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Towards a digital reading lab: Discovering and learning new affordances

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Abstract

Digital reading is not just a straightforward transition from reading on paper to reading on the screen. The differences come into sharp relief when we consider reading as a multiply articulated gesture rather than simple decoding of the written text. This paper considers the various aspects of this articulation and how it is impacted by the translation to digital text. It becomes clear that there are many points in which the fluent process of reading is disrupted by the digital. This underscores the need for a digital reading lab that will both investigate the differences and give students and academics an opportunity to develop knowledge about the tools that are through which digital reading is facilitate. The lab will thus foster skills necessary for modern readers in order to increase the fluency of their digital reading. With this in mind, this paper goes on to describe plans for such a lab at the Oxford Centre for Teaching and Learning. As an appendix an annotated overview of key tools related to digital readings is provided.

Introduction

The idea of digital text is 50 years old this year. In 1971, Michael Hart digitised the first text with the intention of developing a library of electronic texts now known as Project Gutenberg (Manley and Holley, 2012). Digital reading was given a further boost in 2007 when Amazon released the first widely successful e-reading device called the Kindle (Conrad Quilty-Harper, 2007). Nevertheless, despite predictions, digital reading has mostly not displaced paper in most areas. Fiction, non-fiction, textbooks, or academic monographs are still more likely to be distributed and read on paper and the growth of e-books has stalled (Kozlowski, 2020b).

However, academic journals are now distributed almost exclusively digitally (Wolff, Rod and Schonfeld, 2015) and the pandemic has spurred University libraries to increase their digital book collections, as well, with a corresponding increase in e-book usage (Novak, Ohler and Day, 2020; Kodama *et al.*, 2021). There are many advantages to digital texts but digital reading can also reveal the importance of many unappreciated affordances of the printed page (MacFadyen, 2011; Smyth and Carlin, 2012). Reading, through the lens of the print to digital translation, turns out to be an even more complex activity than thought. And many aspects of this complexity that may have appeared trivially obvious in print, gain crucial importance in the digital format.

Productive digital reading is mediated through hardware and software in often non-obvious ways. These new interfaces between the text and the reader require that the reader acquires knowledge and skill which adds a processing burden and takes time (Lukes, 2015). To investigate the variety of these interfaces and to facilitate the acquisition of the requisite skills, we are working to establish a Reading and Writing Innovation Lab. The Lab will also be able to collate feedback from users and

represent it to manufacturers and designers. This contribution describes the dimensions of the lab and reports on early outcomes of pilot efforts.

Reading as a complex activity

Reading is a complex multiply articulated activity. It simultaneously involves aspects of our perception, cognition but also physiology. Furthermore, reading does not take place in a vacuum. The text does not just magically appear in front of our eyes - we need to be involved in complex social and logistical chains before we even start reading and these continue after we have finished with the reading proper (Boyarin, 1993; Pahl and Rowsell, 2006).

Much of this complexity is necessarily beneath our conscious attention and when we discuss issues with academic reading, we typically focus on the cognitive aspects that appear to have direct impact on understanding (Rayner *et al.*, 2012). This complexity of reading is particularly starkly revealed is when we contrast traditional reading with digital reading.

Perceptual aspects of reading

Digital reading has many perceptual advantages. Most obvious of these is that the text can be almost arbitrarily enlarged. Digital text can be more easily enhanced with colour and images. Also, most hardware interfaces do not require external illumination and can be read in more environments.

Perhaps the most important perceptual advantage of digital reading is the potential for converting it to audio. This makes it far more accessible to people with both perceptual and cognitive impairments such as dyslexia (Rello, Pielot and Marcos, 2016).

Physical aspects of reading

On the surface, there is also a significant physical advantage to digital text. It does not require physical storage and has no weight. A reader can fit all of their life's readings on a single device that can be carried around. But in reality, the physical aspects of reading are where the print to digital transition is most felt like a dislocation.

Even such a simple act as turning a digital page requires learning and will often vary between devices and applications. Organising one's readings is also more challenging in the digital realm. Without additional hardware, digital reading also affords much less flexibility in terms of posture or place.

Again, even such simple things as navigating between distant parts of the text such as the body and the reference section can involve many more steps in the digital format. The digital text does offer search and ease of copying but these may not outweigh the disadvantages for some readers (Wolff, Rod and Schonfeld, 2015).

The lack of physicality of digital text also has consequences for perception and cognition. The weight of the printed page or the position of the word on the page can be powerful perceptual signals that aid recall but are not necessarily present in the digital text.

Digital reading mediates many of the physical aspects by an interface that needs to be learned. And this learning requires not only the acquisition of information but also new skills and most importantly new mental models of how the medium of text works.

Cognition and the digital text

In as much as reading can be thought of as the decoding of letters into sounds and ultimately images in the mind (Snowling and Hulme, 2005), there should be no difference between reading on the screen and on paper. But once we get beyond the reading of a single paragraph, this assumption becomes much more tenuous. Because reading of complete texts requires strategic attention, planning, and navigation. This is true of any text, but it is an essential component of academic reading. Studies of reading comprehension in the digital format consistently show deficits for expository text when compared with narrative text pointing to gaps in possibilities of self-regulation (Delgado *et al.*, 2018; Clinton, 2019).

And this is where the mediated physicality of the digital text plays a role. Common activities such as placing two texts side by side, underlining, quickly flipping between pages - activities that on paper we perform without conscious thought in a single gesture - become laborious and fraught with unpredictability. An automatic gesture becomes a series of steps each requiring attention and taking up cognitive resources. This transforms the process of reading whole texts in subtle ways that are yet to be fully explored.

We may get some hints from signals of preferences by consumers. The ebook market is differentiated by genre. For some genres notably romance, fantasy, thrillers ebooks represent as much as 60% of total sales whereas others such as non-fiction or cookbooks that proportion may be as low as 5% (Thompson, 2021). Another data point is reports by students who still reported a preference for printed textbooks (Millar and Schrier, 2015).

Logistics of reading

Of all the articulations of reading, logistics is perhaps the least appreciated. Finding, acquiring, transporting, and opening the text, highlighting, excerpting, collating. Those are all essential parts of the academic reading process that are impacted by the move to digital in both beneficial and detrimental ways.

Discovery and transportation have been greatly facilitated. We may miss the physicality and musty smell of the card catalogue, and something is lost by seeing the book in amongst related readings on the shelf but overall, we are happy to find the text with a simple search and get it instantly.

Also, the fact that digital text can be infinitely copied, and we can add unlimited annotations to a digital paper without ruining it for others is an obvious advantage.

But the logistics of downloading and opening the text, making those annotations, and then collating them in another place are much more complicated. They require that the reader has a mental model of the computer file, its place in the hierarchy of folders or inside the database. The reader also has

to have a knowledge of various file formats and the relevant software for displaying them (Norman, 2013).

"PDF" has become as much a part of the vocabulary of an academic reader as "article" or "monograph". But unlike the "article" which is often in the format of the PDF, there is much less shared understanding of what a PDF is. Not all PDFs allow the same actions, they don't have the same size, same possibility for transformation. And all those differences become mediated through various interfaces with their own ways of signifying their affordances and their own expectations of knowledge and mental models on the part of their users.

Even now that the PDF has become the universal medium of the academic paper, the reader community lacks a shared knowledge and mental model of how it works and what can be done with it (Nielsen and Kaley, 2020). The logistics of reading has become both more and less transparent through the move to digital text. Often, it is the logistical aspects that form the biggest block for academic readers' move to digital text.

Outline of the Reading and Writing Innovation Lab

As more and more of reading is moving to the digital realm, it is time to devote more attention to the whole process of reading and the impact of the digital transformation. And we should aim to expose more students and academics to the knowledge and skills required to develop the same level of fluency with digitally mediated gestures associated with reading that we seem to take for granted with paper.

To facilitate this learning, we decided to establish a Digital Reading and Writing Innovation Lab at the Centre for Teaching and Learning at the University of Oxford. It builds on previous work done at the Saïd Business School with the Digital reading showcase. The purpose of the lab is to collect and test software and hardware and test its various affordances for digital reading.

But most importantly, the lab will allow potential users of these technologies to come and try these tools and give us feedback about their advantages and disadvantages. This will supplement the signals we can see from the market.

The lab will start from the recognition of the complexity and multiple articulation of the reading process. It will be concerned with the impact of digital technologies on the perceptual, cognitive, physical, and logistical aspect of reading. It will be concerned with both hardware and software, as well as the services connecting both. The categories of tools available are themselves revealing. They show a recognition by readers and producers that digital reading requires additional attention. Yet, on closer examination, they have not realised or were not able to address many of the issues I have outlined here. The remainder of this contribution will outline the key categories with examples of products.

Dedicated eReaders

Until recently, there has been very little innovation in the ereader space since Amazon introduced the Kindle in 2007. Incremental increases in speed, the introduction of illumination and functional

touch screens have all contributed to what is essentially a mature market for fiction and trade non-fiction reading.

However, it is only in the last few years, that we have seen usable large screen eReaders that offer the benefit of eInk but also allow for annotation. Sony Digital Paper (Lawler, 2014) was one of the first but companies like Onyx and the Remarkable have drawn the most attention. The lab will offer an opportunity to their potential users to investigate the trade off and become familiar with their various affordances.

Tablets and their reader apps

The iPad and the similar Android-based tablets have become so commonplace that their inclusion in the lab may raise questions. However, that would be to ignore the revolution that has been occurring in the app space.

Apps such as MarginNote or LiquidText are exploring the affordances of the touch interface and they also try to take advantage of the possibilities of supporting cognition by structured annotation and notetaking. Others, such as Notability or Good Notes focus more on replicating the tactile pen and paper experience.

Touch and pen input

A significant proportion of reading is writing. Writing while reading or after reading takes many forms but for many the immediacy of directly annotating the digital text is unsurpassed. People vary in how much they are willing to trade off the benefits of digital text annotation against their disadvantage.

The knowledge gap faced by a newcomer when having to choose between the variety of digital styluses is enormous. And even once the choice is made, developing the skills and mental models for proficient use of a stylus may be a time consuming and frustrating process. A potential user should have a chance to spend time with this device.

The same applies for the many ways in which the touch interface can be deployed.

Conceptualising and mapping reading

Writing is not only a part of reading for annotation but also for organising and exploring the concepts it expresses. Readers often report difficulties with organising or making sense of their excerpts and highlights. For this, the lab will explore various tools for mind mapping or concept mapping (Nesbit and Adesope, 2006), outlining and note taking. In terms of the ICAP framework, while the tools discussed so far explore active reading while these tools will encourage constructive reading (Chi and Wylie, 2014).

Voice: The neglected modality of reading

Historically, silent visual reading has been the exception rather than the norm (Saenger, 1997). For most of history, writing was more often heard than read. Silent reading has given access to text to more people in more contexts, but it has also excluded those who for whatever reason cannot access printed text. Recently, technology has made it possible to convert any digital text to audio just as human-narrated audiobooks have experienced sustained growth (Cobb, 2020; Kozlowski, 2020a; Winn, 2021).

The possibilities for inclusion of combining listening and reading are undoubted (Goldfus and Gotesman, 2010). But most people without specific needs can also benefit from listening to text in various situations. Text in the audio form, however, presents its own challenges - such as difficult control, navigation, or search. There are many ways in which different platforms or apps try to deal with this. This lab will cover apps such as VoiceDream Reader or features like Speak Screen on the iPad, as well as give people a chance to try various voices.

Workflows and digital mental models

Perhaps the greatest disconnect in digital reading is in the area of logistics. This is caused by the discrepancy between the mental models we have of the physicality of print and of the way it is abstracted into the notion of the file.

From simple things like tools for organising reading materials to the more complex workflow of extracting annotations and integrating them into writing, these are all areas where users report difficulties. Things are not helped by idiosyncratic ways in which different technologies conceptualise the idea of a file and of the text in the file.

The Kindle and even more so the iPad have upset the traditional notion of a file hierarchy organised in folders or directories by replacing it with simple search interface. This works for very simple needs such as fiction purchased from a single store. However, difficulties arise when the reader tries to bring in external text. Academic publishers have created a jungle of incompatible standards and formats served through a variety of interfaces that do not take into account the complexity of reading.

The lab will investigate how these disconnects impact on reading experience. It will also survey tools for collating annotations such as Clippings.io or Readwise, tools such as reference managers or plugins such as Zotfile, or library managers such as Calibre.

Conclusion

Digital reading is more than just a simple transfer of the encoding of information from the analogue world. It is an intricate process, and many readers will benefit from guidance on the choice of tools and approaches to using them productively.

However, even more than that, the moments of digital dislocation can reveal aspects of reading that may have otherwise gone unnoticed or ignored as unremarkable. And so even in seemingly

mundane moments of simple choices of hardware and software, we have an opportunity to reflect on the nature of the activity academics hold so dear. Reading.

Appendix: Annotated List of tools planned for the lab

Hardware

iPad	Both 13in and 10in versions are included for testing of the impact of the screen size on reading certain types of texts – such as non-reflowable PDFs with small font and multiple columns.
Kindle Fire	This tablet from Amazon is included to both offer an Android alternative and to be able to test Amazon services.
Remarkable 2	This e-ink reader is very popular for its pen like experience but is also known for relatively little flexibility when working with large PDFs.
Onyx Boox Reader 13	The large screen factor and the support for Android apps of this e-ink reader were behind the inclusion decision.
Kobo Elipsa	The Kobo is included primarily because it supports public libraries and digital rights management.
C Pen Reader	A scanning pen will be included to demonstrate possibilities of converting printed text into audio or digital highlights.
Styluses and digital pens	Pen input is an important modality for interacting with digital text for many users. Users also have very idiosyncratic preferences. A variety of active and passive styluses will be included.
Wacom Tablet	Even desktop computers benefit from pen input, the entry level Wacom tablet is a good example of this modality.
Surface Studio	The Microsoft Surface Studio will serve for demonstrating both Windows-based touch interfaces as well as Windows based software.
Macbook Air	It is important to include MacOS in consideration given the wide range of popular writing and notetaking apps that are available primarily or exclusively on the Mac.

Software

The list of software selected for the lab is quite long and evolving. It includes both free, paid and subscription apps from multiple categories. Selected categories apps to highlight include:

PDF and eBook Readers	For a rich and meaningful interaction with text, a text reader that takes advantage of the digital affordances while taking into account the reader's physical needs is important. Some examples of such apps are: • Margin Note 3 • LiquidText
Text to Speech tools	Engaging other modalities is a key advantage of digital text. This functionality can be built in or a key feature of a dedicated reader app. Some examples of tools: • VoiceDream Reader on iOS • @Voice Aloud on Android • Speak Screen feature built into iOS

	• Read Aloud feature built into Microsoft Office and Edge browser
Text accessibility tools	There are a wide variety of tools that help modify text for the reader's needs. These can be dedicated or built into other tools. • Microsoft Immersive Reader built into the Edge Browser and Office applications • Instapaper or Pocket are dedicated apps for long form reading of web text • TextHelp and Claro Software offer several tools aimed at people with disabilities • Adobe Reader mobile apps now offer advanced Reflow capabilities
Note taking apps	Taking notes is an essential part of reading. The hardware devices will have a number of note-taking apps installed to test different needs and modalities. Examples will include: • Notability or GoodNotes to demonstrate the potential for pen input • Onenote or Evernote to showcase traditional apps • Notion or Remnote as an example of interlinked notes • Bear or Ulysses for a combination of writing and note taking
Mind Mapping tools	Mind mapping and concept mapping tools proliferate. It is important for users to be able to make informed decisions about them. They will include: • XMind as an example of a free desktop app • Mindomo as an example of a web-based mind mapping tool • WriteMapper as an example of a special purpose mind mapping tool • MindView as an example of a traditional mind mapping tool • CMap Tools as an example of a concept mapping tool
Writing assistants	Writing assistants of all kinds have become increasingly popular. These range from grammar and style checking tools (such as Grammarly or Sapling), to text prediction (such as Lightkey). There is also an increasing number of tools powered by machine learning models that generate substantial portions of text from basic prompts (for instance Rytr or Linguix. The lab will give users a chance to try different tools for their needs rather than simply relying on advertising.

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