

# **From Paper to Pixels : Evaluating the Usability of Digitised Books online**

**by**

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# **Abstract**

## **Research problem**

Digital libraries have invested significant resources digitising and providing access to an increasing number of books. The various approaches taken to visualise digitised books online, has potential to effect the usability and usefulness of the book to the user. Previous usability studies focus on the digital library as a whole, this study narrows the focus to the digitised book. The intention being to identify usability issues and investigate the effects a visualisation approach may have on users.

## **Methodology**

An anonymous survey was conducted, employing the Interaction Triptych Framework (ITF) to frame the relationships between the user and digitised books. Two examples of digitised books from the New Zealand Electronic Text Collection and the Internet Archive were used. Participants from library, archives and history fields, as well as general users, were invited to participate.

## **Results**

132 participants began the survey, with 86 participants completing all of the required parts. Results suggest a slightly positive attitude towards the usability and usefulness of the examples, with Open Library rated higher for usability and both examples rated similarly for usefulness. Participant comments suggest many users appreciate features analogous to physical books, with regard to aesthetics, learnability and navigation, while for ease of use and reading, rich text appeared to be preferred over digital image based visualisation.

## **Implications**

Digital Libraries need to continually strive to improve the usability and usefulness of digitised books to satisfy their users, further research is suggested creating prototypes and conducting user testing to gain a deeper understanding of the relationship between users and digitised books online.

## **Keywords**

Usability, digitised books, digital libraries.

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# 1. Problem Statement

## 1.1 Rationale

Cultural heritage institutions and other organisations are investing significant resources in the digitisation of collections and the creation of digital libraries (DLs) to manage and share these collections with users online. DLs that provide access to digitised books have added value through full text availability and indexing, improved discovery features, links to related information, participatory features and the availability of multiple formats.

With the multitude of organisations digitising books, there are different approaches used to visualise a digitised book online. This includes approaches such as rich encoded text transformed into HTML web pages or scanned page images displayed in a book-like fashion. Each approach may have unique usability issues for users and if the approaches are significantly different users may encounter issues when using digitised books across multiple DLs. By evaluating the usability of digitised books and by identifying common usability issues and those unique to a specific approach, institutions could make changes to better meet the needs of their users.

Significant developments regarding digitised books in New Zealand are under way. The National Library of New Zealand has undertaken a pilot digitisation of books (Roulston, 2013) and Victoria University of Wellington's New Zealand Electronic Text Collection (NZETC) is beginning a process to redevelop its architecture (Victoria University of Wellington Library, 2013). Both institutions are requesting feedback with regard to usability in their questions posed to users. Research in this area may be beneficial for local institutions that digitise books and visualise them online, as well as institutions that acquire digitised books to make available to their users.

I previously worked on NZETC digitisation projects at Victoria University of Wellington. Potential usability issues were identified when answering queries related to reuse of content. I found some users misunderstood the nature or source of the digitised content, could not find available full text content or other formats, were frustrated by lack of functions for easily citing books and lack of clarity with regard to copyright and reuse of digitised content. This experience inspired me to explore usability and digitised books further.

Dorner, Liew, & Yeo (2007) interviewed a small group of users of New Zealand digital cultural heritage, and found the users all identified a high level of usability as being essential to reduce barriers to using digital resources. Usability and DLs is a popular research area across the information science and computer science disciplines, and many different methods are used to

evaluate usability of digital libraries. However, very little research has focussed on the usability of digitised books. It is hoped by focusing on digitised books, there is potential to identify issues that are predisposed to the way digitised books are visualised online.

Cultural institutions and organisations around the world are continuing to digitise books and make these available through DLs. Ensuring that digitised books are displayed in an effective and satisfying manner for the end user is essential for these DLs to remain worthwhile services.

## **1.2 Research Objectives**

The main objective is to evaluate the usability of digitised books from different DLs, to identify usability issues that may hinder the user, with the intention to inform future research and best practice with regard to how digitised books are visualised online.

The key research question being:

**What usability issues face users of digitised books made available online through digital libraries?**

Sub-questions include:

- How do different approaches for visualising digitised books online affect usability?
- How could the usability of digitised books be improved for users?

## **1.3 Key Definitions**

### **1.3.1 Digital Library (DL)**

For the purposes of this research, a broad definition of DLs is adopted. They 'are an organized and managed collection of digital information, are accessible over a network and may include service' (Jeng, 2005, p. 47). This includes DLs set up by institutions, such as libraries and universities, as well as companies and non-profit organisations.

### **1.3.2 Digitised book**

Digitised books are the result of digitisation or format shifting an analogue book to a digital visualisation of it. Book digitisation projects vary significantly in size and output, factors such as those identified by Kenney (2000) of available technologies, budget, staff, standards and the needs of the user community, determine the result of each project. For the purpose of the this study, a digitised book is one that is available online and viewable in an internet browser.

'Digitised book' is used rather than 'digital' or 'electronic book', in order to exclude born digital books.

### **1.3.3 Usability**

Usability is 'How effectively, efficiently and satisfactorily a user can interact with a user interface' (U.S. Department of Health & Human Services, 2013). As well as efficiently and satisfactorily, Nielsen identifies three more specific components of usability: Learnability, Memorability, and Errors (avoidance and recovery from) (2012). Another point relevant to DLs is 'how well the system fits within the context in which it is used' (Blandford & Buchanan, 2003).

## **2 Literature Review**

### **2.1 Digitisation of books**

The evolution of book digitisation from human intensive processes to mass digitisation, provides a useful background to this study. Initiated in 1971, Project Gutenberg is considered to be the first project to digitise books (Johnston, 2012). Out of copyright texts were manually keyed following consistent formatting rules, in what is a time consuming process. Texts were preserved and made available in Plain Vanilla ASCII format, a format chosen for its reach, as most devices of the time, regardless of operating system could open and view them (Lebert, 2008).

During the 1970s and 1980s academic institutions initiated projects to digitise or collect digitised texts, including major projects: Thesaurus Linguae Graecae (University of California, Irvine) 1972, Oxford Text Archive (University of Oxford) in 1976 and the Perseus Digital Library (Tufts University) in 1985 (Johnston, 2012). These and other similar projects were situated within the Humanities Computing field. They explored the potential use of computing in humanities research, by providing a depository for texts created by researchers (e.g. Oxford Text Archive), providing researchers access to texts in a specific field (e.g. Ancient Greek texts at Thesaurus Linguae Graecae) and developing the tools to analyse texts and collections of texts.

With the growth of many such text projects, there was a growing recognition for the need of standardisation. Scholars were frustrated with inadequacies of text encoding and the time consuming efforts reformatting texts for use in different software, so the Text Encoding Initiative (TEI) was established to develop encoding standard guidelines for describing texts (Schreibman, Siemens, & Unsworth, 2004). TEI guidelines meant texts could be digitised using

detailed semantic text mark up language. The expansion of projects can be evidenced in the long list of projects in the *Directory of Electronic Text Centers* compiled by Mary Mallery (Mallery, 1994).

The arrival of the internet browser in 1993 created new opportunities for the dissemination of digitised books over the internet. Libraries began to see opportunities to provide access to their digitised collections and publications. An early example is The University of Virginia Library. They transformed TEI encoded texts into HTML and made them available through the browser creating easily searchable and browsable texts and collections (Price-Wilkin, 1994).

Locally, the New Zealand Electronic Text Centre was founded in 2002 at Victoria University of Wellington, by former assistant director of University of Virginia Electronic Text Center, Elizabeth Styron (Victoria University of Wellington, 2002). The primary goal being “to create a searchable electronic archive of New Zealand texts”. In 2006, University of Auckland Library started a project to “provide the keyword-searchable text of significant books published about New Zealand in the nineteenth century” (University of Auckland Library, 2006). Both of these projects adopted TEI mark up standards, and as well as displaying texts in the browser they offer other formats for use.

With all the projects discussed above, the scale of digitisation is relatively small, selective, and based at individual academic and cultural institutions or in small collaborations. During the 2000s a number of mass digitisation projects were initiated, that took advantage of improved technology, large collaborations, and increased interest in the digitisation of books for access. Mass digitisation “is based on the efficient photographing of books, page-by-page, and subjecting those images to optical character recognition (OCR) software to produce searchable text” (Coyle, 2006).

The Million Book project, initiated in 2002 by the Carnegie Mellon University, digitised over a million books and made them freely available online. Project partners included Zhejiang University (China), the Indian Institute of Science (India) and the Library at Alexandria (Egypt) (Carnegie Mellon University, 2007). This project employed OCR to extract text from page scans, to enable indexing and reformatting. Funding was provided by governments and technology businesses to help develop the processes and technology needed for mass digitisation. Digitised books were made available in the browser using image based visualisation employing the proprietary format DjVu (Witten, Gori, & Numerico, 2010).

Google Print (later Google Books) project was announced in 2004 and collaborated with large academic libraries to digitise millions of books from their collections (Google Books, n.d.). They



indexed the resulting OCR text to provide search features, and also made digitised books fully or partially available online depending on their determination of copyright status.

In 2005 the Open Content Alliance, conceived by Yahoo! and the Internet Archive to “build a permanent archive of multilingual digitized text and multimedia content” (Open Content Alliance, n.d.). This large collaborative effort hosted by the Internet Archive included academic, public, and national libraries as well as businesses aimed to make books openly available. Digitised books are made available in multiple formats as well through a book reader interface that presents page images with searchable text, automatically generated by OCR. The Internet Archive now stores and makes available digitised books from numerous projects, including The Million Book project, Project Gutenberg and the openly available books from Google Books.

Mass digitisation project's focus on quantity, has perhaps been at the expense of considering the end user of digitised books. Coyle (2006) suggests “the weakest point of the mass digitization projects so far is the development of user interface to the digitized materials”, citing lack of highlight and copy features, proprietary formats and ebook like features. While smaller scale projects are often made available through custom built and ageing website and systems, each with different approaches to visualising digitised books which creates potential usability issues. That both types of digitisation project provide access to some digitised books is fantastic, but there remain questions around how usable these books are.

## **2.1 Usability evaluation methods**

There have been many evaluation methods developed to evaluate the usability of DLs, however few focus specifically on the usability of digitised books. Blandford, Keith, Connell and Edwards (2004) reviewed four different analytical techniques used to evaluate system usability and they compared the strengths, limitations and scope of each one. They used an action research method to briefly test each technique. The first technique examined was heuristic evaluation. This involved assessment of a DL's pages by a group of analysts against a list of standard heuristics. They found large differences between each analyst's assessments, suggesting the evaluation data collected would not be authoritative, but they concluded this technique was useful for identifying surface usability issues.

Secondly, they assessed cognitive walkthrough, where a team of analysts agree on initial assumptions about the user and then develop possible user tasks. Analysts work through the tasks, and compare findings. They found that it was limited by the assumptions made, but like heuristic evaluation was useful for identifying surface issues.

Thirdly, they used claims analysis, involving evaluating each feature of a DL from the perspective of a user and identifying positive and negative claims for each feature. This technique allowed the use of previous research and theories on information seeking and usability to better inform the evaluation.

Finally they used CASSM which focusses on the fit between the user and system concepts. They found that it did not identify specific issues as well as other techniques. While each technique was useful, they argue that none was ideal. Their study reinforced the need to consider choosing multiple evaluation techniques, and encouraged the potential benefits of using both analytical and empirical techniques.

Tsakonas & Papatheodorou (2008) focused on open access repositories, with the objective of determining which content and system features affect usefulness and usability. They applied a user-centred evaluation approach employing the Interaction Triptych Framework (ITF). ITF models DLs as a triangle of interactions between the user, the system and the content, where usability sits between the user and the system, usefulness sits between the user and the content, while performance sits between the system and the content. At each point of interaction are attributes that are used as evaluation variables for usability and usefulness. The model appeals for its simplicity and the focus it gives to a user's experience of DLs.

They used questionnaires to gather data from users of the E-LIS repository. Their findings indicated that the relevance and scope of content affected usefulness, while ease of use, aesthetics, terminology and learnability were attributes that affected usability. The fact that the repository was open access and provided personalised services also increased usability. The study is limited in that the audience are users of a repository of information science articles, and are possibly more aware of using DL systems than a wider DL audience. The study concluded that more research on content and system attributes and their potential influence on the usability of DLs is required.

Buchanan and Salako (2009) also argue the importance of considering both usefulness and usability when evaluating DLs. Their objective was to identify what to measure and how to measure it; seeking how to extend usability evaluation to include usefulness. Based on reviewing literature they present a measurement framework that addresses usability attributes of effectiveness, efficiency, aesthetic appearance, terminology, navigation, learnability, and usefulness attributes of relevance, reliability and currency. Findings indicated that addressing usability and usefulness at the same time was beneficial and they concluded that these two constructs are dependant.

Joo and Lee (2010) attempted to develop and verify a usability measurement tool focusing on the same four usability attributes: efficiency, effectiveness, satisfaction, and learnability in the academic library setting. They reviewed previous studies to identify these key measurement attributes, and developed a survey method that could complement inspection and formal usability evaluations. Testing the survey on 230 students of an academic DL, they found that the instrument was applicable for DL usability evaluation, however with some limitations including identifying the DL's audience (their sample included only students) and that their instrument was based on a literature review, without consultation with DL usability experts.

Chowdury, Landoni and Gibb (2006) reviewed usability studies in the DL field, with the objective of identifying what evaluation methods are used. They found that no one method of evaluation suits all DLs; rather it depends on the DL's context. They identified content, information behaviour, culture issues, language, localisation and globalisation as issues of interest, but concluded that the primary focus of evaluating DLs should be on target users, applications and context.

## **2.2 Usability studies**

Clark (2004) conducted a usability study of the digitised Belgian-American Research Collection. The study sought to identify usability issues and recommend ways they could be addressed. This involved using two evaluative methods: a focus group and a task oriented field test. The focus group was an informal discussion of the issues, achieved by displaying the DL on a large screen, and discussing and recording issues identified by participants. The field test involved observing users complete a number of tasks, and surveying the users after the test for demographic information.

The findings indicated issues including: a lack of search guidance, problems distinguishing different parts of the collection, unexpected results, collection interface errors affecting both novice and expert users, lack of personal customisation and issues determining what an active record was. From the study the author recommended addressing these issues, and concludes that users and usability need to be considered at DL development and redevelopment stages.

H. H. Kim and Y. H. Kim (2008) aimed to evaluate the dCollection system, created for South Korean academic institutional repositories, with the intention of developing a usability evaluation framework and providing suggestions for improving the usability of the dCollection system. They used multiple methods including a laboratory test with 15 inexperienced users, a remote test with 15 experienced users using the same questionnaire, and a focus group interview with 4 experts. Findings from the tests indicated usability problems with help and support, searching/browsing functions, and visual appearance, while the focus group

discussions inspired the authors to explore how the FRBR model could be implemented to improve the usability of searching and browsing. They also presented mock-up designs addressing the identified issues of visual appearance, with the hope that these could be implemented in a scheduled upgrade of dCollection.

Miller, Choi and Chell (2012) evaluated and compared three large digitised book DLs: the Open Library, Google Books and Hathi Trust. They aimed to examine each DL interface by considering usability, aesthetics and interface components. The authors used an experiment-like usability evaluation with twenty participants with prior experience of DLs.

Firstly participants described perceptions of aesthetics, and then they evaluated usability in the context of ten usability items. Finally, participants tested seven interface components: collection browse, collection search, viewer navigation, viewer options, output options, accessibility and help features.

The data was analysed using ANOVA repeated measure. The findings interestingly showed that participants appreciated visual cues of the physical book (Miller, Choi & Chell, 2012, p. 368) and that Google books rated highly because of the familiarity of the wider Google services to users. This study suggests that different approaches to visualising digitised books online could influence their usability.

Rose (2009) studied the experience of students reading digitised text online. While acknowledging the lack of impartiality in the open interview of ten students, findings identified issues in the shift from reading text in a spatial construct to a temporal construct where content structure disappears with page scrolling and users not being able to physically hold the text. While reading from a bright screen, ease of interruption to reading and restricted physical posture of reading on screen, were also identified as reader experience issues. The author discusses the potential for a 'lack of 'fit' that may prevent students from engaging fully with the content of the e-books and PDF files they read for courses and research' (Rose, 2009, p.525), which indicates usability as an important factor for users reading and experiencing digitised text.

The often cited study by Hornbaek & Frøkjaer (2003) investigated the usability of visualisation techniques used to visualise electronic documents online. Like the proposed study, their focus was on the usability of different approaches employed to visualise documents rather than the usability of the whole system, their argument being that "Although gaining an overview of the collection and formulating queries are important activities, the problematic situation that motivated users to access the collection is ultimately resolved through interacting with the documents" (Hornbaek & Frøkjaer, 2003, p.293).

They conducted an experiment with students who wrote an essay based on reading electronic documents displayed using three different visualisation approaches. They found that that documents that feature an overview navigation tool and the content side by side, were most effective for students to achieve high grades.

The growth of DL usability studies using a wide range of evaluation methods (e.g. Blandford, Keith, Connell & Edwards, 2004), developed for a variety of DLs continues. The use of multiple methods of evaluation that are suited to each DL's context is encouraged (Buchanan & Salako, 2009; Blandford, Keith, Connell & Edwards, 2004). Usefulness has been identified as related to usability (Buchanan & Salako, 2009; Tsakonas & Papatheodorou, 2008), and ideally should be considered in usability evaluations of DLs to better address the user's wider information needs. Previous studies indicate that the way content is displayed online, potentially affects the usability of the DL (Miller, Choi & Chell, 2012; Tsakonas & Papatheodorou, 2008; Hornbaek & Frøkjær, 2003), but very little research has focussed specifically on the usability of digitised books.

### 3 Methodology

An anonymous online survey of current and potential users of digitised books was conducted to evaluate the usability and usefulness of two examples of digitised books from different DLs. The survey used the Interaction Triptych Framework (ITF) (see Fig. 1), described by Tsakonas & Papatheodorou (2008), to frame the view of users. While ITF was developed with the evaluation of a whole DL in mind, many of the attributes that make up the framework are relevant to the this study, and reflect the attributes or heuristics of past usability studies.

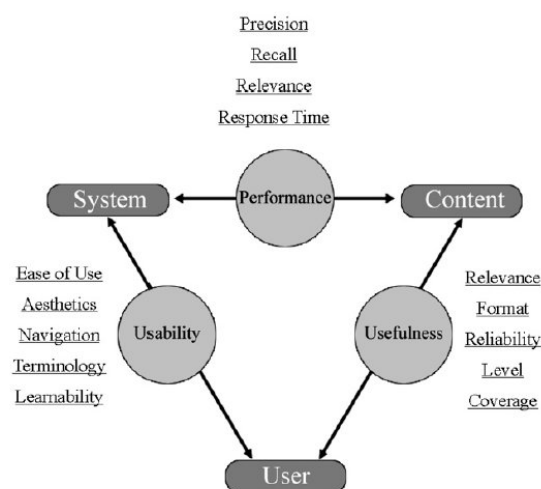


Fig. 1 Interaction Triptych Framework (Tsakonas & Papatheodorou, 2008, p.1238)

The survey gathered data on participants past experience with digitised books online. Participants were then encouraged to briefly read and use each digitised book example, and rate their level of agreement with statements which are based on selected attributes identified in the ITF.

For the relationship between the user and the system, all usability attributes were selected, and the following statements developed to fit the digitised book context:

Attribute	Statement
Aesthetics	I found it aesthetically pleasing
Learnability	I imagine most people would quickly learn how to use this
Navigation	I could navigate through the book easily
Terminology	I understood the terminology and icons used
Ease of use	I found it easy to read and use

For the relationship between the user and the content, the attributes relevance, format and reliability were selected. Level and coverage only apply when evaluating the whole DL, so were not included in the survey. The following statements were developed for the selected usefulness attributes:

Attribute	Statement
Reliability	I could see that it was a reliable source
Format	I could easily find other formats for viewing the digitised book
Relevancy	Relevant information about the digitised book was easily available

Participants rated their level of agreement using Likert scales. A follow up question asked about the performance of each example. The difficulty determining where any performance issue resided (between the system and the content, or between the user and the content) is acknowledged.

Open questions were asked of the participants, on what they liked and disliked about each example. Unfortunately, a copy and paste error in the wording of these questions, meant that they were grammatically incorrect. A small number of participants commented they did not understand the question, however the vast majority who answered appeared to understand

the intention of these questions. Further open questions asked how each example could be improved. Finally a short comparison of the examples was conducted, where participants selected their preference out of the examples with regard to the five usability attributes. For a full copy of the survey see the appendix.

The examples were selected after a search was conducted for books of potential relevance to New Zealand users, and that are openly accessible and are found in multiple DLs. Samuel Butler's *A First Year in Canterbury Settlement : With other early essays* was identified as a candidate found in many DLs : including NZETC and a number of overseas DLs including E-books@Adelaide, Hathi Trust, Internet Archive's Open Library and Google Books.

From these the NZETC and the Internet Archive's Open Library were selected to study. The NZETC's approach reflects the library and academic small scale approach to book digitisation and could be described as visualising books as web pages. The Open library example reflects the mass digitisation approach, the example itself being digitised by Google and archived by the Internet Archive, it is visualised through a book-like reader interface. These examples use quite different approaches to visualise a digitised book online, and offer a good starting point for researching usability of digitised books.

The study is not focussed on the wider digital library interface, such as the search and browse functions, so the entry point into each example was artificial. In the case of NZETC, participants land at the encoded contents level of the book, which unless you have searched for the title of the book may not be a common entry into the book. This is because NZETC digitised books feature marked up text that is indexed by internal search functions and web search engines like Google, so there are many possible other entry points to the content within a book.

In the Open Library 'read online' example users land at the title page of the book, this is accessed from Open Library's page for the book. Alongside the 'read online' option are other formats that are available to download and may be preferable for the user. The focus of this study is on using the digitised books accessed in a web browser, and while other formats such as EPUB and PDF, can be viewed within the browser, it was not the intention to consider the usability of these formats.

A purposive sampling method was used, with participants invited to take part. Possible users were approached through a number of means, including approaching New Zealand librarians, information professionals and archivists by posting the survey to ListSrvs, sharing the survey through social media channels, having the survey shared and posted on the websites of two organisations whose members would likely use digitised books (Professional Historians' Association of New Zealand/Aotearoa and New Zealand Historical Association). Survey research is

self-reported and for a number of reasons people may not report accurately what they think, this small and purposive sample may not reflect wider user's experience, therefore no generalisations can be made from the data collected.

## **4 Findings and Discussion**

### **4.1 Participants**

The survey received 132 responses, however only 86 participants completed all of the required sections. The high rate of withdrawal could possibly be due to technical issues accessing the digitised book examples (some participants commented that they could not access the examples) or possibly confusion regarding the second example being the same title as the first, and as discussed above an error in some of the survey questions may have discouraged participants from completing the survey. Given the exploratory nature of the study, it is still useful to consider all the available responses for each part of the survey, regardless if the respondent completed the survey or not.

119 of the 132 (90.15%) participants had used digitised books before, with 41 (31.06%) describing themselves as using them often, and 50 (38.88%) using them sometimes, and 28 (21.21%) rarely. 56 of 116 (48.28%) participants said they used digitised books for recreation, 38 selected research, 35 selected work and 25 selected study, of these 32 (27.69%) selected more than one use, which highlights that the same user may have different needs depending on the context of use.

108 of 127 (85.04%) participants completed the survey using a desktop or laptop. 18 used either a tablet or smartphone and of which less than half completed the survey (8/18), suggesting technical issues with the survey platform, examples or both on these devices. This view was supported by comments from a participant who noted difficulties with both examples when using a smartphone. One participant selected 'other' device, but did not specify what device was being used.

### **4.2 Usability**

Table 1 presents the level of agreement participants felt with each statement relating to the usability attributes, as outlined in the methodology. Overall they suggest a slightly positive attitude towards each attribute. The Open Library example averaged slightly higher than the NZETC example for all attributes. There was no significant difference between users who described their usage of digitised books as often, to those who use them rarely or never with



regard to usability. This is in line with previous usability studies by Clark, who also found that “aptitude does not make the system more usable” (Clark, 2004, p.123).

Usability attribute	Example	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)	N	Mean
Aesthetics	NZETC	5 (4.76%)	44 (41.90%)	26 (24.76%)	25 (23.81%)	5 (4.76%)	105	2.82
	Open Library	2 (2.17%)	18 (19.57%)	19 (20.65%)	36 (39.13%)	17 (18.48%)	92	3.52
Learnability	NZETC	3 (2.86%)	22 (20.95%)	27 (25.71%)	45 (42.86%)	8 (7.62%)	105	3.31
	Open Library	1 (1.09%)	5 (5.43%)	13 (14.13%)	51 (55.43%)	22 (23.91%)	92	3.96
Navigation	NZETC	5 (4.76%)	26 (24.76%)	26 (24.76%)	35 (33.33%)	13 (12.38%)	105	3.24
	Open Library	4 (4.35%)	10 (10.87%)	15 (16.30%)	44 (47.82%)	19 (20.65%)	92	3.7
Terminology	NZETC	2 (1.90%)	11 (10.48%)	28 (26.67%)	50 (47.62%)	14 (13.33%)	105	3.6
	Open Library	1 (1.09%)	5 (5.43%)	17 (18.48%)	52 (56.52%)	17 (18.48%)	92	3.86
Easy to use	NZETC	1 (0.95%)	24 (22.86%)	25 (23.81%)	44 (41.90%)	11 (10.48%)	105	3.38
	Open Library	3 (3.26%)	8 (8.70%)	16 (17.39%)	46 (50.00%)	19 (20.65%)	92	3.76

*Table 1 : Usability results*

This difference between examples is most significant with the aesthetics attribute, where 53 of 92 (57.60%) participants agreed or strongly agreed that they found the Open Library example 'aesthetically pleasing', compared to 30 of 105 (28.57%) participants who felt the same about the NZETC example.

Many participants when commenting on what they liked about the Open Library example said that it appeared more like a physical book, for example:

- “This is a much more book-like interface”
- “Original appearance of page preserved”
- “I felt I was looking at the original. A meaningful experience.”

These views match previous studies of digitised texts where ‘participants appreciated the use of elements that are analogous to their physical counterparts’ (Miller, Choi & Chell, 2012, p. 368). Although the page turning animation in the Open Library example was divisive: with some participants liking this feature, while others found it tedious or 'gimmicky'. A number of participants commented that what they did not like about NZETC example was that it did not feel like a book, for example: “Looks very different from the printed book. I didn't feel like reading a real book, more like reading webpages”. Many participants commented positively on its simple and clear layout.

73 of 92 (79.34%) participants agreed or strongly agreed that most people would quick learn how to use the Open Library example. It appeared from the comments that the Open Library's book-like interface made it easy to learn. Many participants commented on its intuitiveness,

for example: “The similarity of this book to standard print books makes using it more intuitive, and feels quite comfortable.”.

Just over half (53 of 105) of participants felt users would quickly learn how to use the NZETC example. Some expressed difficulty getting started, such as these:

- “I didn't immediately realise that you could click on the next section hypertext link to get to the body of the text”
- “I didn't understand how to get into the text of the book, I went around in circles for a while”

Less than half (48 of 105) of participants agreed with the statement that the NZETC example was easy to navigate. A number of participants expressed confusion with the navigation options, including comments such as “The hyperlinks were a little confusing - it was sometimes hard to know where in the book you were.” and others commented on the number of clicks required to get to content, such as “multiple clicks to open different layers and navigate through to actual text”. These issues bear a similarity to the findings of Clark (2004), where users had difficulty distinguishing between records, and navigating around a collection.

Whereas 63 of 92 (68.48%) participants agreed or strongly agreed that it was easy to navigate the Open Library example. Participants commented that they liked that it had multiple navigation options including an internal search function, navigation or 'progress' slider, options to browse by thumbnails, turn pages and click on left and right arrows. Potential issues were also commented on including a lack of hyperlinking, for example: “No hot links to navigate to a specific chapter. or back to the beginning”. One participants also reflected on how this may affect their use: “There was no where to enter which page I wanted to go to immediately, I had to click 'next' to go through each page which could take a long time. If I was using the book a lot during an assignment, I'd want to be find a quote quickly by going straight to the source.”.

The terminology in use for both Open Library and NZETC was understood by the majority of participants. For the NZETC a number of participants commented on confusion with the use of 'next section' in the books, some wondering if it referred to page or chapter, perhaps further indication of user expectation for a digitised book to be organised and described in the same manner as a print book.

The majority of participants agreed that they found these examples easy to read and use, with Open Library at 65 of 92 (70.65%) and NZETC at 55 of 105 (52.38%). The rich text of NZETC was

well regarded, as it made it easy to read and available resize and copy. Many participants commented on the font:

- “It is easy to read, the font is a good choice”
- “Clear large font”
- “Clear typeface.”
- “The typeface is clear and easy to read.”

One participant mentioned having vision in one eye, and noted that they “found the NZETC digital format far easier to read with my vision.”. The flexibility of adjusting text size was appreciated: “Clear, could make the writing smaller or bigger” and “It’s easy to modify the text size”, which is important for addressing web accessibility standards.

Participants appreciated the ability to easily copy text in the NZETC example, conversely expressed frustration at not being able to easily copy text from the Open Library example, which does not provide for highlight and copy, users would have to open a different format to do so. Coyle (2006) identified the lack of highlight and copy functions as user interface issues with digitised books that are the outcome mass digitisation projects such as this one.

There were some comments on difficulties reading the Open Library example:

- “The typeface was a little blurry”
- “need to zoom to be readable - slightly fuzzy text otherwise”
- “The type is not so easy on the eye and I found it too close together”

A couple of participants acknowledged that the scanned page images, while original or authentic, were not as easy to read:

- “The original typeface was quite hard to read - though felt like an authentic experience”
- “Because it is a direct scan of the original book, typeface etc makes it a little difficult to read”

Suggesting the benefits of the book-like interface, in terms of aesthetics, learnability and navigation are countered by the usability issues reading the image based visualisation of the text.

Other issues were identified with the internal search function not finding words that were identified on the page, which suggested issues with OCR, where errors in recognising letters may make specific words throughout a book difficult to find. This be a may result from issues with the digitisation process, or the condition of the original book that was digitised.

### 4.3 Usefulness

Overall there was a slightly positive attitude to the usefulness attributes considered in the survey, and very similar results between the two examples (Table 2).

Attribute statement	Example	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)	N	Mean
Relevance	NZETC	2 (1.90%)	11 (10.48%)	26 (24.76%)	49 (46.67%)	17 (16.19%)	105	3.65
	Open Library	2 (2.17%)	16 (17.39%)	21 (22.83%)	46 (50%)	7 (7.61%)	92	3.43
Format	NZETC	12 (11.43%)	23 (21.90%)	26 (24.76%)	32 (30.48%)	12 (11.43%)	105	3.09
	Open Library	6 (6.52%)	25 (27.17%)	23 (25%)	31 (33.70%)	7 (7.61%)	92	3.09
Reliability	NZETC	1 (0.95%)	10 (9.52%)	12 (11.43%)	63 (60%)	19 (18.10%)	105	3.85
	Open Library	1 (1.09%)	8 (8.70%)	12 (13.04%)	54 (58.70%)	17 (18.48%)	92	3.85

*Table 2 : Usefulness results*

The majority of participants agreed that relevant information about the digitised book in each example was easily available and useful (NZETC: 66/105 (62.86%) and Open Library: 53/92 (57.61%). One participant commenting on the NZETC example liked that there was “More information clearly to the right. Tells you about the source of the text.”. While some comments mentioned difficulty locating information about the book with the Open Library example, which could be a result of artificial starting point to the book rather than the Open Library's bibliographic record page for the digitised book.

Just over 40% of participants agreed that they could easily find other formats for viewing the digitised book. Participants commented on the specific formats available: “I liked how it could be read in PDF format or sent to Kindle – awesome!”, “I did open a PDF version of this one as well as the default version from your link. Both seemed fairly nice to use.”. The availability of audio book version on Open Library was acknowledged: “The audiobook feature is a nice touch, though I would be unlikely to use it myself” and “The audio was mechanical but if I was blind then something like this would be better than nothing”, another participant suggested it was not well executed: “couldn't understand the dialogue of the audio-what do the numbers mean?”. The numbers mentioned may be a result of OCR errors, where perhaps letters are misread as numbers.

In both examples nearly 80% of participants agreed or strongly agreed that they could see that it was a reliable source. A few participants commented on the authenticity achieved by focusing on the facsimile page images of the Open Library example: “I liked the original, more authentic format. I liked the handwritten notes”.

Issues with the quality of the digitised book were raised noting cropped page images, and the poor quality of the scan. A small amount of quality errors are expected with mass digitisation projects, and even those with errors can still be useful (Leetaru, 2008), however some participants identified that the pages between 39 and 84 of the Open Library example are missing, a major error. This would obviously impact on the usefulness of the book, and meant the page count on the navigation slider became out of sync and not as usable.

#### **4.4 Performance**

The survey asked an open question regarding the performance of each example. Most participants found there were no performance issues. A number of people commented on past experience with slowness and pages not loading with the NZETC. With the Open Library example, a few participants reported being unable to access the book at all at the time of the survey, while others commented on lag when browsing new pages, possibly a result of being an image focussed interface. The performance of both examples is influenced by external factors, such as the internet connection or the browser of the participant, so it is difficult to identify where identified issues may lie.

#### **4.5 Improvements**

Optional questions asking how each example could be improved received a good response from participants. As reflected elsewhere in the survey results, a number of participants commented on the need for improved navigation with the NZETC example. This included suggesting better use of a table of contents:

- “Move contents to a more prominent position”
- “A clearer 'normalised' contents page - so I can be sure I am seeing the full contents list.”
- “More clarity between 'Table of contents' and 'Contents' which seemed to refer to different things”
- “If the table of contents could be more prominent that might help. It just seems like a bit more mouse-clicking is required to get to the body of the text.”

In particular, a shift of the contents to be displayed side by side with the digitised content:

- “table of content displayed all the time in the left vertical table”
- “It could be improved by having the table of contents in a sidebar to improve ease of navigation.”
- “Contents as a side bar”

This appears to reinforce the study by Hornbaek & Frøkjaer (2003). While they considered electronic documents rather than digitised books, they found that an overview navigation tool and the content side by side was most effective for users in their study.

There was also a clear desire for a more book like interface:

- “To mimic a real book (i.e. the ability to turn the page) and to be a digitised image of the pages”
- “I didn't like the page numbering to the side of the text, I would much rather have the different pages on separate digital pages that you click through”.

There was encouragement for having the “Scan and text options in parallel” and to “Retain connections to the page images so that the reader can see what it originally looked like.”. It appears that the familiar unit of the page, with its reference to the print book is a desired feature for some users.

Further suggestions encouraged aesthetic and design improvements, notemaking or bookmarking features, a mobile friendly interface and the use of breadcrumbs to better locate the user.

For the Open Library example improving the function and availability of table of contents was also discussed:

- “Make contents page clickable.”
- “Chapter/section links in a table of contents would be helpful.”

A few participants also suggested the use of hyperlinks within the text to improve navigation, for example: “Hyperlinks to take you to the different pages and chapter sections.”.

Suggested improvements for the readability of the text were common:

- “Some manipulation of font to make it easier to read whilst still giving the look and feel of the original”
- “Sharper crisper and less blurry font”
- “Improve the font and update the version of book used”
- “Use a different font - a clearer , sharper font that is not so dark”

Alongside better access to the textual content itself:

- “A link to a 'plain text' version”
- “parallel facsimile and transcription/OCR”

Also mentioned was annotation features, more contextual information: about the book and DL.

## 4.6 Comparison

Participants were also asked to select a preference between the two examples whilst considering the usability attributes of ease of use, aesthetics, navigation, terminology and learnability (see Table 3).

Attribute	NZETC	Not sure	Open Library	Response
Ease of use	24 (27.91%)	22 (25.58%)	40 (46.51%)	86
Aesthetics	18 (20.93%)	19 (22.09%)	49 (56.98%)	86
Navigation	28 (32.56%)	21 (24.42%)	37 (43.02%)	86
Terminology	20 (23.26%)	38 (44.19%)	28 (32.56%)	86
Learnability	20 (23.26%)	26 (30.23%)	40 (46.51%)	86

**Table 3 : Comparison results**

The Open Library example was preferred by more participants in relation to each attribute. These results matched the earlier findings (see Table 1), where a higher percentage of participants agreed or strongly agreed with the usability statements in relation to the Open Library example. There was a considerable number of 'unsure' responses, and from the comments it became clear some participants recognised that these different approaches met different needs:

- “The NZETC was obviously a front end for a bunch of data available in different formats. The Open Library was intended to be read on screen. Comparing them is a bit strange as they are obviously for different purposes.”

- “I think the preference would very much depend on what sort of information you needed to get out of the digitised book. To find specific answers to particular questions, the improved navigation of NZETC would help, but to read the entire book, I'd much prefer the Open Library version.”
- “To read historic material for really serious research or just for pleasure I would use Open library. For interpretation, and fact finding I would prefer NZETC”
- “I like how NZETC doesn't try to pretend it's a digitised physical thing. The predominance is on the text, therefore the content is paramount over the object approach of the Open Library. The difference in approaches makes me think that NZETC are treating the digitised text like a research resources, rather than the reading approach of Open Library.”

#### **4.7 Further research**

The original intention of the study was to conduct a survey in conjunction with heuristic evaluation (HE). Joo and Lee (2010) used a survey approach, and found that a survey method could be used to complement inspection evaluation methods. HE involves an analyst(s) examining and assessing a website according to prescribed heuristics or rules “that seem to describe common properties of usable interfaces” (Nielsen, 2001). It is effective for identifying local or page issues, rather than issues across a whole DL (Blandford, Keith, Connell and Edwards, 2004). Using HE with these particular examples, could provide a complimentary set of data with which stronger conclusions could be made. The combination of multiple methods when evaluating usability is encouraged by previous usability studies (Buchanan & Salako, 2009; Blandford, Keith, Connell & Edwards, 2004).

The data collected from the online survey included a large amount of comments, while some open coding of the results has identified themes as discussed above, further more structured analysis of the comments collected could provide a deeper understanding of study.

The survey method has provided a good starting point, but the data is self reported, further research could be conducted using observations or focus groups like those of previous studies (Clark, 2004, ; H. H. Kim and Y. H. Kim, 2008). An interesting angle would be the creation of prototypes in conjunction with user studies such as observation. As part of their research process, H. H. Kim and Y. H. Kim (2008) created mock-up designs of the repository they evaluated which addresses the issues identified. While Hornbaek and Frøkjær (2003) designed three different interfaces to investigate how the visualisation approach affected the performance of users of electronic documents. The creation of prototype digitised book



interfaces could be tested in a similar way, with the findings fed back into the development of further prototypes through an iterative process.

## 5 Conclusion

This study has identified a number usability issues faced by users of digitised books. These included the challenges of learning and navigating an encoded digitised book (NZETC example), visualised as linked webpages and a part of a collection of linked texts and resources. These issues were countered by its readability and the flexibility of its rich text.

While the difficulties reading an page image based digitised book (Open Library example), and its issues of reliability that reflect the mass digitisation processes used to create it, were countered by the aesthetically pleasing and intuitive interface. It was clear the different approaches had unique issues that could be addressed.

There was a preference expressed for a book-like interface, for its intuitiveness and aesthetics, and page images were appreciated for their authenticity. Better navigation features through easily accessed and hyperlinked table of contents was encouraged. Participants recognised the need for both rich text and image based visualisations, depending on the context of use, and some suggested having them in tandem.

Application of the ITF to the study has been effective, providing a sound structure to build the survey and collect useful data from participants. Usability and usefulness attributes can be seen as related. A good example of this was where the reliability issue of Open Library example missing pages, affected the functions of the navigation slider. Digital Libraries need to continually strive to improve the usability and usefulness of their digitised books: improving the digitisation processes and outputs to ensure they are useful and improving the interface for visualising a digitised book online to meet user needs.

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## 7 Appendix: Online Survey

### **Research project title:**

From paper to pixels : evaluating the usability of digitised books online

### **Researcher:**

Richard Robertson, School of Information Management, Victoria University of Wellington

As part of the completion of my Master of Information studies, this study is designed to evaluate the usability of digitised books from multiple digital libraries, to identify usability issues that may hinder the user and consider the affect that the approach taken to visualise a digitised book online may have on usability.

This survey aims to gather data from current and potential users of digitised books with regard to the usability of digitised books online. It uses two examples of a digitised book from different digital libraries and requests the participant briefly use and then evaluate each example. The same book is used in each example (A first year in Canterbury Settlement with other early essays by Samuel Butler). The examples are from the New Zealand Electronic Text Collection and the Open Library.

For the purpose of this study digitised books, are defined as books that have been format shifted from analogue to a digital visualisation of it, and which are made available online and viewable in an Internet browser. Victoria University requires, and has granted, approval from the School's Human Ethics Committee.

This is an anonymous survey, no information that identifies you is being collected. By taking this survey you are giving consent for the use of your responses in this project. It will take approximately 15 minutes to complete. Participants will be able to view the results of the research in the final report to made available through the Victoria University of Wellington Research Archive from March 2015.

If you have any questions or would like to receive further information about the project, please contact me at [Robertrich3@myvu.ac.nz](mailto:Robertrich3@myvu.ac.nz) or telephone 021 02868891, or you may contact my supervisor Sydney Shep at [Sydney.Shep@vu.ac.nz](mailto:Sydney.Shep@vu.ac.nz) or telephone 04 463 5784.

Thank you very much for your participation.

Richard Robertson

I use digitised books ...

1. Never (1)
2. Rarely (2)
3. Sometimes (3)
4. Often (4)

I use digitised books mostly for ...

1. Study (1)
2. Work (2)
3. Research (3)
4. Recreation (4)
5. Other (5) \_\_\_\_\_

What device are you currently using to complete the survey?

5. Desktop (1)
6. Laptop (2)
7. Tablet (3)
8. Smartphone (4)
9. Other (5) \_\_\_\_\_

Browser Meta Info

Browser (1)

Version (2)

Operating System (3)

Screen Resolution (4)

Flash Version (5)

Java Support (6)

User Agent (7)

### Example 1: New Zealand Electronic Text Collection (NZETC)

Please open [A first year in Canterbury Settlement with other early essays by Samuel Butler](#) from the NZETC in a new tab or window in your browser and spend about 2-3 minutes browsing and reading this book.

#### Usability:

Please rate your level of agreement with the following statements about the usability of this digitised book. Feel free to look at the book again while you consider your selections:

	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I found it easy to read and use.					
I found it aesthetically pleasing.					
I could navigate through the book easily.					
I imagine most people would quickly learn how to use this.					
I understood the terminology and icons used.					

#### Usefulness:

Please rate your level of agreement with the following statements about the usefulness of this digitised book. Feel free to look at the book again while you consider your selections:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I could see that it was a reliable source.					
I could easily find other formats for viewing the digitised book.					
Relevant information about the digitised book was easily available and useful.					



**Performance:**

Did you notice any performance issues (e.g. slowness, page errors) when using the book? if so please describe below.

**Open Questions:**

What do you like about the way this digitised book interface?

What don't you like about the way this digitised book interface?

How could it be improved?

## Example 2: Open Library

Please open [A first year in Canterbury Settlement with other early essays by Samuel Butler](#) from the Open Library in a new tab or window in your browser and spend about 2-3 minutes browsing and reading this book.

### Usability:

Please rate your level of agreement with the following statements about the usability of this digitised book. Feel free to look at the book again while you consider your selections:

	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I found it aesthetically pleasing.					
I imagine most people would quickly learn how to use this.					
I found it easy to read and use.					
I understood the terminology and icons used.					
I could navigate through the book easily.					

### Usefulness:

Please rate your level of agreement with the following statements about the usefulness of this digitised book. Feel free to look at the book again while you consider your selections:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Relevant information about the digitised book was easily available and useful.					
I could easily find other formats for viewing the digitised book.					
I could see that it was a reliable source.					

**Performance:**

Did you notice any performance issues (e.g. slowness, page errors) when using the book? if so please describe below.

**Open Questions:**

What do you like about the way this digitised book interface?

What don't you like about the way this digitised book interface?

How could it be improved?

**Comparison:**

Considering the different approaches taken by NZETC and Open Library to visualise digitised books, please indicate your preference with regard to the following usability attributes.

	NZETC (1)	Not sure (2)	Open Library (3)
Ease of use			
Aesthetics			
Navigation			
Terminology			
Learnability			

Please add any further comments about the usability of the two examples.

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Richard Robertson – 300242329

2015.02.15

WORD COUNT: 8050