiikan sähköistymisen tutkija Sanghyun Jang katsoo, että "digitaalisten natiivien" ikäluokan syntyminen vaatii yhtä radikaalia muutosta koulutukseen kuin oli agraariyhteiskunnasta siirtymisessä moderniin. (Jang, 2014 #870@73)

Digitaalinen natiivi on opetuskeskeisen Marc Prenskyn termi 2000-luvun alusta. Hän ku- sittaa digitaaliseen maailmaan syntyneiden erilaisuutta niihin "digitaalisiin maahanmuuttajiin", jotka ovat tutustuneet digitaalisuuden kieleen myöhemmällä iällä. Prenskyn mukaan digitaalisille natiiville nativille sopiva opetus on lähtökohtana erilaista, opetettaessa tulisi käyttää natiivien idomeja, joista yleisimmäksi hän nostaa pelit. (Prensky, 2001 #861@4).

Tämä uusi **idomi** korostaa itseohjautuvuutta, oppilas ei ole enää vastaanottaja, vaan jopa tiedon tuottaja. O- ja ei ole valva ohjaaja, vaan enemmänkin opetuksen mahdollistaja, mentori. Opetuksen tulee olla adaptiivista, se personoidaan oppilaan tarpeisiin. Opetus on hyvin mediarikasta, se tarjoaa vapaan pääsyn moninaisiin lähteisiin internetissä (Jang, 2014 #870@74-75). On selvää, että perinteinen oppikirja on tässä ympäristössä vähäisessä roolissa. Jangin summaus kuvaa hyvin ns. Strukturalistisen pedagogiikan ja tietotekniikka painottavan ajattelun symbioosia.

Kaikki eivät ole kuitenkaan aivan samaa mieltä edes siitä, onko olemassa uudenlaisten oppijoiden ikäpolvi. Hollantilainen opetuspsykologi Paul Kirschner ja kumppanit ovat tiivistäneet diginativeille räätälöidyn pedagogiikan kritiikkinsä "oppimisen urbaaneiksi legendoiksi" (Kirschner, 2013 #888@170-177)

1) Diginativien legenda
Ajatus siitä, että on olemassa uusi sukupolvi, joka luometaan tiedä kaikki tietotekniikkaa voidaan käyttää oppimiseen ja jolla suuret rakentaa merkittäviä aineellisia voimavaroja tietotekniikan avulla. Diginativit oppivat esimerkiksi pelimalla ja he ovat kehittyneet hyvin tehdi monia asioita samalla tavalla.

2) Legenda oppimistyylistä
Tällä spesifisellä oppimistyyllä (virtuaaliset, analyttiset, holistiset jne.

P 6

oppijat, joiden yksilöllinen opiskelu tulisi soveltaa ja joiden mukautettu räätälöitynä tietotekniikka voitaisiin perinteisen opetuksen ei perustu tieteseen.

3) Legenda itseohjautuvuudesta
Opetusjärjestelmän edellyttämien itseohjautuvien oppijain, jolle tulee antaa sekä maksimaalinen kontrolli omasta opiskelustaan että oppimistensa arvostamista.

Kirschner artikkeli käy kaikki kohdat läpi olemassa olevan tutkimuksen pohjalta ja päättyy siihen, että mikään ei puolla näihin "legendoihin" perustuvan "minimaalisesti ohjatun" ja "konstruktivistien" oppimiskäsityksen tehokkuutta. Sen nähdään jättävän huomiotta ihmisen kognitiivisen rakenteen muuttumattomuuden. Tällä viitataan omaksumiskykyyn ja erityisesti pitkäkestoisien muistin keskeiseen merkitykseen oppimisessa, jonka ymmärtäminen on Kirschnerin mukaan vain kasvanut viime vuosina. Jos pitkäkestoinen muisti ei kehity, oppimista ei tapahdu. Ongelmakeskeinen oppiminen, jossa oppilas itse rakentaa tiedon esillä olevien ongelmien ratkaisua kuormittavien lyhytkestoisista työmuista, eikä joida tehokkaaseen oppimiseen, välttää Kirschner. Huonot ja keskinkertaiset oppilaat kärsivät heikosta ohjauksesta, lahjakkaat pärjäävät tilanteesta riippumatta. (Kirschner, 2006 #872@76-77, 80).

Psykiologian professori Liisa Keltikangas-Järvinen on samoilla linjoilla. Hän korostaa, että ongelma ei ole tietotekniikan käytössä sinänsä, vaan sen mukana kulkevassa modissa oppimiskäytännössä, jolla ei vain puutu tieteellinen pohja, vaan joka on myös osoitettu virheelliseksi. (Keltikangas-Järvinen, 2015 #869).

peda

Kuuluuko tää tähän?

Näin suuri muutos ei voi olla vaikuttamatta kouluun. Jotkut näkevät tämän kulttuurisen muutoksen niin suurena, että sen nähdään vaativan paradigman vaihdosta koko opetuksessa, ja sillä on merkitystä myös kirjan kannalta. Pedagogiikan sähköistymisen tutkija Sanghyun Jang katsoo, että "digitaalisten natiivien" ikäluokan syntyminen vaatii yhtä radikaalia muutosta koulutukseen kuin oli agraariyhteiskunnasta siirtymisessä moderniin.

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Retour Les idéaux-types de Max Weber

Idéaux types	De Max Weber [1864-1920]	Contemporains
La rationalité en valeurs	L'aristocrate qui défend son honneur, le chevalier qui part en croisade, le capitaine qui reste sur son navire en train de couler.	Le croyant pratiquant, le militant convaincu, le patriote.
La rationalité en finalité	L'entrepreneur qui recherche le profit maximal, le chef d'armée responsable, le savant qui fait avancer la science.	L'élève qui veut obtenir le baccalauréat, l'homme public qui veut briller en société.
Les sentiments affectifs	La gifle, qui répond à un réflexe émotif.	La colère dans les banlieues, les manifestations contre la violence.
La tradition	Les activités familiales	Le repas, la séance de



iTunes stores (USA, France, Italy, Finland). Apple iOS was selected because this platform has the most paid content. The search words were *electronic textbook*, *textbooks*, *textbook*, *biology*, *libro de texto* and *manuel numerique*.

Because e-books contain such diverse material, the research focused on biology books, a very common type of textbook which combine images and text and which require multimedia presentation and notes.

The initial search was performed for the most popular middle school or high school (Higher K12) natural science books (Math & Science > Life Sciences > Biology). If one was available, I searched for similar records for other educational levels, and if not I searched for an equivalent book from another subject.

In practice, this did not work out quite as expected. Sourcing material was complicated by the low availability and high prices of books in the selected subject area (in the USA often over \$200) and various restrictions on access to the files (territorial restrictions, country-specific checks, and school-specific access). A great deal of time was spent on various login procedures.

Once the material had been classified by functionalities, a qualitative content analysis was performed (cf. Mayring 2000) to identify the common characteristics of the source material and create categories, which were edited, consolidated or deleted as the volume of material increased. Finally, the data was placed in the resulting matrix and analysed.

Content analysis proceeded step by step, inductively and iteratively. When enough common characteristics were found, an initial category criterion was created, and this was corrected as required when more material was added.

The material is so heterogenous, it was difficult to classify. Image: Flash BAC S.E.S. 'Textbook' designed by Hachette for French smartphones. It is part of a series of revision material in various subjects for the BAC, the high school exam required for university entrance in France. S.E.S. means economics and social sciences.

The format that stood out immediately was the print replica. The web page was a difficult category, because EPUB or hybrid categories may not technically differ from a web page, however the web page is an online concept, while EPUB is an XHTML-package for offline viewing. The way in which information is presented on pages is enough to distinguish between them. Navigation at the top menu with the sub-menus underneath it; page and column scrolling; and page background and column layout, links leading outside the book etc. are absent in the EPUBs.

In the end, multimedia pages were easy to pick out as they typically had a large viewing area, little text and scrolling one screen at a time, as with CD-ROM.

Once the formats were defined, the next step was to identify their functionalities.

The classification model I proposed for the Next Media project (Heikkilä, Laine, & Nurmi 2013, 22–28) was used as a basis for this. In that research, the functionalities of the digital book were based on those of the printed book, but extended and divided into categories based on findings from 33 reading services. This matrix was supplemented by additional e-book functions identified in this investigation, such as flashcards and tests.

Since the purpose was also to find out what could potentially be done with textbooks, new categories which were not found in the material were also included by cross checking. For example, a social version of a digital scrapbook was not found in the material, but was seen as a potential category because the category 'creating a scrapbook' was found.

3

What are the existing formats?

The majority of the American sources consisted of a variety of print replicas. Other types identified included website-like e-books, multimedia formats and a new hybrid format.

The website-type publications included a lot of interactivity and linked material but utilized less traditional textbook material. The majority of the Finnish sources fell into this category.

A newer format emerged which did not seem to belong anywhere in the existing framework. I call this the hybrid model. The hybrid book can be a book-like way of organizing information but it applies modern hypertext techniques. It is not a borderless publication such as a web page, but clearly an entity of its own, which has attracted attention because of its usability, particularly for internal navigation.

Hybrid books also differ from print replicas in that the text and layout are adaptive, and the text is 'live text', not just an image of the text, which means the publication can work on different end devices. The publication can be optimized for different screen sizes.

Responsive and adaptive design is increasingly important as the screen size of end devices is varying more and more. Five years ago the vast majority of tablets on the market had the same screen size and aspect ratio, so it was possible to use text as an image. There was also only one size of iPad; in 2015, the iPad's market share had dropped to below 25%, and the models were available in three different sizes.

It should be noted that live text is not the same thing as fixed text. For example, PDFs contain fixed text that can be copied from one programme to another and highlighted, but the text size cannot be changed and it cannot (usually) be reflowed. The PDF format which is traditionally used for print replicas is based on PostScript, a programming language used for layout. The basic unit of a PDF is the page. Its layout and page numbers are fixed, corresponding to the printed publication.

One attempt to solve the problem of 'text as image' in print replicas is to place a layer behind the image from which the text can be copied, but this only solves part of

the problem. For example, highlighting does not work in this solution because the visible part of the text is still an image.

All the investigated publishing platforms and products are listed at the end of this study and some of them are discussed in more detail in this section. If the platform is discussed here, the listing only includes basic information about the product in italics. Otherwise, more details are included, such as an image of the product or a link to the product and its price. In the text describing the product features, the letters in brackets refer to the images in alphabetical order.

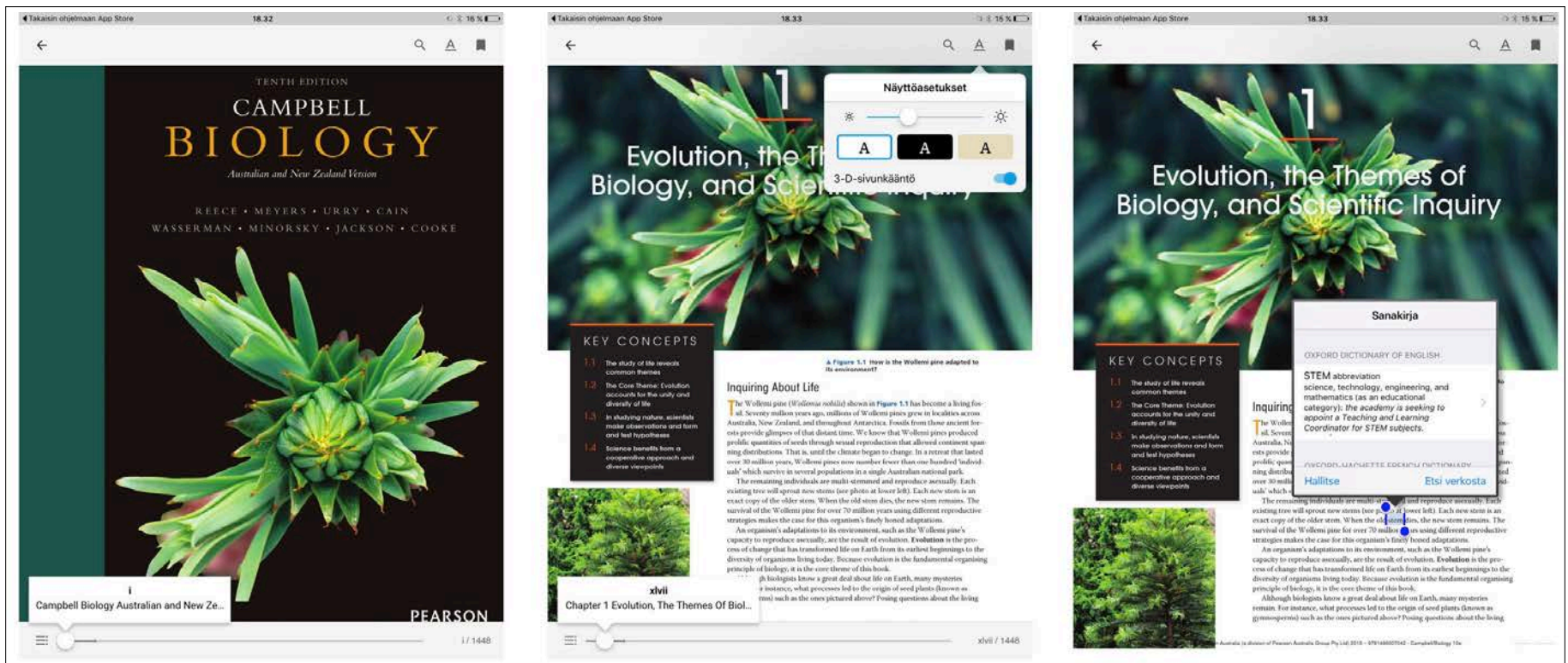
3.1 Print replica

A print replica is a digital copy of the printed book. You could say it is semi-analogue. The layout is not adaptive.

The advantage of print replicas is that they look like the printed book and are easy to publish, but the disadvantage is that the pages are not adaptable to varying screen sizes. Of course, print replicas are not editable.

An A4-sized book is understandably quite difficult to read on your smartphone, because the text size cannot be changed – the only way to do so is by increasing and decreasing the size of the whole page view. This non-adaptability is perhaps the biggest drawback of print replicas, because continuously resizing the image soon irritates readers.

The most common print replica technologies are PDF, Adobe Flash, pixel image publication (like [Adobe DPS](#)) and, more recently, fixed layout.



EXAMPLE OF A PRINT REPLICA

Google Books

Major publishers (e.g. Cengage, Wiley, Pearson, McGraw-Hill, and Macmillan) publish simple textbooks as print replicas.

Features:

- searching, copying, bookmarks, dictionary (e.g. right image)
- page background colour can be changed (e.g. centre image)
- text cannot be highlighted
- iOS, Android and browser

Google Books print replica (Campbell Biology, Pearson 2015.)

Print replica with a wide range of interactive content by Intel Education. Biology 10th edition (Sylvia Mader, McGraw-Hill Higher Education/KNO/ Intel Educational Study, 2014, \$145 for 6 month subscription) in iOS programme

zes. Houghton Mifflin Harcourt is the main partner publisher. Intel acquired Kno in the autumn of 2013 and subsequently subsumed the software into their own brand.

Kno has developed many advanced functions. With the MyJournal scrapbook function, the student sees their own annotations and can add images and video. The SmartLinks function opens up an explanation of a word or additional video at the top of the screen (e.g. below, top). Kno also has the following features:

- highlighting, searching, and notation are supported, as is copying text (but only within the app),
- integrated SmartLinks term dictionary (e.g. bottom)
- integrated SmartLinks video linking

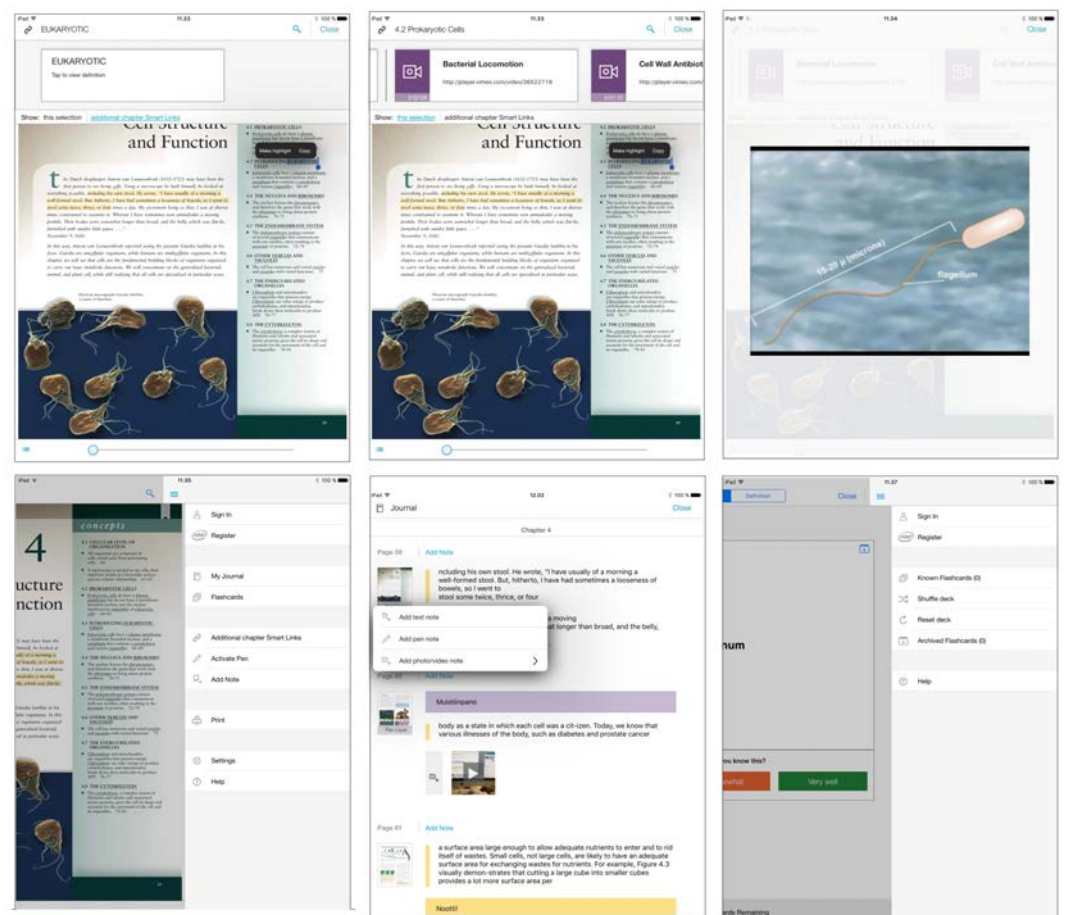
EXAMPLES OF AN ENRICHED PRINT REPLICA

In this format a variety of interactive functionalities are added onto and alongside the image layer. In the publications researched here, this was more than just media enrichment – for example, bringing the book to life through animation or videos. The new functionalities went much further to exploit the network potential for learning.

Intel Education Study (Kno until 2015)

Kno textbooks originally appeared on its own tablets. Kno's flagship model consisted of two screens closed like a book in a large tablet. I tried out the device at the Digital Book Seminar in New York, in 2011. The left-hand screen was a print replica, and the right-hand one was a single-screen workspace that was used with a pen. The device seemed ambitious, but heavy and costly.

Kno has subsequently concentrated on software. Kno has three product groups: Kno for School, Kno for College, and Kno for Publishers. The latter is a production environment in which the publisher can add interactivity to their products. The publishing environment can be used to enrich PDFs, for example by adding image quiz-



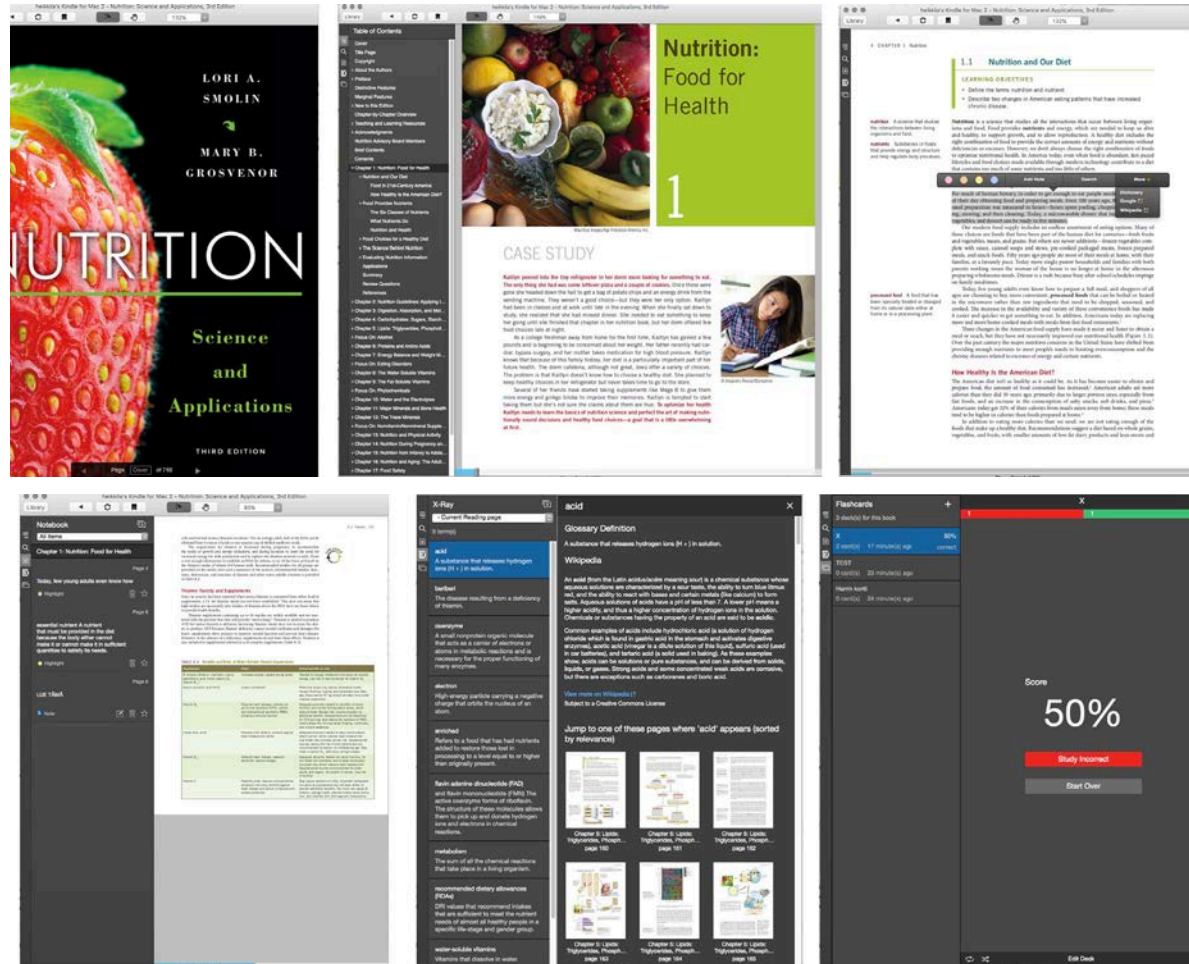
- flashcard function (e.g. bottom)
- MyJournal interactive scrapbook compiles notes and highlights)
- access to Google and Wikipedia via the activated text
- iOS, Android, Windows, browser

Kindle eTextbooks

The world's largest paper and electronic book store service, Amazon, offers two e-textbook formats: the print replica and more advanced eTextbook platform. These books should not be confused with the ordinary Amazon e-books, which are usually available in .azw format – a comparable format to EPUB that is also used for simpler textbooks.

eTextbooks look like a printed book, but have a number of additional functions:

- highlighting, search, and notes are supported, but not copying text from the programme
- dictionary, access to Google and Wikipedia via the activated text (e.g. top right)
- scrapbook (Notebook) compiles notes and highlights (e.g. bottom left)
- flashcard function (Flashcard) for self-testing. Concepts and terminology can be added to two-sided cards and tested from memory in random order. Correct and incorrect answers are shown in the summary (e.g. bottom right). Flashcards can also be created automatically from scrap-books.
- interactive term bank (X-Ray) (e.g. bottom centre) shows the main terms and concepts in their locations on linked page thumbnails,
- support: iPad, iPhone, Android, Mac and PC via Kindle reader
- Format: AZW4, designed for Amazon proprietary textbooks
- AZW4 does not work on Kindle e-paper devices, nor could I get it to load on Kindle-tablet



Six pages of the Kindle eTextbook Nutrition-Science and Applications, 3 Edition (Smolin, Grosvenor, Wiley/ Amazon Kindle eTextbook \$83, 6 month subscription \$50)

- highlighting, searching, and notation are supported, but not copying text from the programme
- dictionary, access to Google and Wikipedia via the activated text
- discussion environment
- TextSmart and WriteSmart functions
- support: iPad, iPhone, Android, Mac and PC via Kindle reader
- Format: HMH's own

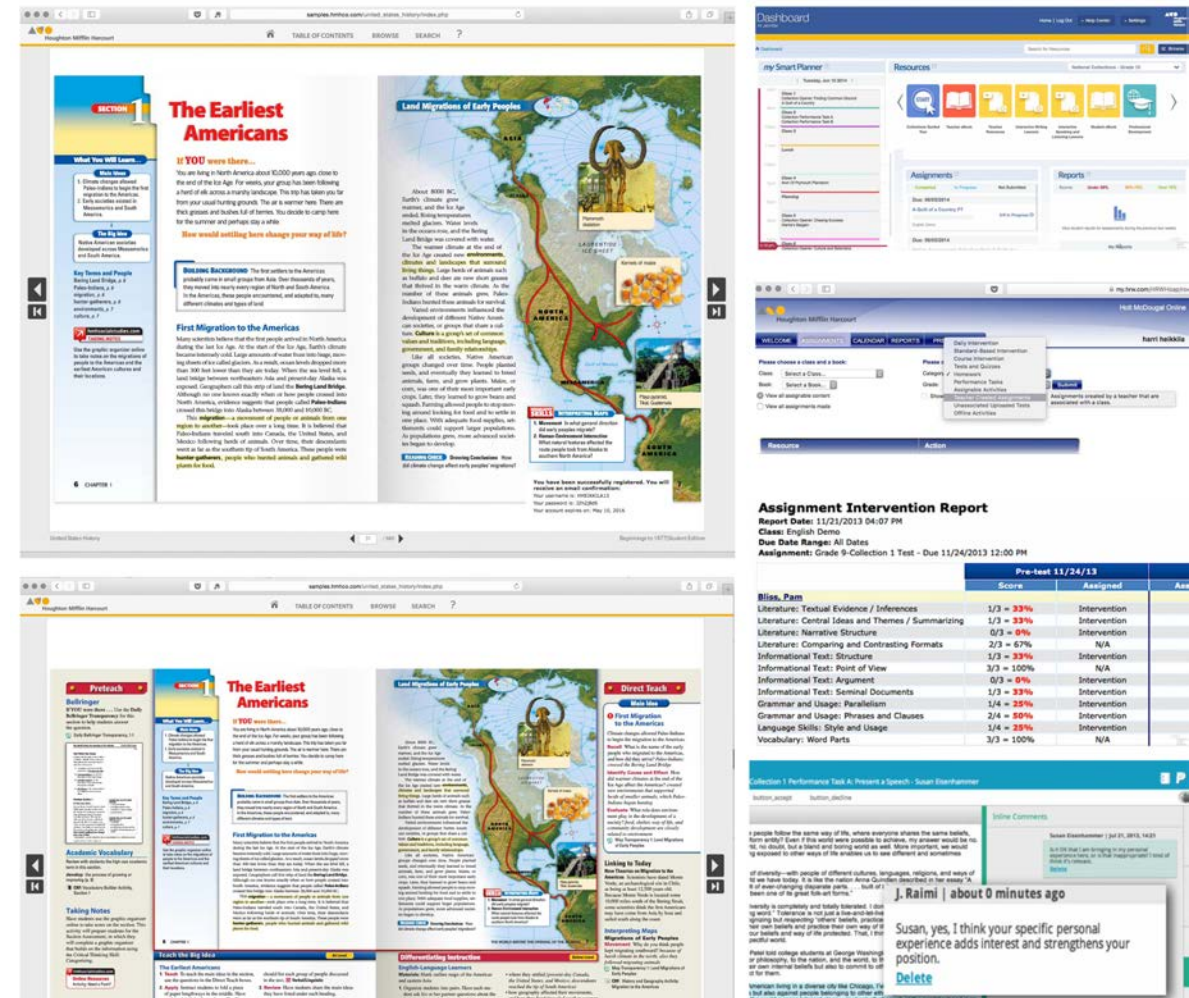
EXAMPLE OF A PRINT REPLICA WHICH IS CONNECTED TO A SEPARATE VLE/LMS ENVIRONMENT

Houghton Mifflin Harcourt (HMH)

Houghton Mifflin Harcourt connects print replicas to their own learning environment, which enables very diverse functions. For example, the teacher can assign tasks and additional reading material, create reading groups, monitor the discussion within them and answer questions. The student can for example 'reference' digitally.

HMH's features include:

- two different modes in the print replica: the teacher sees the version with tasks, the students have the basic version



3.2 Web page

A website-like book is navigated and functions similarly to a traditional homepage.

Boundless

Boundless is not a traditional publisher, but it compiles textbooks from the web and open sources to create low-cost teaching materials. This approach has led to copy-right disputes.

Features:

- the teacher can edit the text
- classes can be managed from the site
- ready-to-use tasks and quizzes
- looks like Wikipedia

Aleks

Aleks is McGrawHill’s learning environment in which students see a simple website-like exercise book while the teacher’s management view has a wealth of features, including student tracking and statistics. You can read more about the product via [this link](#).

3.3 Multimedia

The multimedia model is related to the popular 1990s vision of the future: the book on CD-ROM. It is a format of its own, characterized by generous use of media and screen by screen progress.

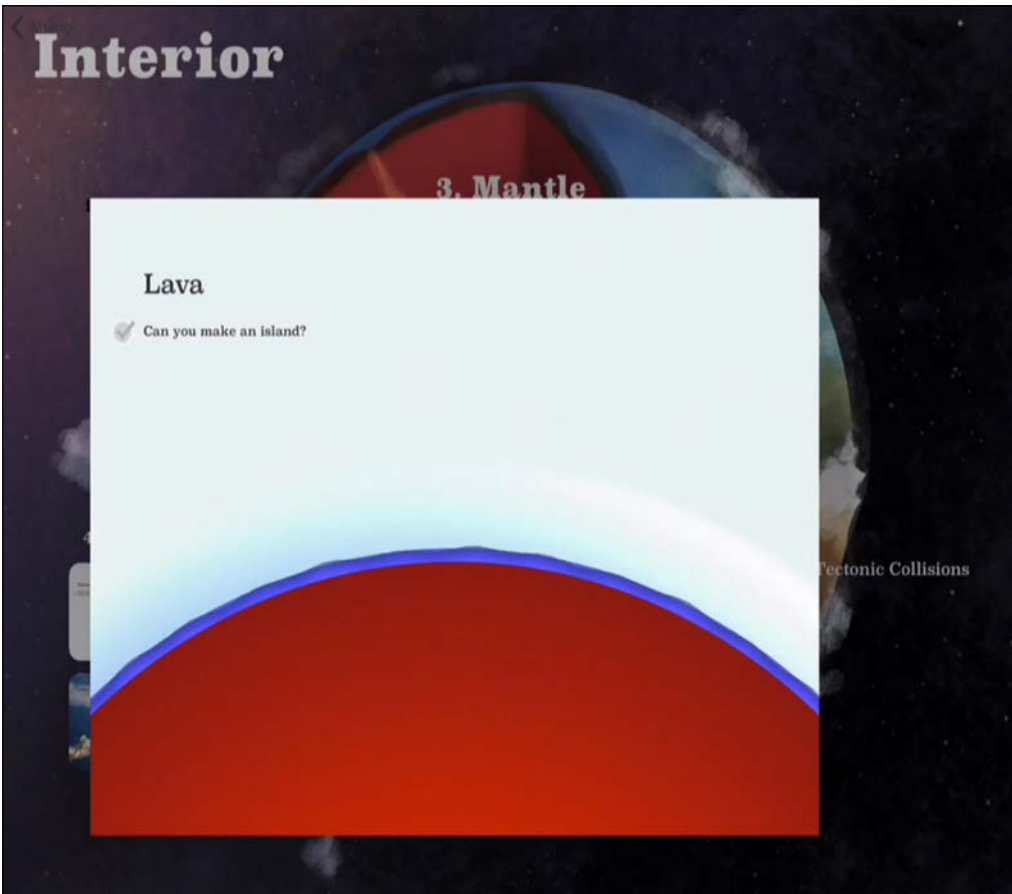
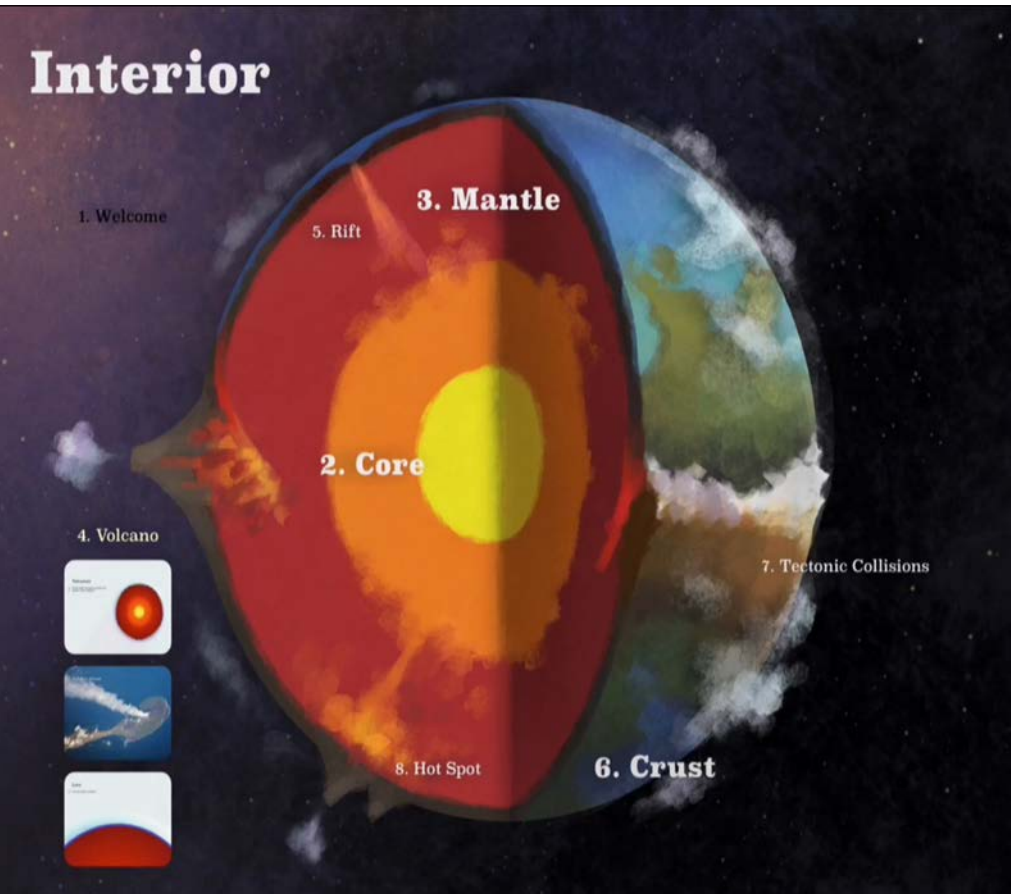
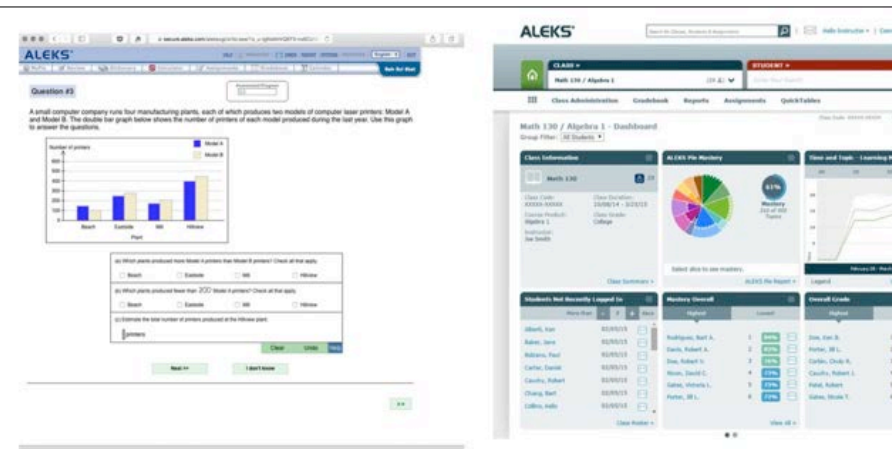
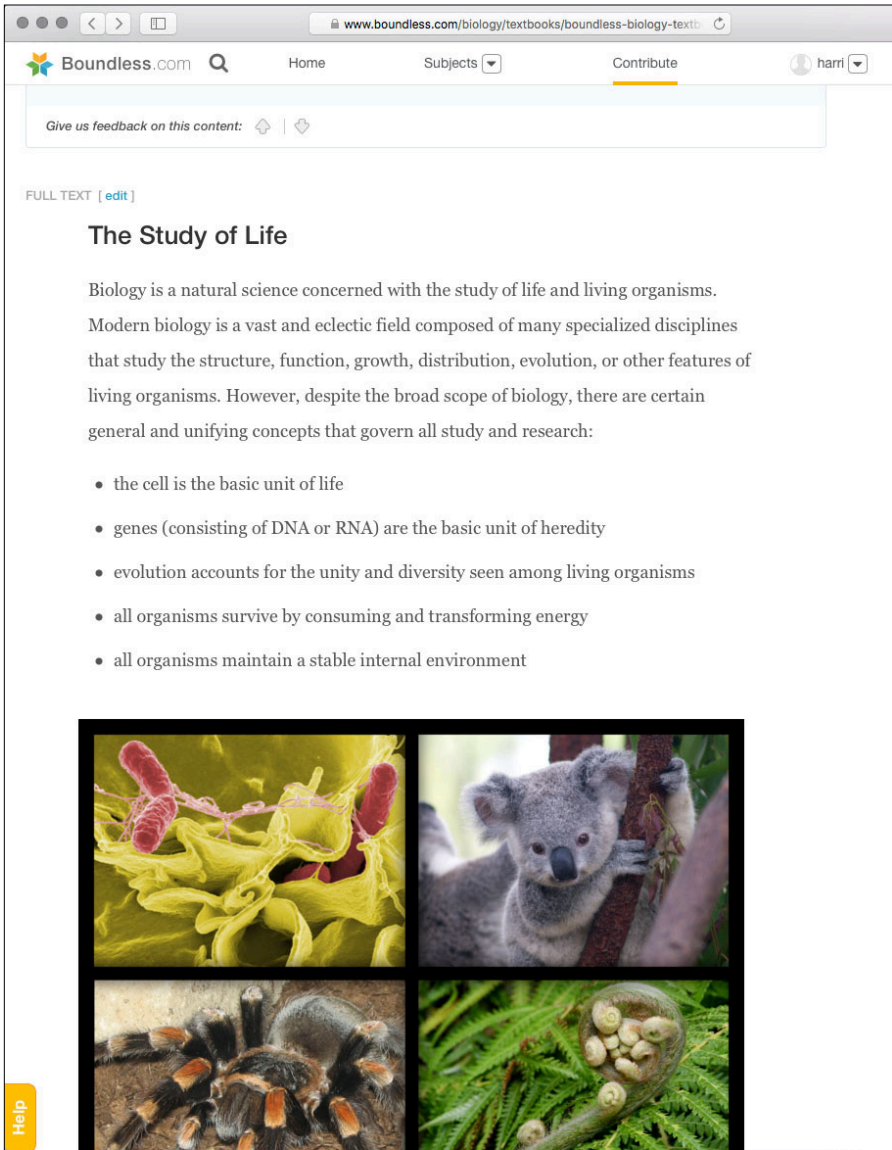
Earth primer

- not much text
- interactive full-page images
- videos

Biology book by Boundless is compiled from online sources.

McGrawHill’s mathematics textbook, which supports a separate learning environment.

Readers move through multimedia books one screen at a time, and the focus is on illustrative visualization.



3.4 Hybrid

In this model, a book-like environment combines the web, interactions and a learning environment. It is neither a print replica nor a website, but a format all of its own. The development of the hybrid appears to have been directly impacted by the emergence of a group of tablet products. For example, Inkling was founded in 2009 when Apple's textbook director saw Apple's iPad plans 'for the textbook of the future' and established his own company for this. Similarly, the Finnish Tabletkoulu (literally *tablet school*) was conceptualized for use on a tablet. The tablet is a more book-like environment than the computer, and also a more personal device.

EXAMPLES OF HYBRIDS

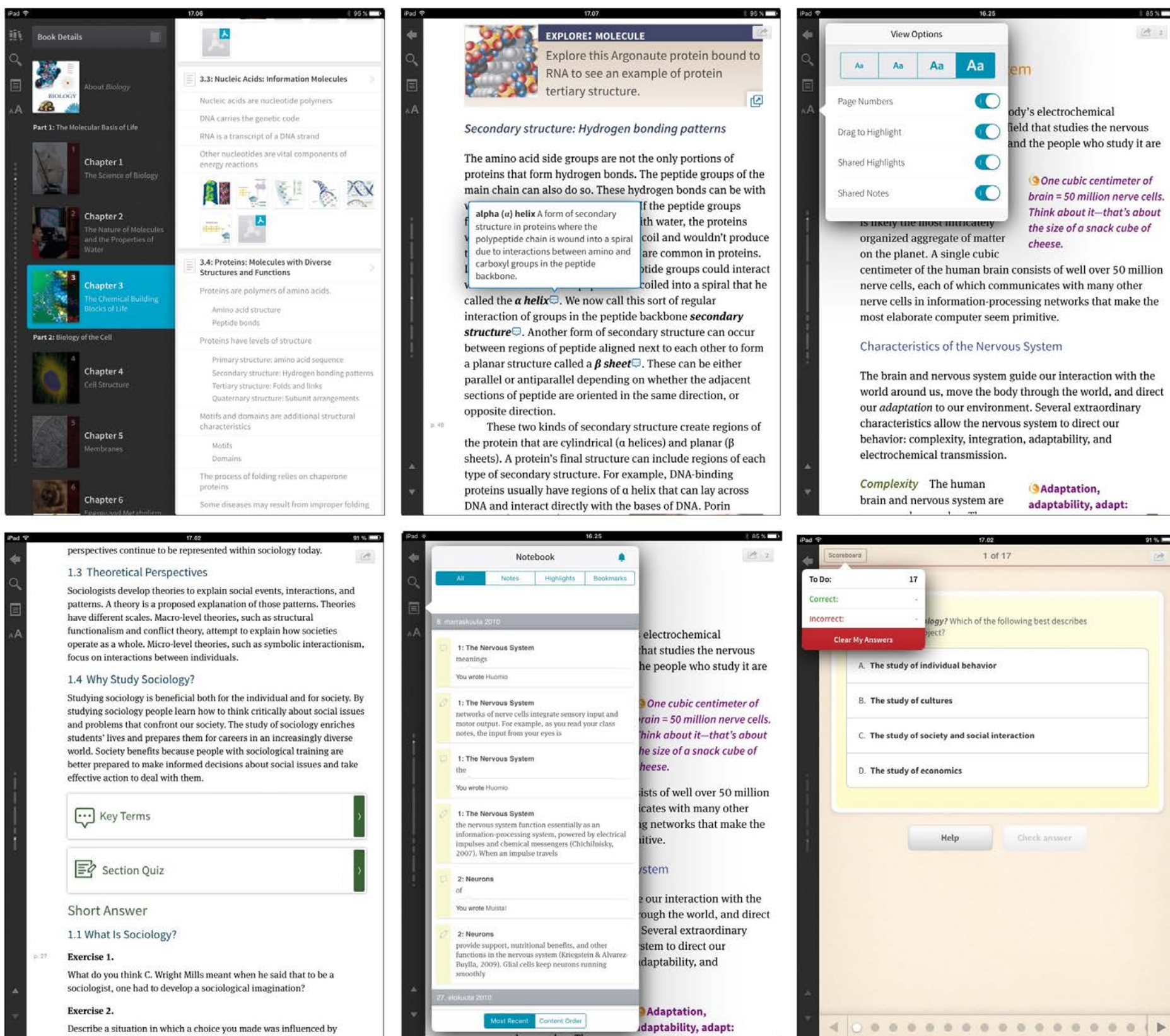
Inkling

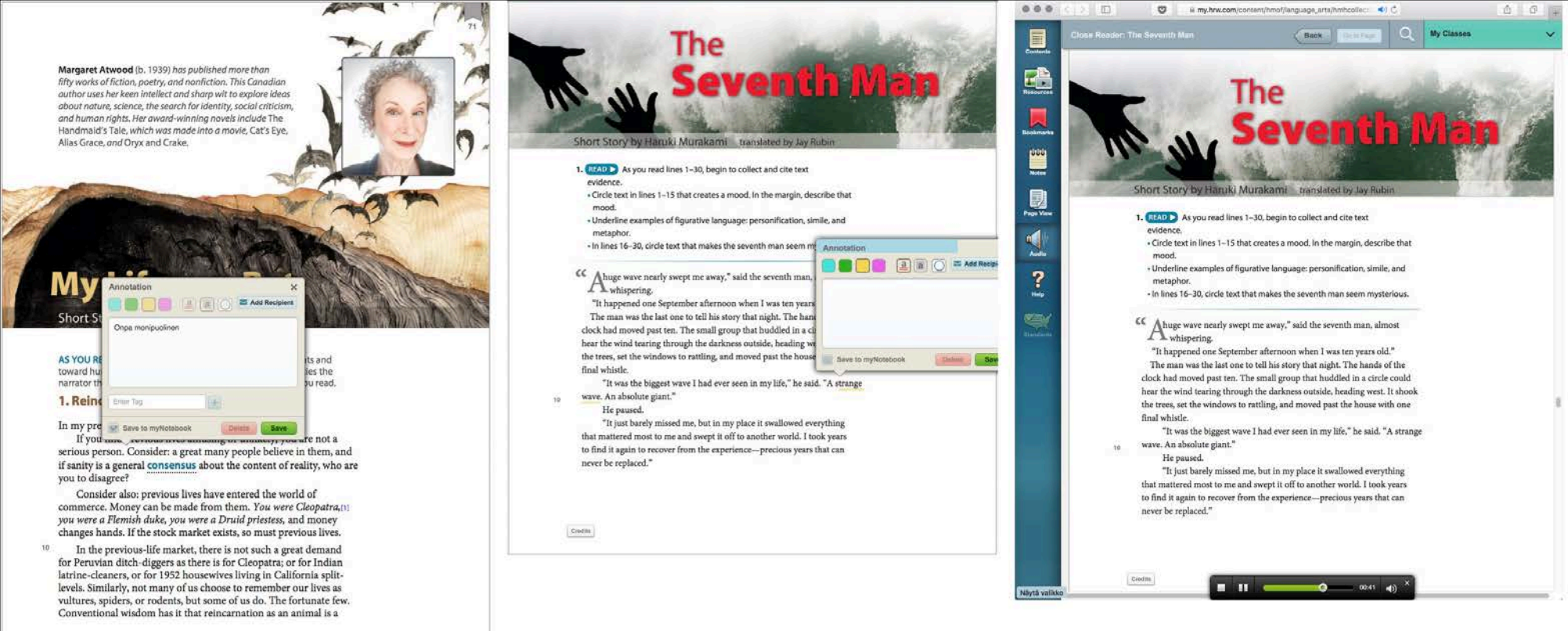
Inkling's business idea was to make interactive e-book versions of textbooks by major publishers and sell them.

Since then, the idea has changed. For Inkling, what the textbook industry really needs is not more publishers, but a scalable publishing platform for publishers to create high-quality new textbooks themselves.

Inkling no longer only converts existing books to digital format, but offers its customers subscription services for developing digital books themselves. The new concept is software as a service (SAAS). Habitat is Inkling's advanced cloud-based publishing environment utilizing a set of tools in which the publisher, writer and designer can work collaboratively. Interactivity is based on drag-and-drop type plug-ins. Inkling Axis is the component that enables web integration of more features. Inkling Latitude is a multimedia software development kit. The development kits are web-based and a whole team can work on one publication at the same time.

All Inkling user interfaces are similar to each other and production is based on strong style guides. It is well thought out: pages scroll vertically, and you move between chapters horizontally. The typography is high-quality and





Houghton Mifflin Harcourt's hybrids of books by Margaret Atwood and Haruki Murakami

additional features are integrated into the book. Besides Kno, Inkling is one of the best funded startups established in the last ten years within the publishing businesses.

Features:

- bookmarks, highlighting and notes are supported
- integrated term dictionary (previous page, top centre)
- end-of-chapter learning review quiz in three categories: understand, apply, connect
- notes and highlights can be shared with the group (e.g. top right)
- navigation is well thought out, pages scroll vertically, chapters and sections scroll horizontally (a left bar navigation tool displays chapter lengths and locations, see top left and centre images)
- a lot of multimedia and internal linking
- one copy of each book available free of charge
- platforms: iOS, Android, browser

Houghton Mifflin Harcourt (HMH)

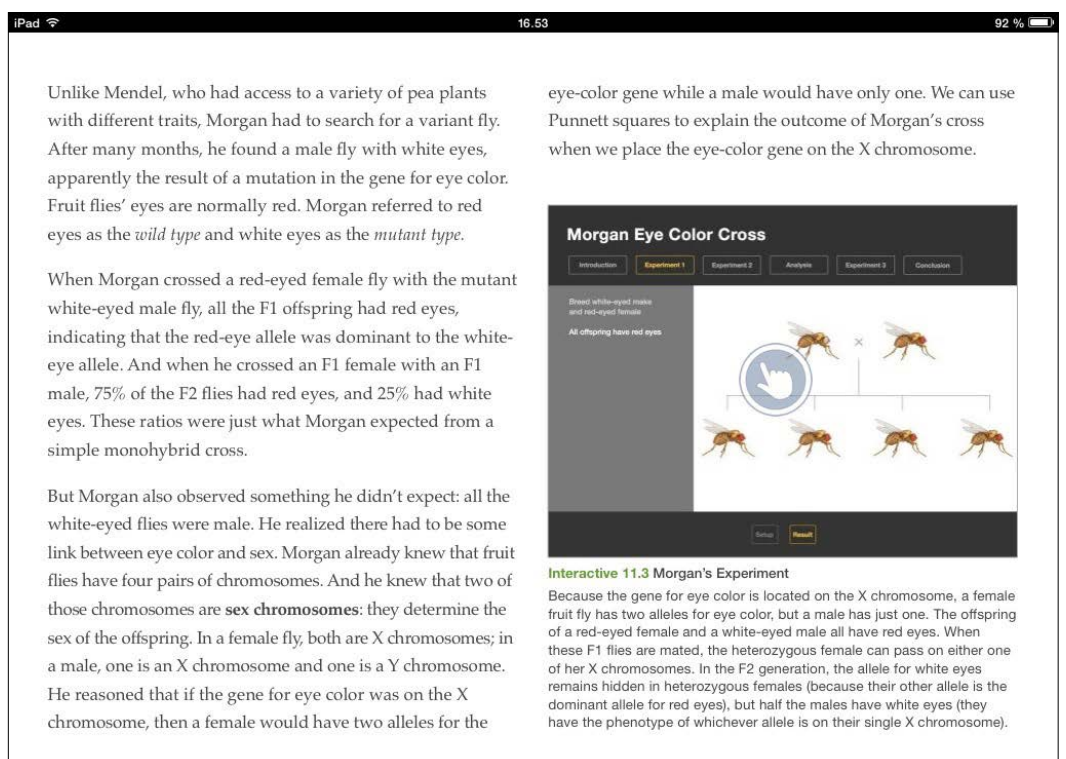
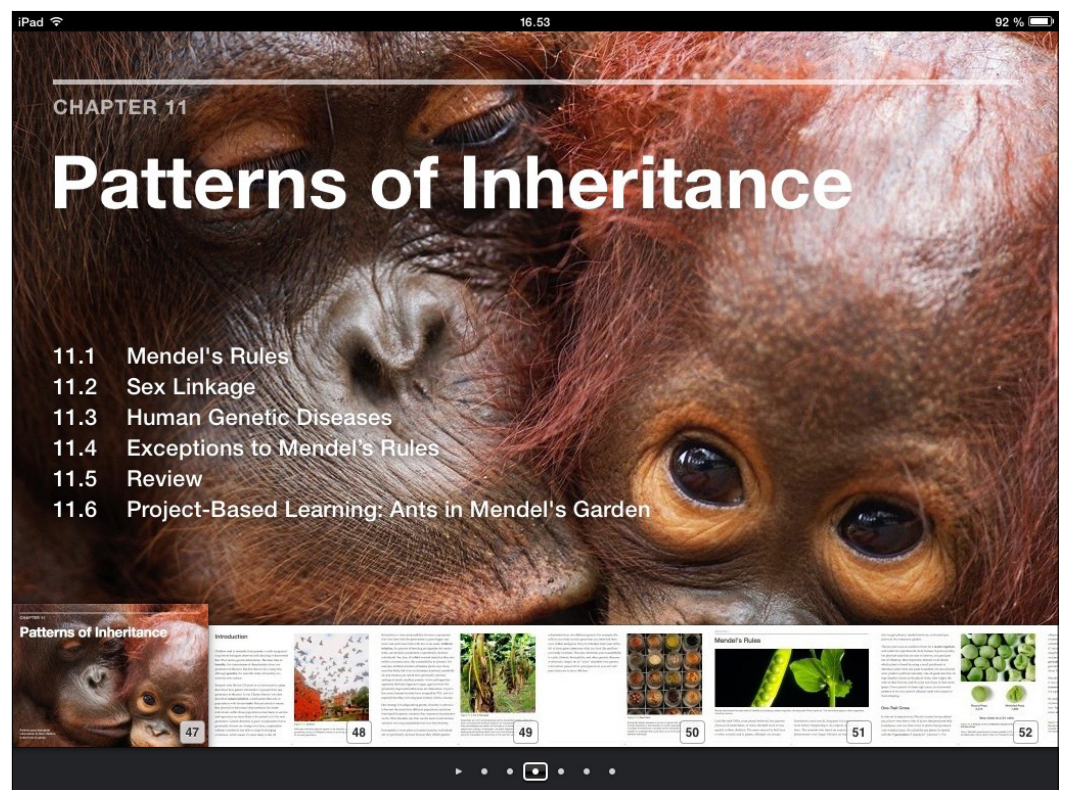
Harcourt has developed a platform that is closer to the hybrid idea than the HMH print replica platform presented above. Some features of the VLE are imported into the document from a separate web environment.

iBooks

Apple Computer's iBooks Author (IBA) is based on EPUB 3, but includes its own undocumented XML and CSS additions, which limit its use to the Apple ecosystem. The software supports mathematical formulas and plug-ins which can increase interactivity. Ibooks supports annotation and scrapbook functions in a programme called Study Cards.

iBooks features:

- highlighting
- quizzes etc., enrichment through plug-ins
- annotation



Apple iBooks: Life on Earth (Gael McGill, Edward O. Wilson & Morgan Ryan 2014). See demonstration [here](#).

EPUB

EPUB is technically a web page for local offline use, which has been developed especially to support linear books, for example novels.

The latest version, EPUB 3, allows for a more complex layout, such as multiple columns and the integration of rich media. However, EPUB 3 does not fully meet publishers’ needs and additional specifications are in development. One of these initiatives is EDUPUB, which allows for example educational plug-ins.

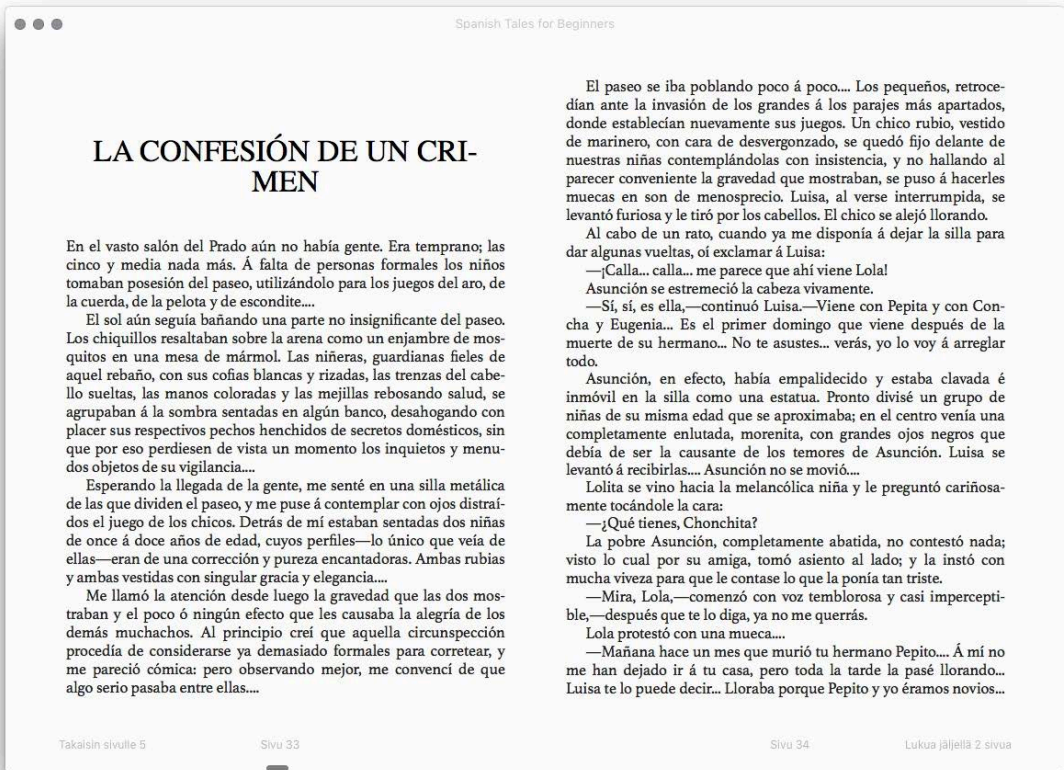
Subtext

Subtext is a social reading software by Renaissance Learning which has a variety of functions. The teacher can create and manage student groups, import books into the programme in different formats, and share tasks, notes, and highlights at will. Team members can also see each other’s annotations. Hellman & Friedman bought the business in 2014, and now the software is also available with a new name, Accelerated Reading 360.

Subtext only supports the EPUB format. It is an e-reading programme which has been extended into social reading and is intended for educational use.

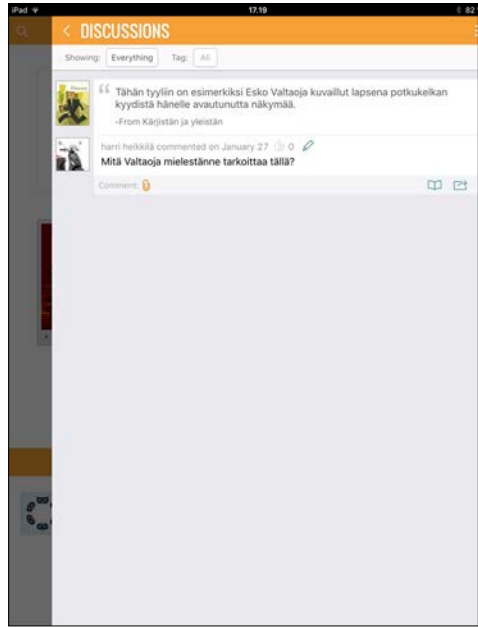
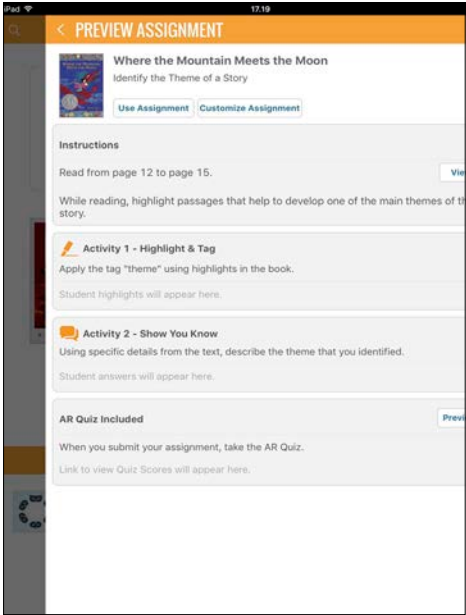
Features:

- bookmarks, sharable highlighting and notes
- the teacher can create groups with Google, manage them within the program, and assign tasks
- the same program is available under another name, Accelerated Reading 360 (AR 360)
- Available from Apple Store (US)



Spanish tales for beginners (Infogrid Pacific, 2013). A typical EPUB 2.1 book, this is a simple linear novel. You can download trial versions of books in EPUB format, for example, [from here](#). You need to have the Adobe Digital Editions programme on your computer, or its equivalent. For Android, [Aldiko](#) is a popular reader, while iBooks, which comes with iOS, supports different EPUB formats well.

The Subtext app enables group work on a book. The teacher can allocate tasks and create reading groups. Team members can see each other’s highlights and comments.



4

Functionalities: Findings and possibilities

Korean Sanghyun Jang divides digital textbook functions into educational resources, learning management, learning support and progress functions (Jang 2014, 77). At first I attempted to classify the books by functionality based on Jang’s model, but because I identified many more functions, such as sharing, I decided to create my own model.

The functions of the e-book may be divided into three categories. The first category includes electronic versions of traditional functions, like reading and annotation by hand and may be called Book 1.0, as opposed to the book of the future, Book 2.0, where these functions are also included but as networked versions. The third category includes the LMS functions which are enabled within the book.

A surprisingly large number of Book 1.0 functionalities have found their way into print replicas. Kindle eTextbooks is the richest of these. The annotation and testing functions can be combined to create an intuitive and varied learning platform. The multimedia products did not really have these features.

The hybrid products showed as many features of Book 1.0 as the enriched print replicas, but with additional characteristics of an integrated virtual learning environment. The most advanced examples of this were Inkling and Tabletkoulu.

Just like with printed books, the student can read, highlight, browse the book and check their bookshelf or take notes and make flashcards. The digital book can support all of these functions more effectively and in some cases automatically. For example, term lists and flashcards or quizzes created from these materials add educational value which cannot be achieved with a paper book.

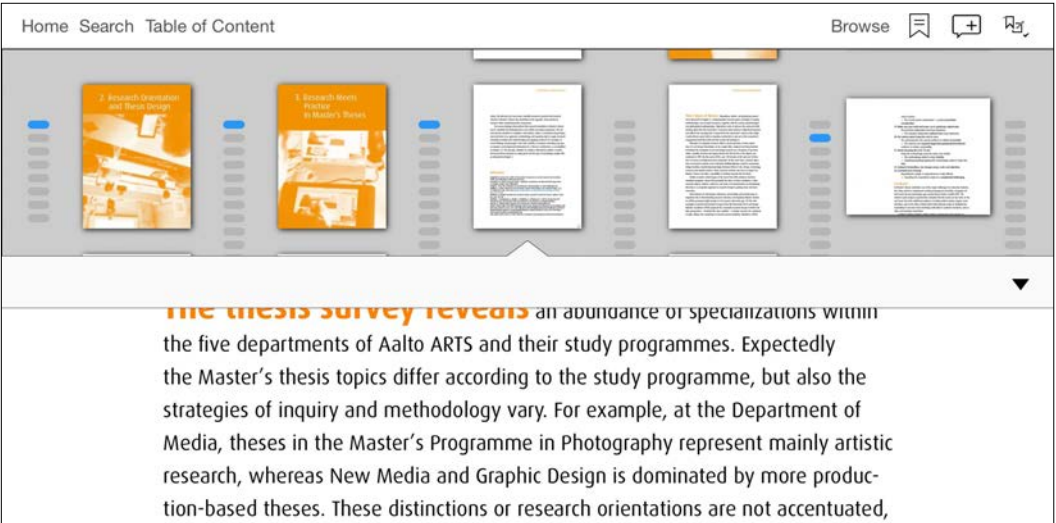
4.1 Book 1.0 functions

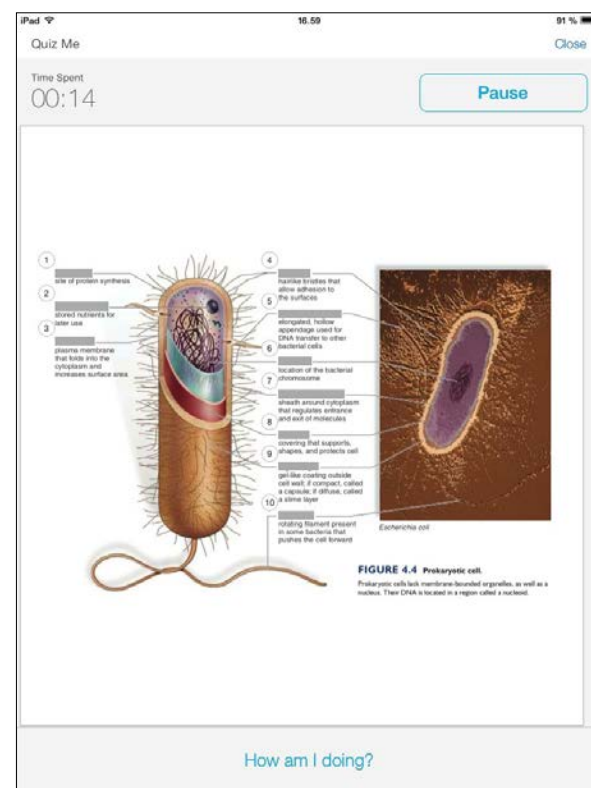
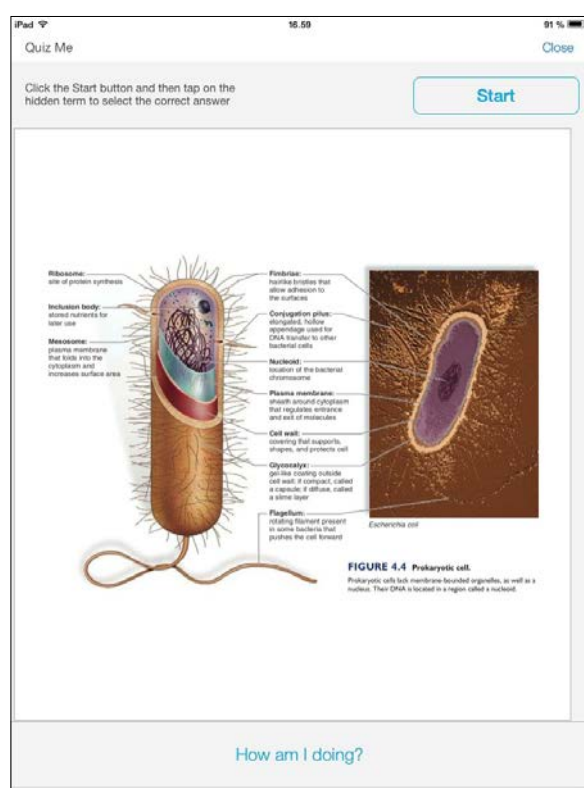
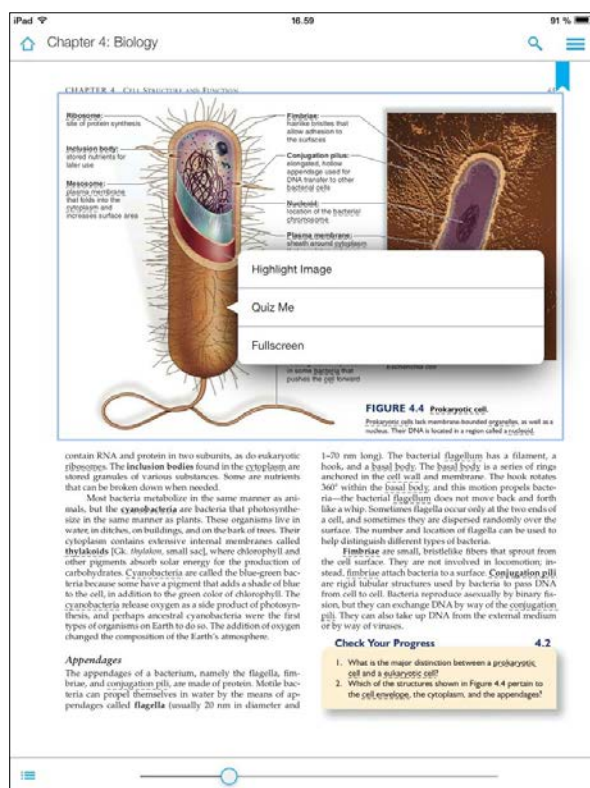
The most obvious Book 1.0 function is reading the text, and analysing images and figures. Reading a digital text changes seemingly obvious things such as browsing or searching for a particular point into a different kind of navigational activity. In general, the digital platform does something to facilitate this, for example by providing a slider or page thumbnails. You can almost always find things using your search function (except in pixel-based print replicas).

TABLE 1 LEARNING FUNCTIONS IN DIGITAL VERSIONS OF THE BOOK

FORMAT	FUNCTION	DESCRIPTION
BOOK 1.0 Digital versions of traditional learning tasks	Reading	Reading and analysing the texts and images, browsing pages, navigation and search
	Annotation	Adding comments, highlighting and making bookmarks
	Creating scrapbooks	Saving and enriching the existing version with e.g. links, images or sound
	Using multimedia	Video, audio, animation, 3D
	Testing learning	Answering quizzes
	Learning assessment	Doing tests
	Content management	Bookshelf
	Flashcards	Flashcards created by the user or programme

It matters how the navigation of the digital book is arranged. The image shows Aquafadas’ solution for the iPad. Page thumbnails arranged by chapter can be displayed at the top of the page, next to the page number indicator. Marja Seliger & Young-ae: Thesis Design (Aalto ARTS Books, 2015)





Blind Image Quality Assessment / Intel Educational Study

Annotation

Annotation is understood broadly here, to include all ways of marking the text: side comments, underlining or highlighting and bookmarks.

Creating scrapbooks

A scrapbook consists of your own annotations with links to material copied from elsewhere. The digital version of this can be a very rich part of the book, like [Evernote](#), where related links, images, text, video and audio are collected. You can add material to a scrapbook yourself, but it can also be added automatically based on your usage.

Using multimedia

Multimedia refers to the use of video, animations and audio and the text-to-speech function.

Material management

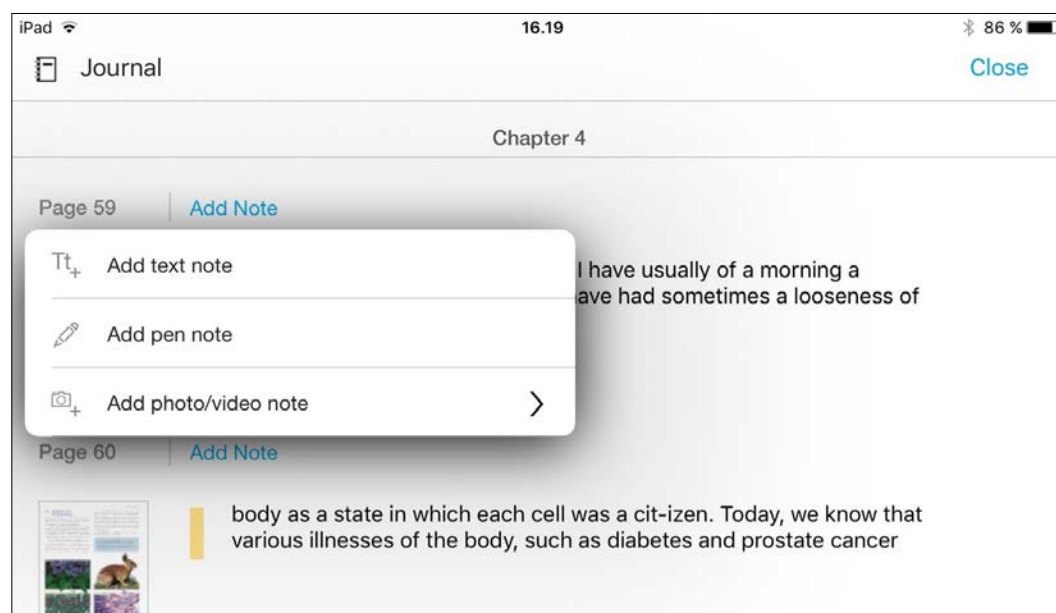
You manage your own electronic bookshelf.

Testing learning

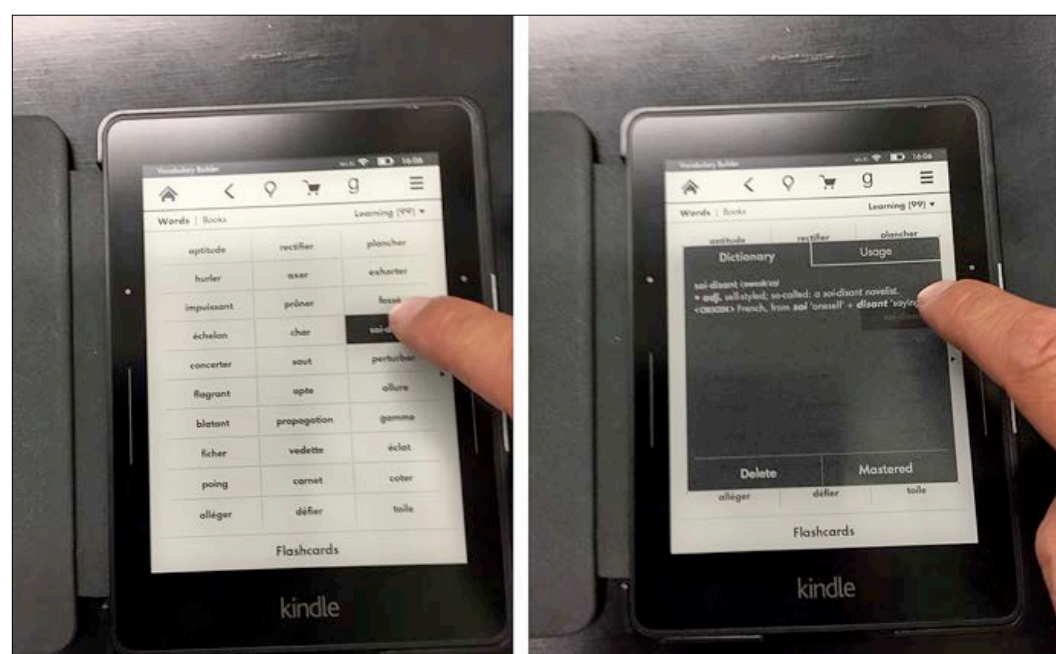
Testing learning includes flashcard functions, tasks and tests. The tool can be used to add terms or they can be created automatically, for example, based on dictionary use.

A smart book may be able to list its own key words, or create them based on choices made by the student. In Kindle, for example, automatic flashcards are created when the service recalls words the reader has checked in the dictionary and automatically creates a quiz from these. This can be used to test your memory and delete cards when you get the right answer. The book can also create a quiz based on its key words. In many cases, you can also create flashcards yourself by adding terms which are new to you and testing your knowledge of them later.

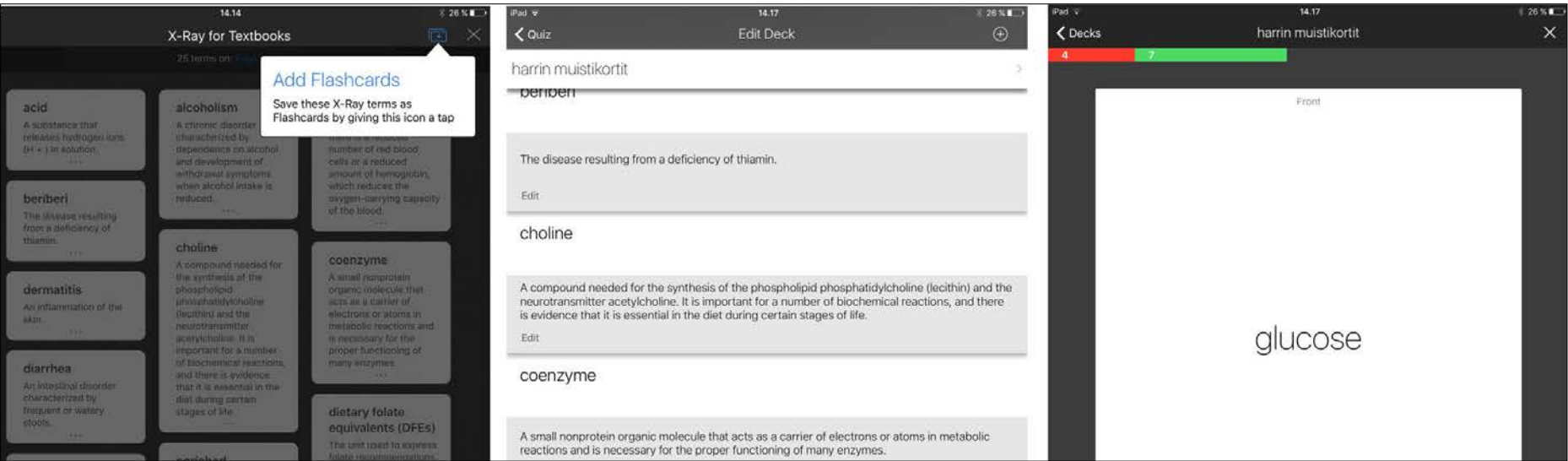
Quizzes can be created in various ways. The options range from reading tests (true/false quizzes) to game-like solutions, often played against the clock (e.g. Gener-



Scrapbooks in Intel Educational Study compile notes and highlights, which can be edited and enriched within the book.



Kindle Vocabulary Builder automatically updates each word looked up the dictionary to the flashcard database, and the reader can test themselves on these using flashcards.



The X-Ray function in Kindle textbooks lists key terms in the book, and you can also add these to your own flashcard to test your own learning using the Quizz function.

ation 5 publisher games, MultiTables, image X). One quiz format in Kno was hiding the explanatory text from figures to create a blind test. The student’s task was to write the names of the parts of the cell to see how much they knew. Besides the publisher’s own, these books also contain tests that are created by the reader or generated automatically.

4.2 Book 2.0 functions: the book as community experience

The functions listed above can also be shared in three ways. Readers can share their own activity, for example highlights, or see the activities of someone else. It is also possible to do things together, for example, to discuss matters related to the book from within the book. The book can also function as a learning environment.

SOCIAL READING

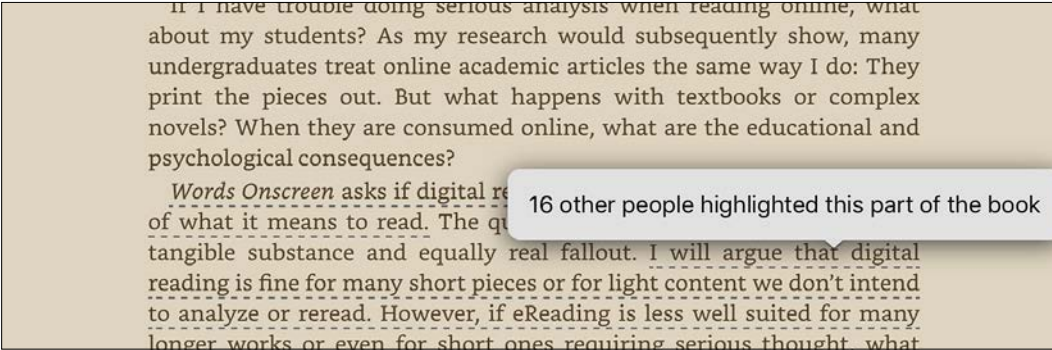
Social reading means reading together: contact with a reading group or other virtual community through the book. It is horizontal communication, discussion and commentary on the book, in the book.

Social annotation

Social annotation is sharing side comments, highlights, and bookmarks with others and also viewing other people’s notes. (e.g. the second image from the top shows that 16 other readers have underlined a particular phrase in a Kindle book.)

Social scrapbook editing

Social scrapbook editing is both sharing your scrapbook with others or viewing other people’s scrapbooks and editing scrapbooks together.



Kindle is able to display the number of other highlights made by other readers within a book. In this image, one section of Naomi Baron’s book Words Onscreen has been highlighted 16 times. The Fate of Reading in a Digital World. Image of Kindle reading programme for iOS

TABLE 2 SOCIAL FUNCTIONS OF THE BOOK: THE STUDENT AS SENDER OR RECIPIENT

FORMAT	FUNCTION	DESCRIPTION
BOOK 2.0 Learning tasks as social version of the book. The student as sender or recipient	Reading	Sharing read information with others. Receiving information from others' reading.
	Annotation	Sharing bookmarks, notes and highlights with others and receiving these from others.
	Creating scrapbooks	Sharing scrapbooks, or checking other people's scrapbooks
	Testing learning	Sharing or receiving test results, creating tests for others
	Content management	Sharing your own bookshelf or looking at others

TABLE 3 SOCIAL FUNCTIONS OF THE BOOK: STUDENTS TOGETHER

FORMAT	FUNCTION	DESCRIPTION
BOOK 2.0 Learning tasks as social version of the book. Students together	Reading	Reading together
	Annotation	Annotation together
	Creating scrapbooks	Creating scrapbooks together
	Using multimedia	Using multimedia together
	Testing learning	Creating tests together
	Learning assessment	Taking exams together
	Discussion	Discussion thread, chat

Social use of multimedia

This means sharing multimedia with others or receiving it from others.

Social content management

Social content management is sharing your bookshelf or viewing other people’s bookshelves.

Social testing

Social testing means doing tests on the learning material together or sharing and receiving test results.

4.3 Book 2.0: the book with a learning management system (LMS)

The functions listed within this category are related to education management. It will also describe the functions that have not been dealt with and are not obvious.

Groups

The teacher can create study groups, manage their rights and monitor group discussions within the book.

Monitoring

Analytics can be used, for example, to monitor reading progress. Students’ page turns and time spent on pages can be stored on a server. Actions taken on a page can also be registered.

Personalization

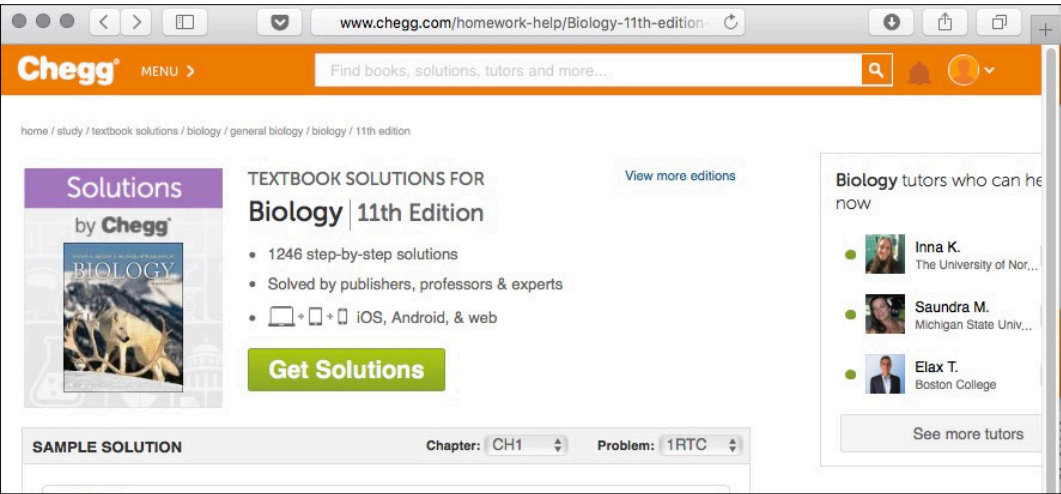
Extended or shortened versions of articles can be provided as required. Paratext can be expanded.

Link services

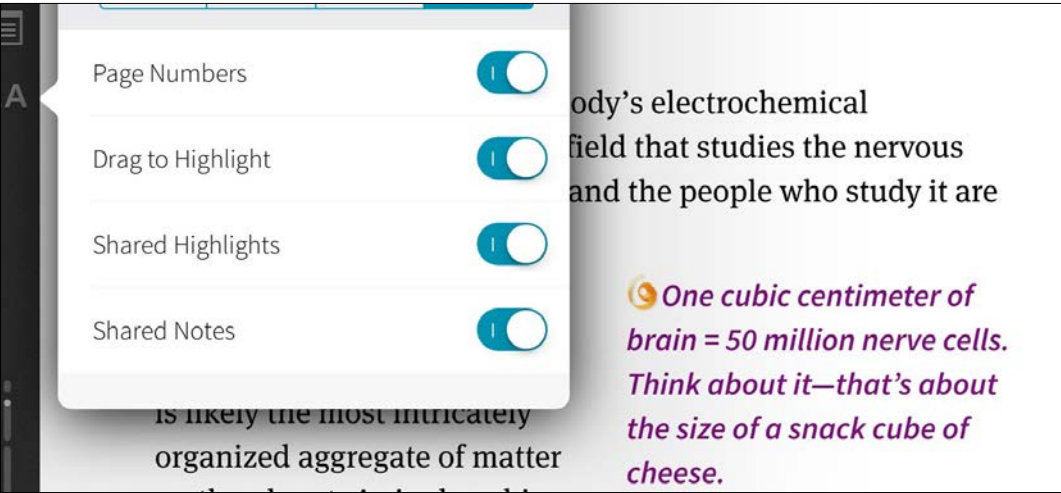
Links to additional services can be embedded in the text, usually to various dictionaries or Wikipedia, but also to other databases and crowdsourced services like Shelfari, Goodreads, or Anobi.

Guidance

Students can contact the teacher directly through the book. They can ask questions, the teacher can answer directly in the text, and the student can ‘reference’ in the book.



Chegg offers online tutors with the book, who can respond to questions about it via video link.



Inkling has a clear dialogue box for publishing highlights and notes. It is important that the user knows whether their annotations are private or visible to everyone.

TABLE 4 BOOK FUNCTIONS IN A VIRTUAL LEARNING ENVIRONMENT

FORMAT	FUNCTION	DESCRIPTION
BOOK 2.0 Link to LMS environment	Annotation	Reading and analysing the texts and images, browsing pages, navigation and searching
	Multimedia	Saving and enriching the existing version with e.g. links, images or sound
	Groups	Digital versions of traditional learning tasks.
	Grading	Link to assessment tools
	Tasks and tests	Drafting, sharing and receiving the results of tasks and quizzes
	Monitoring	Monitoring reading and performance
	Learning management system	Documenting the student’s learning process
	Content management	Student content management
	Additional materials	Independent learning materials
	Personalization	Extending or cutting articles to suit the student
	Link services	Various resources linked through a book
	Editing	The teacher can change or add to text in the book
	Guidance	Support through the book

5

Discussion

The possibilities of e-textbooks are mostly unexploited. Even the basic digitized learning functions of e-textbooks (Book 1.0) are inadequately supported and the greatest potential of e-books, social reading – the book as collaborative learning environment (Book 2.0) – has remained largely unexplored.

Most of the e-books reviewed here were print replicas. For other material, it was not always clear whether the publications could even be called books, as many were more like web pages or old multimedia CD-ROMs.

Nevertheless, print replica books are developing in the same direction, away from a closed model towards networked and accessible information resources in a virtual learning environment. Many of the American resources were *semi-analogue* publications in the print replica tradition, which were surprisingly interactive and genuinely digital. For example, the Kindle eTextbook has digitized quite a large number of traditional reading functions, and added something else. Flashcard functions are available on many print replica platforms and are an imaginative way of adding value over printed books.

The latest development is the hybrid book, which clearly draws on all the previous types. These textbooks differ from previous versions in terms of text content. Also, the interface is more book-like than a CD-ROM or web page, but it is quite different from that of a print replica. Hybrid books not only add exercise book functions to the traditional book content, but also learning environment tasks. Inkling, from the USA, is probably the first example of this format. The best examples of products with these features on the Finnish market are Tabletkoulu and e-Oppli. The EPUB group also falls into this category.

Integration can happen in two ways: in the older model, books are added to a separate learning environment, while in newer models the aim is to create networked content within the book.

The community functions of Book 2.0 would work well with hybrid books. Using these functions within a book is different from going to another environment to comment or discuss. A separate virtual learning environment easily causes confusion. The idea of embedded technology

***Printed
textbook***



***Digitized
textbook
(BOOK 1.0)***

*Print replica,
enriched
print replica*



***Digital
textbook
(BOOK 2.0)***

*Hybrid book
Networked
print replica*

means just that, that features are there where the reading happens, in the book.

Social reading is a new thing. Things which used to be private become public: what has already been read, what one wants to read, mutual recommendations, discussion about topical texts, following a favourite author's work (Brembs 2014; Becker 2014).

As Hanne Weber (Weber 2014, 697) has pointed out, the existing VLE/LMS systems can be easily developed to better support opportunities for social reading within a book. Questions could be answered in the immediate proximity of the reading, which could link entire discussions to the text. This would directly support learning. Discussions could also be saved on the server for use in the next semester.

Readers can exchange ideas from within the book they are reading socially without even putting the e-book down, as readers add comments to a text which other people can see.

Social reading could promote reading, because children and young people like to comment. They can move from social reading via publishing platforms to writing, commenting and evaluating, which enables instant feedback from people of a similar age and views. Children and young people learn critical and constructive ways of thinking when they evaluate others and themselves. This develops reading comprehension and expression. At its best, this can be the tool to make the online generation more interested in reading. (Schmid-Ruhe in 2014.) This would combine young people's IT expertise and use of social networks. The result would be a more intense relationship with the material that the teacher could moderate (Becker, 2014). Peer tutoring, like the Chegg service, could also be a natural fit.

Publishing platforms can store a variety of metadata which is not available elsewhere. This type of information includes, for example, reading time, marked sections, highlights, reading speed, skipped pages, notes, external links and the concepts readers look up. (Schmid-Ruhe 2014; Brembs 2014.) This gives the publisher an entirely new channel for getting feedback. When they know their

readers better, publishers will be able to develop their products better. (Brembs 2014.) It is possible to take this idea even further. Metadata filtering can be used to process user information that directly benefits the reader. It could be possible for students to see highlights made by other readers at the selected level within the textbook: A student could, for example, use a slider to view only points that have been underlined over a hundred or five hundred times. This would create a whole new dimension to textbooks: a hive mind could highlight the most viewed points.

It is also important that all this happens inside the book. This enables different additional functions. The automation which Brembs refers to already works on Kindle. The device's vocabulary builder remembers which words the reader looks up in a dictionary, for example, when reading in a foreign language, and stores a database of these, which can be used for learning. When a reader thinks they have learnt a new word, they can delete it from the flashcards.

Sharing and receiving annotations via the book opens up a whole new perspective. The teacher can, for example, share a book chapter notes or annotations with students.

They can access link services from their own chapter, to connect to existing crowdsourcing services which enrich the book's metadata. Shelfari and Goodreads (both now owned by Amazon) both work like this.

You can see an example of a link service on page 26. The reader activates the name of a character in a novel by touching it. The X-ray function in Kindle searches for crowdsourced information about the character in Selfari (Kindle 8.7.2 iOS).

5.1 Print replica, web or hybrid?

E-books and traditional books differ not only in terms of usability problems with the devices and software, but also in terms of the electronic text itself. According to some researchers, the very nature of hypertext leads to weaker performance than traditional linear presentation. The argument is that the reader constantly has to choose between following a link or concentrating on reading. Cognitive load increases. So restricted access to links may particularly promote learning for inexperienced users or readers with low concentration levels (DeStefano & JoAnne 1617, 1631, 2007, 1616-1636). Restricted access may mean that clicking on a link does not change the whole screen, but the link opens in a pop-up window, so the reader still stays in the text.

In a recent study, Anna Mangen (Mangen et al. 2014) drew attention to the fact that there is very little existing research measuring digital reading of long narrative texts. Research to date has focused on rather short texts that are read on a computer screen, and compared this to reading on paper without paying enough attention to the fact that the documents being compared are of a different nature. A PDF cannot be compared to the ePub format.

Mangen and partners argue that readers of digital publications are uncertain of where they are within a whole document, and this lack of spatial affordance or awareness may affect reading cognitively in terms of remembering, understanding, and reconstructing the plot. (ibid.) Printed matter leads to a better understanding than digital media because the reader has immediate access to the paper version of the full text, rather than having to scroll back and forth to find a particular point in the text. In addition, the printed book gives the reader more visual and tactile clues: the reader can see the length and physical dimensions of the text, which helps them to understand and remember it. (Mangen et al. 2012, 61-62.) Looking up words in a paper dictionary is an active process which supports memory. But simply write the word on the screen, and the digital dictionary definition appears (Jönsson, 2015, 27). Although e-book text is, in principle, hypertext, it is usually managed differently on e-readers, and hypertext research findings may not apply directly to e-readers. Online reading is based on browsing and following a trail of links, as Jacob Nielsen has shown in 'Why Web Users Scan Instead of Reading' (Nielsen 1997) and 'F-Shaped Pattern For Reading Web Content' (Nielsen, 2006).

Usually, external links are not directly displayed in the books on e-readers. Links do not compete with the text in that they are not visible, but only show up in a pop-up window after a word is activated. This presumably does not break up the linearity in the same way, so the selection or navigation problems associated with reading hypertext on a computer browser can be avoided as the reader will not follow the links away from the page and out of the book.

Monica Landoni (1997) has questioned whether it is worth preserving the metaphor of the printed book for e-books. After testing different versions, her answer was yes, as the qualities of the printed book positively influenced satisfaction, memorability and usability. Landoni concluded, based on research together with Ruth Wilson, that it would be good for e-books to combine the features of a well-crafted paper book and the web (Wilson et al. 2003, 475). The results were presented as the EBONI design recommendation for e-books (Wilson & Landoni 2002; Wilson 2003, 471). The recommendation was to try to combine good typographic features with hypertext, but to draw a clear distinction from the internet.

This research data would support such a hybrid type of book format, which is often designed for tablet platforms. The tablet is a more book-like environment and more personal device than the computer. It is the most natural and effective platform for e-books, as it is less comfortable to read a book on a desktop (Hibbard, 2014, 51-54). Basic digitized print replicas do not have any other particular benefits besides portability. Tablets may be the natural successor to print replica as they are more likely to improve learning outcomes, since using tablets largely avoids an inherent problem of print replica: lack of adaptability to different screen sizes.

5.2 Ways forward

If the e-textbook is to become mainstream, it should not only offer advantages over paper books for everyday learning but also be capable of overcoming its weaknesses compared to paper books in terms of usability and user experience.

The new functionalities described above offer plenty of scope for meeting the first objective. The only problem is that it should be possible to provide standards for these functionalities, so that they can be used simultaneously on multiple platforms. Now they depend on the ecosystem, channel or proprietary standard. Standards and compatibility would help ensure that the features keep working, even if the platform used by a school changes. Learning data from e-books can only be exploited if the data is not confined to a single platform. When a teacher or learner changes school, or if there are teaching staff changes, the learning data should be transferable. This definitely requires a common standard.

Standards are also important for publishers, as it is expensive to develop a new feature from scratch. Publishers also find it difficult to predict the levels of usage and demand for a new functionality. The list of functionalities in this publication is intended to contribute to meeting this need.

Again, the problem here is the lack of standards; there are no existing link services to enable social reading between different platforms. It is clear that these interactive features are on their way into e-books. It is particularly important to develop standards for a variety of platforms using plug-ins, otherwise open platforms will be less competitive. These standards are in development. A common problem with e-books is that each individual provider launches their own solutions before there is time for any open standards to be developed.

Improving usability and poor user experience remains a significant challenge. The most ergonomic reading platform for e-books is probably the e-reader. These should be capable of taking specific design characteristics into account (cf. Heikkilä 2012) and solving teething problems with using the books (cf. Antikainen et al., 2013, 48-54, 95-98).

A common publishing platform is the ideal, as this would enable both high-level multi-channel publishing and cooperation between various experts to support educational link services. In an ideal environment tools would be standardized, so there would be no need to code the same things over and over again in different places. No publisher can afford to create new software for every publication by programming. What is needed is an easy-to-use WYSIWYG publishing framework, so efforts can be focused on raising quality.

High-quality material should be created to empower designers. Content creators, graphic artists and educationalists could collaborate with usability and interactivity experts. At the moment, such systems are proprietary, for example Inkling Habitat or Woodwing or Aquafadas. Good design is not just about aesthetics. It is about organizing information into a comprehensible form and hier-

archy. At the moment the visual quality of a lot of e-learning material is not very high.

The debate on workable models has only just begun. The digitization of learning materials is seen as too much steered by the technology which supposedly dictates development. It is possible to see this development from the other side, however. In this view, the technology itself does not play the decisive role, but the technology is evolving all the time in dialogue with the various parties involved. Technology only sets the limits. What is ultimately realized depends on the conversation between users and technology providers about what technology is adopted or rejected. The poor success rates for e-textbooks imply that technology users and providers have not been able to find a model that works well enough.

If you want to encourage innovation, you need to locate problem areas and focus on developing these. The problem does not seem to be that students do not have enough mobile devices, but that there is a lack of innovation in terms of the content for mobile devices. The e-textbook is the innovation that needs development – the tablet is already available. That is why the major technology-driven projects discussed above – such as large-scale acquisition of tablet computers or 100% digitalization – have little chance of success.

This is complicated by the fact that e-books are not a traditional format but the technological environment that enables the content, and this must be taken into consideration. The e-book exists in a reading programme located on some kind of device, which in turn is linked to some sort of ecosystem. Ease of use is not an in-built feature of e-books, but also requires an simple ecosystem: the book should be easy to access. The aim should be to achieve the seamlessness of Kindle or Apple ecosystems, but applicable to multiple platforms. Signing in with one ID should be enough to access all the online material and download it for offline use. This means one-key identification, or a national login system or service bundle with a single account.

The ecosystem should not simply be seen as a burden: it is also an opportunity. The features of Book 2.0 only work when they have a lot of users. In this sense, a small language area like Finland presents a problem, but various actors should be able to work together. They should seek to ensure that the various learning materials can be sourced from a single location and that the teacher can compare and assess them before buying.

From this perspective, the Finnish Ministry of Education and Culture project Educloud has a great deal of potential, but it needs resources and a clear focus, and stable, sufficient funding. Finland is so small that is not worth doing the same thing in more than one place at the same time. Large public technology projects also run into problems due to overly high expectations, which often represent the political structures. A politician may talk about their own concepts of the technology and create unrealistic expectations. Politicians change, but the technology should be developed. Government projects should not suffer from a lack of continuity, but be able to take the long

view, which commercial actors are not always in a position to do.

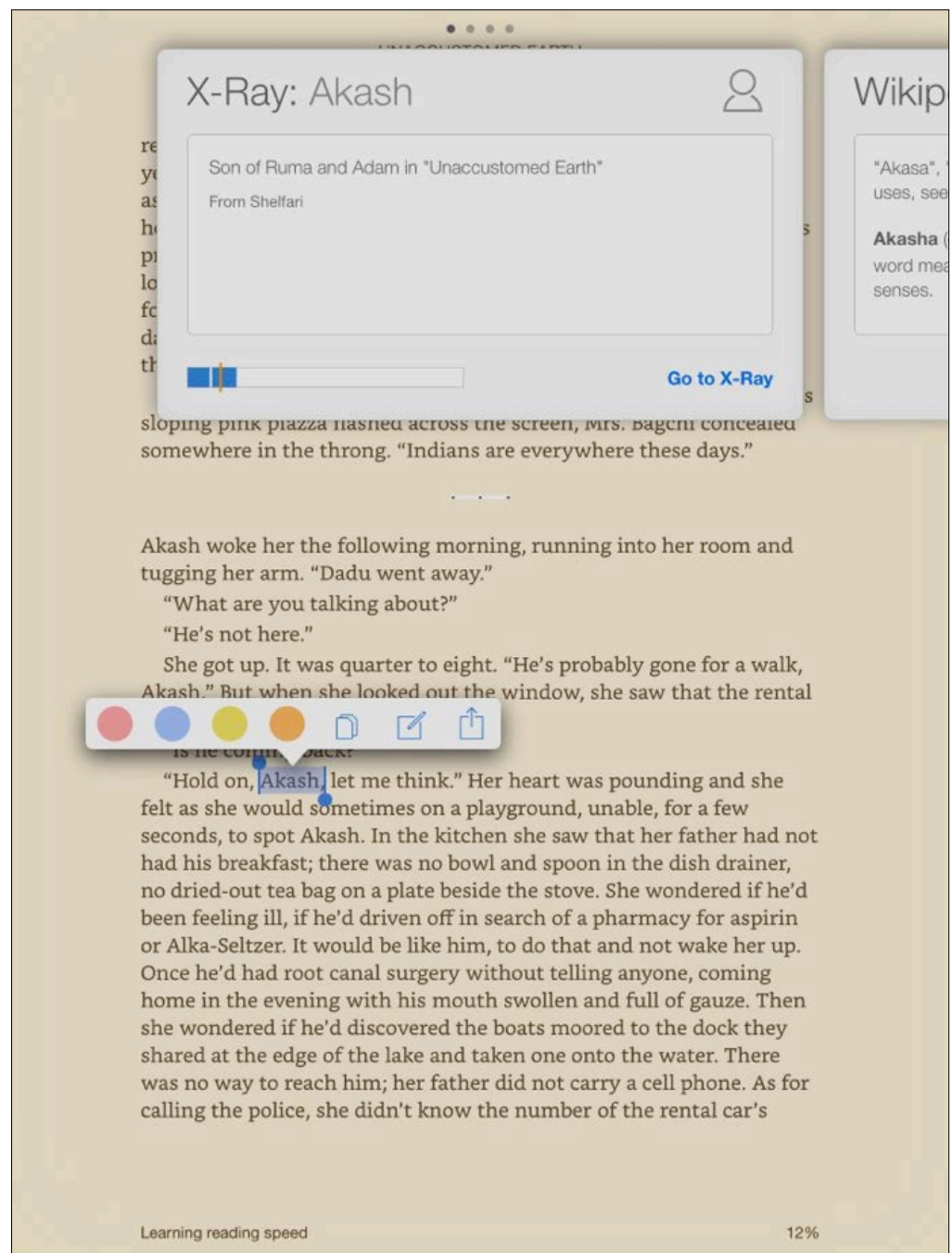
We need practical research about which e-learning models and functionalities yield the best *learning results*. Researchers have much to learn from Mangen in terms of study design (p. 24).

5.3 Conclusion

In this research I have often referred to how technology is instrumentalized. Related to this, when technology matures, I believe we need to go back to basics. When the OECD (2015) states that equal rights in the information society are more a matter of basic skills than technology, they have the same idea in mind. Instrumentalization means that as the technology (devices, interfaces and services) appears increasingly more natural, seamless and easier to use – a move away from the machine model towards the human model – the user is less and less instrumentally involved in the task itself. It is no longer a case of reading in a reading programme, but just reading. Not learning how to use a drawing programme, but drawing. Not taking courses in word processing programmes, but writing.

Touch-screen equipment is a big step in this direction. Fans of coding in schools have heard me joke about this: Who needs to learn how to use a lathe when 3D printing has already been invented? Seriously, I can understand that the aim is to teach programming, but still: why should this be a more important part of an all-round education than literature, media analysis or debating skills? It is not our job to understand computers better, but on the contrary, computers need to understand people better. Have we reached the network society when all of us know how to code, or when we all stop asking why we are coding?

Technology has changed and it will become more and more people-friendly. We are in a transition phase. This can also be seen in e-books, which can be used digitally and networked in many ways, without losing their essential nature, although e-books are still developing as a positive reading experience.



The X-ray function in Kindle can be used, for example, to show information about the characters in a novel. The information is crowdsourced from the Shelfari service. This type of link service make e-books more useful, but do not conform to standards; they have advanced furthest in closed ecosystems.



Aquafadas' schematic diagram of textbook enrichment with SCORM widgets directly in InDesign.

6

The way forward

Key points to consider

- We need to analyse and learn from the failures of large digitalization projects that were technology driven. It must be repeatedly stressed that we need to move away from this model.
- We should approach technology by defining the objectives and issues first, not the other way around.
- This means not only considering what the new information technology will add to education, but also what it takes away. How does it change the teacher-student relationship?
- Technology is not an automatic route to improved teaching; it can even interfere with education, for example due to distraction and usability issues.
- Technology must be built around people. It needs to take human cognitive structures into account and be information-based.
- It must promote uninterrupted reading, which supports long-term memory.
- The new educational culture should be based on learning outcomes.
- Mainstreaming is only achieved when technological solutions meet the needs of the majority, not just those of early adopters. The majority's relationship to technology is instrumental: it does not want a technical revolution, but solutions to everyday problems.
- Information technology embedded into daily life means that the technology works transparently and unobtrusively to help people.
- The use of e-books only spread with the advent of e-readers, not computers. Tablets are more personal, and using them feels more like reading a book, resulting in a better e-book reading experience.
- To continue to gain educational ground, e-books should implement varied interactive features, such as flashcards and key words.
- Hybrid books are designed for tablets and combine the features of both these learning materials in a promising way.

Digital textbooks: strengths and weaknesses

- + Autonomy
- + Ownership of learning
- + Space saving
- + Stimulating curiosity
- + Working together, problem solving together
- + Freedom of choice
- + Interactivity
- + Personalization
- + Upgradability
- + Annotation
- + Diversity of sources
- + Inquiry-based learning
- + Upgradability
- + Customization
- + Transportability
- + Availability regardless of location
- + Integrated dictionaries and term banks
- + Spoken text (e.g. as a language learning aid)
- + Extensive library management
- Usability: especially login and reading offline
- User experience: browsing, reading comfort, sense of place
- Annotation function often lacking
- Lack of standards
- Lack of a single point of sale, e-bookshop
- No resale value
- Digital textbook user rights may be limited
- Page loading may take too long
- Schools may have insufficient wireless bandwidth
- Printing is often limited
- High price

(e.g. Chong et al. 2009; Garneau 2011; Karsenti & Fievez 2013; MindCet 2012; Mumenthaler 2010; Wees 2011)

- Digital textbooks need to be more clearly defined in contrast to educational web-pages and other network type materials.
- Embedded technology means, for example, features of social reading within the book.
- Social reading could provide e-textbooks with much-needed added value, and would promote learning by enabling communication within the book.
- If the e-textbook is to become mainstream, it should not only have advantages over traditional books for everyday learning, but also be capable of overcoming its weaknesses compared to paper books in terms of usability and user experience.
- Quality requirements increase as a technology matures, and the quality of the digital learning materials currently in use is not, on average, very high.
- Quality material is designed collaboratively: content producers, graphic designers and educationalists work together with usability and interactivity experts.
- There is a lack of scalable and easy-to-use publishing tools.
- Good design is not just about aesthetics, but also about organizing information into a comprehensible form and hierarchy.
- There is a need for standards that make it possible to access the same functionalities from different platforms, and transfer learning data between them, for example by using plug-ins.
- An effective cloud-based service would work on a one-key basis with effective user management and serve as an attractive distribution channel for publishers.
- Technology is not the solution, it is a tool.



Sources

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