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TITLE PAGE

The Case for E-Book Literacy: Undergraduate Students' Experience with E-books for Course Work

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ABSTRACT

This paper investigates how electronic books (e-books) are used for scholarly activity. It focuses on the end-users of e-books in a case study which aimed to establish how scholars use and learn from e-books and the limitations of academic e-books.

There have been a number of calls for more user-focussed research on e-books to understand how they are used rather than *how often* they are used. In-depth case studies of end user behaviour are, by design, very labour and resource intensive and generally limited in terms of the numbers of participants and the ability to generalise from analysis of the results. However, this type of research provides a valuable insight into how scholars interact with e-books to attempt to fulfil their information needs. These studies produce a very rich data set which enables the researcher to understand *how* scholars use, and wish to use, e-books.

Analysis of our empirical results, together with those obtained from previous research examining user needs and experiences of e-books, has enabled us to draw general conclusions about what is required in future e-book design and development. More specifically, we present a typology of e-book interactions relevant to the design of e-books (content and features) and to library/academic instruction in the effective use of e-books ('e-book literacy').

INTRODUCTION

Higher education institutions are spending an increasing amount of money on the provision of e-books for use by their students and staff (SCONUL, 2010). However, while use of e-books in the academic community is increasing, the resource has long been regarded as having failed to be assimilated into the academic mainstream in the same way as electronic journals. This notion may now be redundant: the report on the national e-books observatory project conducted by the Joint Information Systems Committee (JISC) declares that "e-books are now part of the academic mainstream," with 65% of staff and students having used an e-book

(JISC, 2009). However, this level of 'use' does not necessarily mean that academics are using e-books regularly and effectively to achieve their academic goals.

Some of the reasons for slow acceptance of e-books have included limited academic e-book provision by publishers, lack of awareness of e-books among potential users, user discomfort from reading online and poorly designed interfaces on e-book platforms. Despite increasing usage of e-books in academic settings, JISC (2009) reports that these issues remain as barriers to their use today. This suggests that e-books are being more widely used for reasons other than for their improved usability (although it is acknowledged that some improvements have been made within the constraints of the current delivery model) – they save money when budgets and storage space are limited and they offer remote multi-user access.

Surveys of user attitudes and deep-log analysis (which captures user statistics and behaviour on an e-book platform) have shed light on user practices (CIBER, 2009). However, there have been calls for research to examine exactly *how* users interact with e-books during scholarly activity to better understand how users work (and would like to work) with e-books as well as the exact nature of some of the difficulties experienced during use.

The aim of the empirical research presented in this paper was to explore how undergraduate students use e-books for completion of a coursework assignment. The objectives were to investigate how students use e-book functionality (e.g. searches) to obtain information for their assignment; to determine how students use information presented in e-book format to fulfil their learning needs and to evaluate the usability of e-book platforms for ease of discovery, reading and processing the information they required to complete the assignment. This qualitative study explored the case of an undergraduate class of sixty-three Level 3 Physics students (41 male and 22 female) studying a Quantum Mechanics module at the University of St Andrews. In addition to the results of this empirical research, the results of previous case study research on e-book user behaviour are also considered in the analysis of

the accessibility and usability of e-books for scholarly activity in this paper. The following section reviews previous research in this field.

Literature Review

An e-book is “an electronic version of a printed book which can be read on a personal computer or hand held device designed specifically for the purpose” (Anuradha and Usha, 2006). According to Carden (2008), e-books “are primarily computerized representations of a physical book,” and he adds, “they may be scanned page images (viewable as PDFs), or re-flowable text-streams that are reconstructed by a software application to resemble pages on a reading device.”

Research which has explored user perceptions of the advantages of academic e-books is very revealing. Chelin et al (2009) conducted a survey at the University of the West of England with 88% of over 2,000 responses indicating that 24/7 availability was the most appealing attraction of e-books. This was closely followed by “instant online access” (77%) and “no need to visit the library” (68%) as reasons for the appeal of e-books. Shelburne (2009) describes similar results in a survey at the University of Illinois, listing benefits as “instant, desktop access (27%), ability to keyword search (25%), access from anywhere (17%), portability (15%) and environmentally better (7%).” The JISC national observatory project report (JISC, 2009) supports these findings with “online access” being the greatest reported advantage of e-books.

If online access is seen as the main advantage of using an e-book rather than a printed book for academic study (and cost and storage space reduction is seen as the main advantage for libraries that provide access to them) then it is not surprising that the use of e-books is still very limited. If e-books are to be widely adopted as an alternative to the printed book for academic work, then they must provide a better user experience and tangible enhancements for scholarly work.

Wilson et al (2002) focused on functionality and the adoption of standards required for successfully linking e-book provision with user needs and expectations. Such approaches combine evaluating the design features of e-books, and the functionality they can offer (e.g. search tools, bookmarks, ability to highlight, multimedia features, instant access), with criteria for evaluating user interfaces. Diaz (2003) identified such criteria as including aesthetics, consistency, self-evidence, naturalness of metaphors and predictability. Importantly, this work recognises that the features e-books offer (as enhancements to printed book content) are only as beneficial as the user's ability to grasp and use them in an intuitive and user-friendly way. In our previous research (Muir et al, 2009), we argued that there is a need for a new approach to how e-book content is delivered, and that such a model should be very different from the printed book paradigm. Taking a 'business' perspective which includes not just the needs of end-users but the commercial implications for authors, publishers and e-book aggregators, as well as how educators and librarians might be best served is required.

Understanding the user experience is critical to the design of academic e-books to meet the needs of the scholar. Rowlands et al (2007) argued that "more work on actual, rather than self-reported, reading behaviour is urgently needed." The user experience can only be captured by direct observation of users of e-books for their scholarly activity. What people say they do (in an interview or questionnaire response for example) is not always what they actually do when performing a practical task. For example, our previous study (Muir et al, 2009) discovered that although the research participants reported that they would not read a book sequentially for a long period of time, when they were observed and recorded using e-books for an assignment, they did just that.

The JISC (2009) e-book observatory project report made recommendations for further research. In response to this call, the research community has begun to focus on the end-user experience of e-books with potentially exciting opportunities for the development of e-books that break the printed book mould and offer genuine enhancements to the academic user for their scholarly activity. We draw on that research in addition to our own to make recommendations for the development of academic e-books of the future.

Research in the field is beginning to move away from large scale surveys of users' opinions of e-books towards in-depth small scale focus groups (Information Automation Limited, 2009) and observations of users' actual interactions with e-books (Abdullah and Gibb, 2009; Muir et al, 2009). The value of a qualitative study is that it "explores attitudes, behaviour and experiences" (Dawson, 2006). It takes a social constructivist world view: "the goal of the research is to rely as much as possible on the participants' views of the situation being studied" (Cresswell, 2009).

METHODOLOGY

An observational case study approach was adopted to explore the use of e-books during an assignment undertaken by a group of students. The case study approach involved multiple data collection techniques to achieve "triangulation" (Pickard, 2007); to investigate how students use e-books to achieve their scholarly objectives and to understand how students use information presented in e-book format. Gorman and Clayton recommend that, for an observational study: "The group aspect is most important. You might look for groups that consciously share a common identity" (Gorman and Clayton, 2005). The students chosen to take part in this case study were selected as a 'purposive sample' (Gorman and Clayton, 2005, p128). They were Level 3 undergraduate students at the University of St Andrews, taking a module on Quantum Mechanics, taught by Dr Antje Kohnle who was interested in exploring how e-books could support learning within the School of Physics.

Data Collection

The study employed three methods of data collection. A questionnaire (see Appendix 1) was issued to all sixty-three students in the Quantum Mechanics class to determine their attitude and experience of e-books and to seek volunteers for direct observation. Direct observation, of a sample of students, was conducted to capture their interaction with e-books during a coursework task (see Appendix 2). After the observed sessions, the participants were

interviewed (see Appendix 3) to enable them to reflect on their experience of using e-books for the task.

Questionnaire

A pre-task questionnaire (Appendix 1) was designed to ask four main questions of the students: how much experience they had of e-books; what features of e-books had they used; what problems they had encountered in using e-books; and what would make them more likely to use e-books in the future. The questionnaire design also catered for students who might not have used e-books previously. Most of the questions allowed multiple answers, in order to allow participants to report more fully on their experiences, along with the option of adding free text comments, where desired. The questionnaire included a form which gave students the opportunity to volunteer for the observed task. To maximise the response rate, a lecture given by Dr Kohnle was used to distribute the paper questionnaires to the students and time was allowed in class for students to complete it. All sixty-three students in the class completed the questionnaire.

Observed Task

Forty-one students of the sixty-three students in the class volunteered for the observed task, of which 15 were randomly selected to participate. Of these, one student was subsequently unable to take part, and so 14 students participated in the observed task and interview. The observed task sessions were conducted in a private study room within the JF Allen Library at the University of St Andrews. Participating students were asked to complete a coursework-related task which required the use of e-books. Individual students' online interaction with the e-books was recorded using Screenflow screen-capture software, which also captured the students' facial expression and commentary through a built-in webcam on a Macbook Pro.

Key to the successful design of this case study was the fact that students undertaking the observed task were engaged in work integral to the Quantum Mechanics module being

studied. The module leader designed the task (and solution) to ensure that it required the use of Quantum Mechanics e-books, was relevant to the course and that the students would be motivated to complete it.

The task content and execution was tested by postgraduate students from the School of Physics before conducting the study with the undergraduate student volunteers. Postgraduate students were able to complete the task within 15-20 minutes. It was decided that the undergraduate participants would be allowed 45 minutes to complete the task. If participants did not complete the task in the allotted time they were permitted to take their notes with them, for later submission in a tutorial class. Copies of the notes or solutions made by students during the observed tasks were also retained to support the data collected.

The participants were instructed to use two Quantum Mechanics e-books (Rae, 2002; Robinett, 2006) hosted on the NetLibrary and MyiLibrary platforms, respectively. The task (Appendix 2) was to discover the meaning of an unfamiliar quantum mechanics concept¹ ('sudden approximation'), to explain why it was relevant in their answer to a set question and to find two examples where sudden approximation could be applied.

All the information necessary for the solution could be found in either one or both e-book texts. During the task, participants were asked to 'think out loud' to explain what they were attempting to do with the e-books and why. This approach had been implemented by Muir, Veale and Nichol (2009) who noted that although students' ability to do this while concentrating on a task varied considerably, they found that it did nonetheless provide some additional valuable information about students' thought processes and experiences.

Post-Task Interview

¹ The participants were not familiar with this concept prior to taking part in the task.

Following the observed task, all fourteen participants took part in a 15 minute semi-structured interview (Appendix 3). They were asked to reflect on their experience of using the e-books for the task.

The results obtained from the questionnaire responses, over 14 hours of audio-video recordings (of the observed task and interviews) and copies of students' notes taken during the observed task produced a rich data set for analysis.

FINDINGS

The focus of this empirical study was users' interaction with e-books. As qualitative studies of e-book use tend to involve small groups of users (due to the vast quantity of data which is collected for analysis from each user) two similar independent studies were also considered to determine if there is wider consensus on the student experience of e-books.

The study by Muir, Veale and Nichol (2009) aimed to "examine the students' journey through an e-book" and "record their behaviour and experiences as individual case studies of e-book interaction." It observed the experiences of seven students (including students with dyslexia and visual impairment) using e-books (mostly on the MyiLibrary and NetLibrary platforms) for academic coursework.

Employing a focus group methodology, Information Automation Limited (2009) sought to "gain a deeper understanding of the ways in which the JISC e-books are used by (61) students and academic staff in (10) UK universities." Their approach was taken to "enrich and enhance" the quantitative data (obtained from deep log analysis) uncovered by the national e-books observatory project (JISC, 2009).

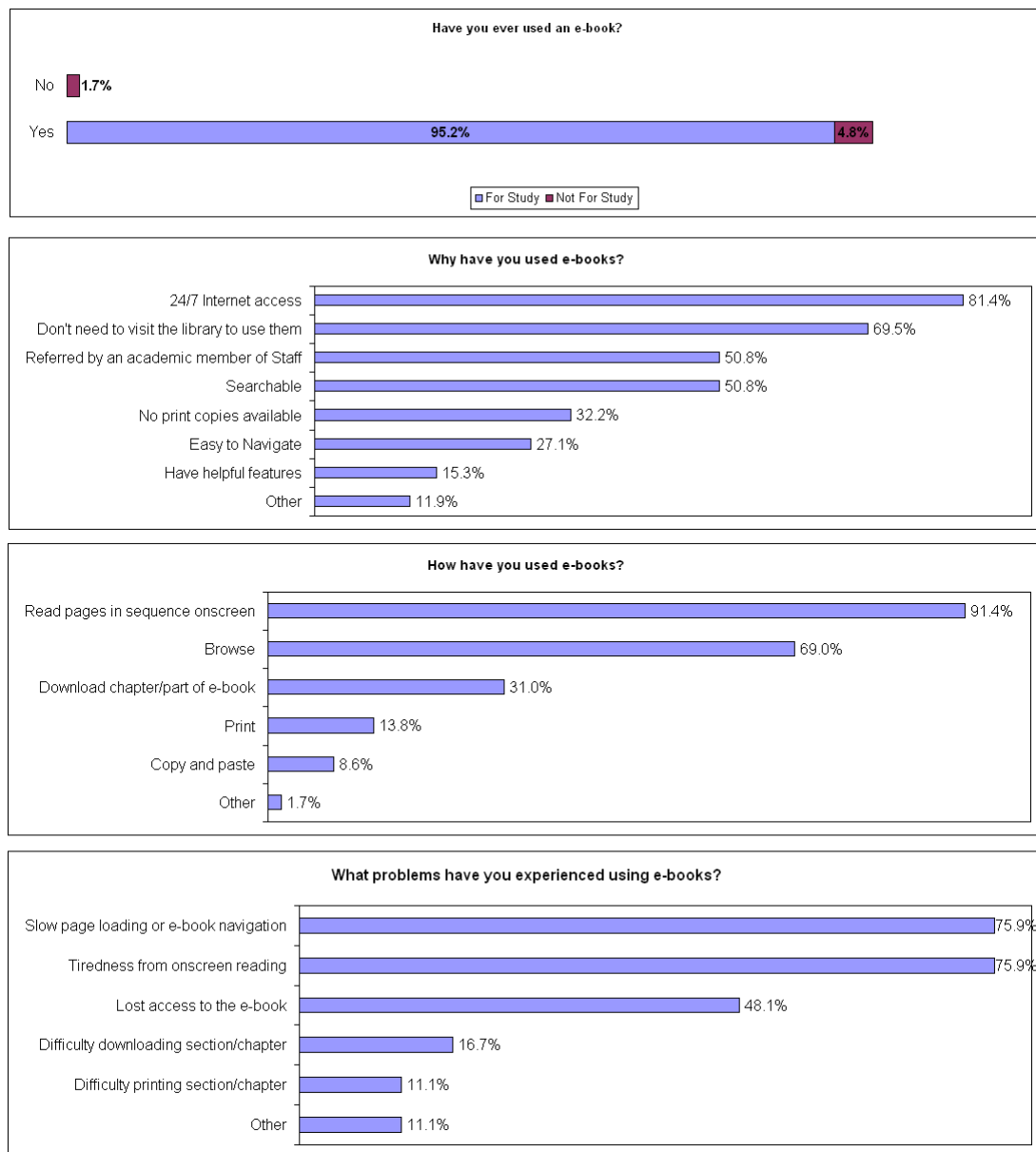
This section discusses the results of this study, compares them with results from previous user-focussed e-book research and explores the future development of academic e-books based on these findings.

Perceptions of E-books

The pre-task questionnaire responses in this study revealed if and how the students had used e-books prior to the study. Their reasons for using e-books and the experiences and motivating factors that would motivate them to use e-books more in future are presented in Figure 1.

Figure 1

Self-reported Usage of E-books prior to the Observational Study



Most of the students (98.3%) had used e-books prior to the study. Of these, 95.2% had used them for academic study. All three students who had not used e-books cited dislike of onscreen reading as the main reason. Just under half of the students who had used e-books (48.5%) stated that they had used them more than ten times and so might be considered experienced users of the resource. However, this does not imply that they had successfully mastered the features of e-books and it was evident (in the observed task) that some of these students struggled, even with basic navigation, despite having used e-books previously.

The majority of the class had a positive perception of e-books prior to the task, something which most students retained even when they encountered problems during the observed task. When asked for reasons why they had used e-books, most of the respondents cited the convenience of 24/7 access, which supports the findings of the JISC (2009) national e-books observatory project. This was closely followed by the convenience of location (not having to go to the library to use them).

Availability and convenience were reasons given in the post-task interviews. "It's all here" commented Student B, indicating the laptop. This student, who in fact had difficulty in using the e-books, stated that the experience was "better than just coming to the library for just one book...it's nice to have the option of e-books."

Around half the sample also reported instruction from academic staff as a reason for using e-books and that peer usage was not a motivating factor (or only one student actually admitted that it would be). Half of the students also reported the ability to search e-books as a reason for using them. Surprisingly perhaps, only a third of the class reported lack of availability of print copies to be a reason they had used e-books, this despite the fact that 85% regarded this reason as a likely driver for further use of e-books. This suggests that the students had perhaps used e-books because they were instructed to do so, or out of interest or desire to explore the format, but that further engagement with e-books would be driven by need to access a text in whatever form was available (with print as the preferred option).

When asked how they used e-books, this group of students contradicted one of the key findings of the national e-books observatory project (JISC, 2009) and supported the observations of Muir, Veale and Nichol (2009). In response to this question, fifty-three students (91%) reported reading whole pages of e-books in sequence and 69% (40 students) also stated that they browse pages for key information. This reading behaviour was evident during the observed task. When this result was discussed with the module leader, one of the reasons given as an explanation was subject specific, i.e. that it is very difficult to browse through a textbook on Quantum Mechanics – careful reading is required to understand meaning.

We argue that e-book reading behaviour is determined by the nature of the scholarly objectives of the reader and that this, therefore, demonstrates that only direct observation in action and an inductive approach to e-book use research can give a true picture of how books are used. The following sections of this paper discuss the findings from the observed task.

Search Strategy

Accessing information from the two e-books was generally an iterative process, combining searches, using the Table of Contents (ToC) or index and navigating from page to page.

In performing each of these actions, students encountered various issues to a greater or lesser extent – some were reading relevant text within a few minutes, for others finding this information took ten minutes or more.

Twelve students opened the Robinett (2006) e-book first. The two students who opened the Rae (2002) e-book first declared previous familiarity with that text as their reason for doing so. One student (Student H) opened two tabs on the browser and accessed both e-books before proceeding with any searches. This was interesting as it is similar to the approach students might have taken with printed books, i.e. consulting more than one book at a time and using them open on the desktop.

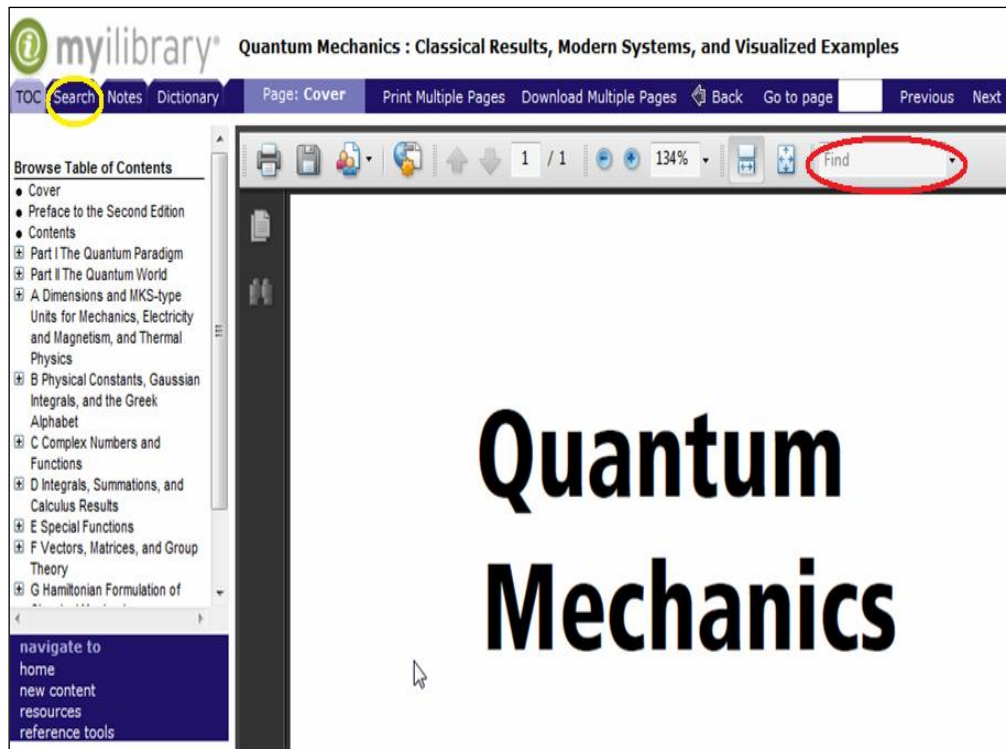
Having accessed an e-book successfully, the students took different approaches to begin their task. Their starting strategies were: looking through the Table of Contents (ToC) in the left-hand pane (Students A, D, E and F), attempting to conduct a search for 'sudden approximation' (Students B, C, G, H, L, M, N, and P), looking in the index within the e-book (Student J) and searching the Contents section of the e-book (Student K).

Subsequently, the students used a (sometimes) complex combination of the search function, ToC, and index to get to information relevant to answering the task.

The most immediate and obvious challenge students had in using the search function, in the MyiLibrary platform, was discovering the search box. Most of the students first used the PDF 'find' box (highlighted to the right of Figure 2) to search the Robinett e-book, mistakenly thinking this would search the whole book (it only searches the current page). They were puzzled when they were unable to enter their complete search term 'sudden approximation' in the PDF find box, and those who did not notice this first problem were puzzled when there were no results returned. In fact the search box would have been found by clicking on the tab highlighted on the left in Figure 2.

Figure 2

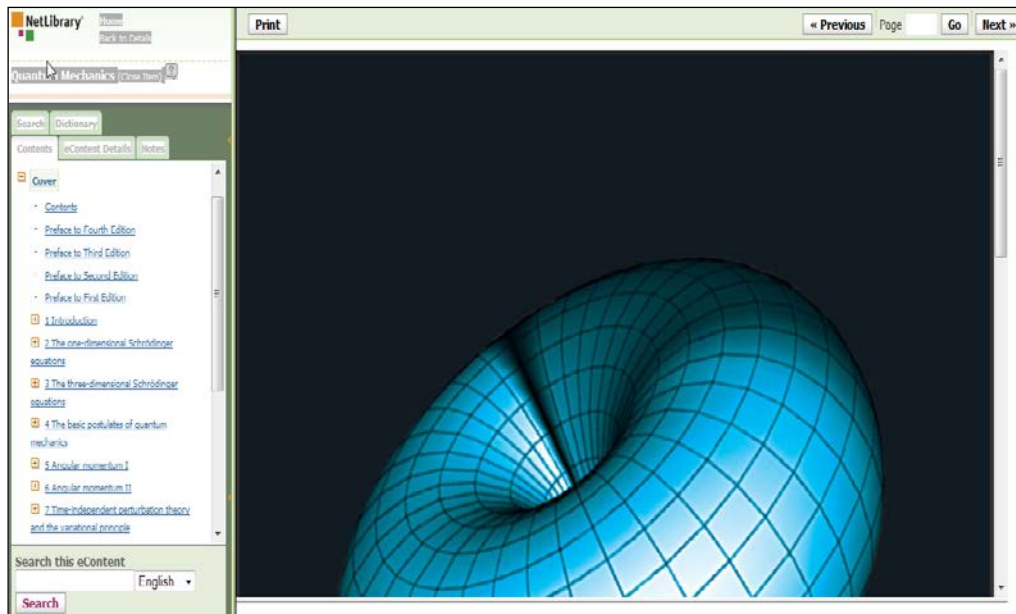
'Find' and 'Search' in MyiLibrary



The same problem did not occur in the NetLibrary platform, which did not include a PDF viewer. As most of the students used Robinett in the first instance, by the time they used Rae they did not have a problem finding the search function, which was located at the bottom of the left-hand pane on NetLibrary (Figure 3).

Figure 3

'Search' facility in NetLibrary



Student B tried to search using the PDF 'find' box in MyLibrary four times and then gave up. She paged forward through the e-book and was delayed in finding relevant information. She never discovered the search function and commented (in the reflective interview after the task) that she would have "liked to have been able to search the whole e-book." Student J tried using the PDF 'find' box once and when this produced no results he used the index and ToC for the remainder of the task.

Student F did not employ the search function at all, not because she did not discover it but because she chose to use the ToC and index to get to the information she was seeking.

Once the students carried out successful searches on the e-books, they discovered four results returned in Robinett (2006) and five in Rae (2002) for the term 'sudden approximation'. The key problem at this stage became the lack of context for the results returned. Typically, a student would click on one of the results and be taken to the relevant page, but would have no idea where this page was located in the book:

"the search function is annoying, it only gives the excerpt, without any context"

[Student A]

“I clicked on the first result and now I don’t know where I am – that’s a bit of a problem” [Student G]

The students would typically navigate back from the page they had ‘landed in’ from clicking on the search result, seeking to establish some context. They would go as far back as a section or even a chapter heading to try and ascertain where they were in the book and what the subject matter of that part of the book was.

Where students attempted to search for numbered parts of the text, results were mixed: Student M, for example, wanted to find ‘example 6.3’ and this search was successful – taking him to one of the examples he needed to complete the task. However, Student C tried a search for ‘section 10.5.3’ and this returned nothing. Success depended on the student replicating the exact layout of the text as it appeared in the e-book, within the search box.

There was also evidence that students used the search function as a form of navigation device – if they felt they had lost their way in the text, they would search again for ‘sudden approximation’ to bring up the initial results to quickly return them to the most relevant pages.

Students were quick to recognise that the search function was particularly useful in a task like this, when they were seeking to understand an unfamiliar term:

“you can search for specific references that you would not necessarily find in a print copy” [Student E]

“in this case the search is quite an advantage” [Student L]

In his reflective interview Student D, a proficient user of e-books, who nevertheless retained a strong preference for print, expanded on this theme of e-books being particularly useful as reference tools, or for investigating specific terms:

“I like the way you can use it almost like a search engine, it’s a more informed way of searching, like if you were going to go to Google, and you can search books in the same way and you get results that are more accurate, which is good, if I didn’t understand something specifically.”

Student N expressed his appreciation of the search function while qualifying it with a comment in the reflective interview about the lack of context (as others did):

“It’s probably easier to use the search function in an e-book than to use the index in a normal book, because the index in a normal book, you know, they can be listed under the strangest terms... whereas here if you type in the search box you’ll get it...it’s immediately easier to pick up on where the words are mentioned, [but] more difficult to get them in context”

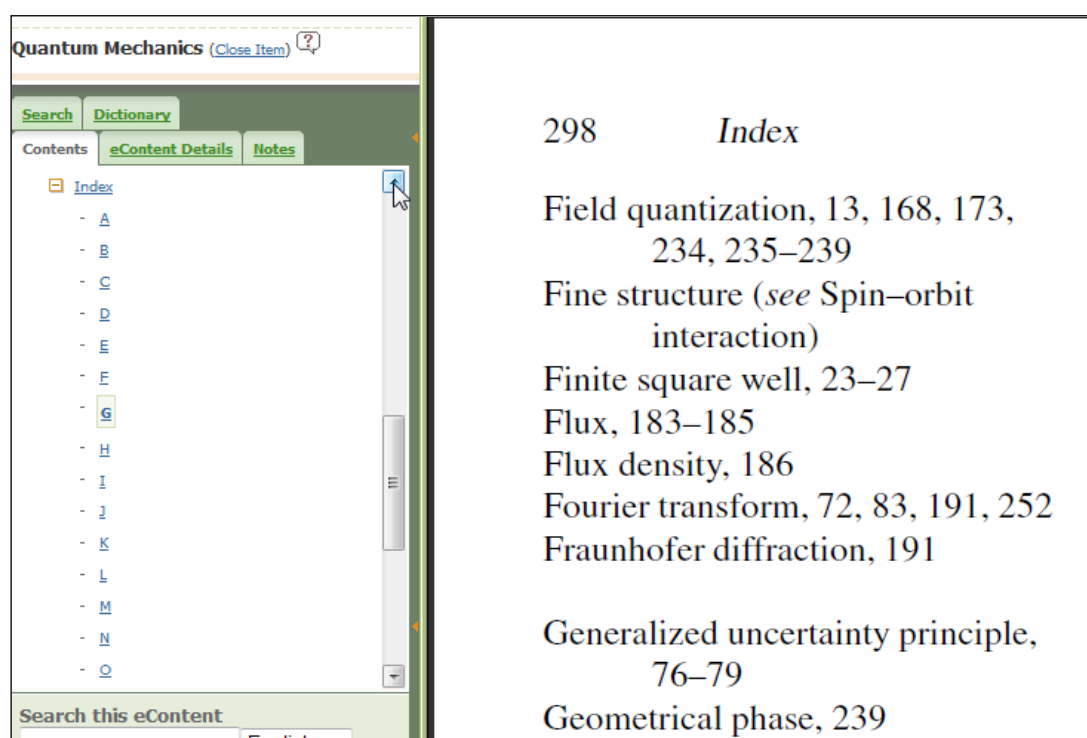
In this study and in the research conducted by Muir, Veale and Nichol (2009), students valued the search function, but resorted to using the ToC and scrolling backwards through the text to establish context for their search results. The results of both studies showed that some individuals liked the ToC feature and used it for navigation. The Information Automation Limited (2009) study found that students and academics used search and ToC about equally and “on the whole search was seen as both quicker and more efficient” [than a print book index].

Use of the Table of Contents

In both the MyiLibrary and NetLibrary platforms, ToCs were featured in panes on the left hand side of the main text view. Both worked in a similar way; however, in NetLibrary, the Rae (2002) e-book also allowed users to navigate through the index by individual letter (Figure 4).

Figure 4

Snapshot of the index in the NetLibrary Table of Contents



This feature was popular with the students, as indicated in the reflections of Student F (who did not use the search function and instead used a combination of the ToC and index to find relevant passages in both texts):

“The index in Robinett is difficult to get through. In Rae it has just a list of all the letters and I can click on where I want to go to whereas here [Robinett] I have to flick through all the pages”

The NetLibrary ToC was found to be difficult to use for different reasons. Student A commented that the text was too small to read easily on the Table of Contents pane, causing her to miss the section on ‘sudden approximation’. Nevertheless, on reflection, most of the students stated that they liked the ToC pane and appreciated the added value it brought to the e-book experience:

“It was good that it was all here because you could see the contents down the left and the page you are looking at on the right, so you can flick between them.” [Student B]

The ToC was used to provide some context for students, something that search results did not provide. For example Student C, while trying to locate section 10.5.3 in Robinett (2006), first clicked on Chapter 10 on the ToC on the left hand pane, in order to establish what this part of the book was about. In this way he arrived at the relevant section knowing something about the context of the information contained there.

Page to page navigation

Most of the participants in the observed task struggled with page to page navigation: from discovering the features which allowed them to navigate the pages; to using them properly; to general frustration at the slowness of page loading and the inability to scroll down through pages.

Student N was 19 minutes and 23 seconds into the task before he noticed the 'go to page' function on MyiLibrary: "I honestly never noticed before" was his reaction. Twenty seconds later he discovered the page back button for the first time. On the MyiLibrary platform in particular the crowded interface, with buttons along the top, did not facilitate instinctive deduction of how to get from page to page. Student K, while reflecting on the task, observed:

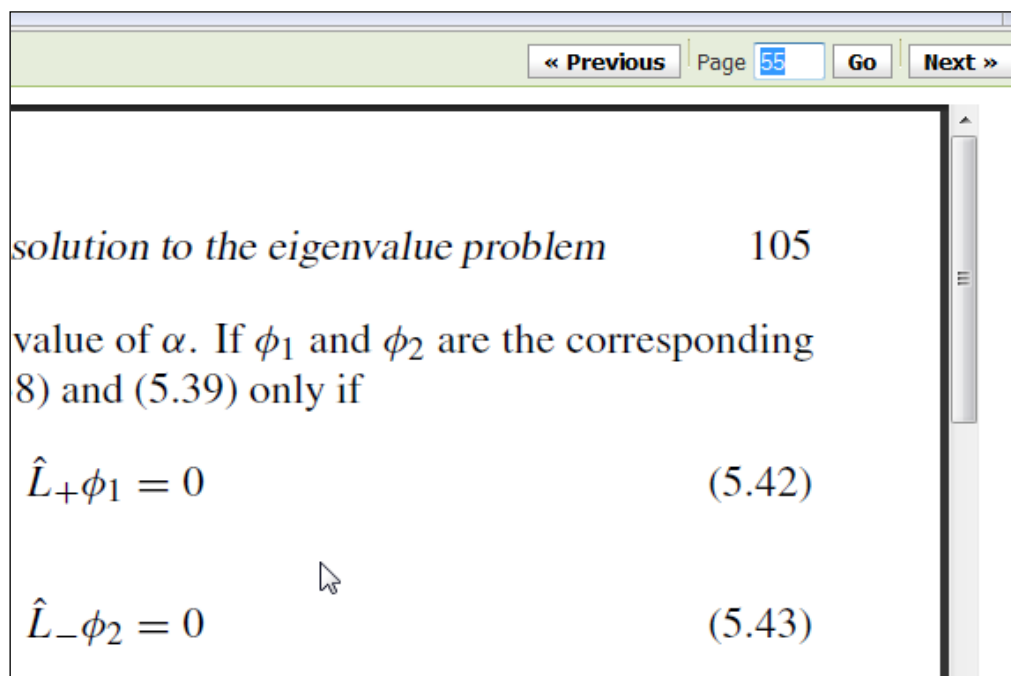
"I think it would be easier if there was a thing where you could literally just choose the page you wanted to go to, say like, I need page 163 and just go straight to page 163."

For this student the navigation set-up on the e-book failed him: he did not notice the 'go to page' function.

Even where students did discover the 'go to page' function, they did not necessarily use it effectively. Student B tried to use the function on the NetLibrary platform, by entering the page number in the box and pressing 'enter': when nothing happened except for the title page loading again, she gave up on the feature.

If a user entered a page number on the NetLibrary platform and pressed 'enter' instead of clicking on the 'go' button they would normally be taken to the page before the one they are currently on: not the page they entered into the box. In Figure 5, the user entered '55' into the 'page' to box and pressed 'enter' (instead of clicking the 'go' button) and the e-book reloaded from page 106 to show page 105.

Figure 5
The NetLibrary 'Go' to page function.



Student J noticed this problem and described it, with a degree of sarcasm², as “counterintuitive, perhaps”. Students experiencing this problem used the Table of Contents as an alternative way of getting to the page they wanted to get to; although this took considerably more time as they were guessing page numbers while clicking on chapter headings.

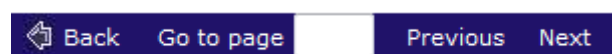
² Note that sarcasm and other emotions were captured by the methodology applied in this research.

The MyiLibrary platform allowed users to enter the page number into the 'go to page' function and press 'enter' – this allowed much more intuitive use of the feature.

The lack of consistency for the user moving between the two platforms and the fact there is no single standard interface caused problems because buttons and tabs were in different locations, “keeping you on your toes” as Student A observed wryly. The lack of a standard interface was a problem in the context of page to page navigation.

When students attempted to navigate through pages consecutively, using the 'next' and 'previous' buttons, NetLibrary performed better (although students also commented on lack of consistency across platforms as being an annoyance with these functions). The MyiLibrary interface featured a 'back' button as well as 'next' and 'previous' buttons (Figure 6) and this caused problems for many of the students who clicked on 'back' when they wanted to navigate to the page before the one being currently viewed. Clicking on 'back' returned users to the last viewed page, not to the page before the one being currently viewed. On realising what 'back' actually did on the MyiLibrary platform Student G succinctly commented: “that's not good.”

Figure 6
MyiLibrary toolbar buttons



When students were navigating from page to page in consecutive order (either forwards or backwards), the slow loading speed of pages was a problem; “a bit laborious” as Student H commented. This remark was representative of the recorded experience of all the participants in the observed task.

Linked to slow page to page navigation was the students' desire to scroll down through pages rather than load separate pages individually. Student B thought that being made to wait for a page to load "stopped your train of thought."

Overshadowing all consecutive page to page navigation was the student fear of being 'locked out' of the textbook: this was clearly a psychological barrier to enjoying the resource and something all participants mentioned during the task or in the reflective interview.

"The thing that always makes me nervous about e-books is that I've heard that people get locked out if you cycle through a lot of pages rapidly." [Student N]

While the search and ToC features of e-books were appreciated by students and attracted them to use e-books (despite the associated issues), poor page to page navigation tools and slow page loading were significant negative factors, and prompted students, in their reflections, to compare e-books unfavourably to print:

"I'm thinking about using a [print] textbook as opposed to this, in terms of finding something unknown it would be a bit quicker because, you know, you can flick back and forth through the pages at a faster speed." [Student E]

All three studies show user dissatisfaction with navigation functionality in e-books. Participants in the Information Automation Limited (2009) focus group disliked having to scroll to view a whole page while also having to use a 'next page' button. In addition to this inconvenience the study states that browsing becomes "dangerous" as the lower half of pages could be inadvertently passed over. The study by Muir, Veale and Nichol (2009) found that "flicking and scanning...was typically not well facilitated in the e-books." They reported further frustration by users who experienced slow page loading times and the need to scroll up and down to view lengthy pages. In our study, students complained about the poor design of navigational tool bars which exacerbated these other problems.

Understanding and using information

The observed tasks provided an insight into what students did with information relevant to the task once they found it: how they read, extracted and used the information to complete the solutions to the set questions.

Reading

Once the students had discovered what they felt to be relevant sections in the two e-books, they began to read for better understanding of the unfamiliar concept in the assignment, 'sudden approximation'. The students who were directed to parts of text directly from search results would generally navigate back in the text to find the beginning of a section to read: this behaviour was attributed to the lack of context in search results.

The most immediate and unanimous comments on reading were about the inability to view two consecutive pages at one time:

"It would be good if you could get two pages up at the same time, instead of flicking back and forth, back and forth." [Student E]

"One thing I'd maybe say that I've just clicked onto the next page, I can't view the end of the first page and the start of the second page, so it just makes scanning through a wee bit more difficult." [Student M]

This experience was particularly frustrating when a sentence, or more significantly, an equation, was split between pages, with the intervening wait to load up the next page typically regarded as being "annoying" [Student P]. Student M identified the ability to scroll through pages (as with e-journals) as being the solution to this problem. Student B regarded the problem as being so severe that she took the step of copying and pasting passages from the

e-book into a Word document because it was “easier to read.” This behaviour is also discussed in the context of note-taking (in the following section).

The desire to view a single page in its entirety was also something students made explicit. Only MyiLibrary offered students this facility (via the PDF controls) and only Student A discovered and used it. Other students commented that they would have liked to have been able to view the entire page:

“Scrolling through it can be a pain, sometimes you want to see the whole page.”
[Student J]

Once the students had found relevant material they were quite content to read consecutive pages. Students G, H, J & K read for extended periods during the observed task, despite the presence of the researcher.

The strain of reading on screen did not feature significantly in student comments during the observed task.

There were similarities in the students’ experiences of reading in all three studies. Slow loading of pages and the interruption of sentences between pages caused frustration – in one specific example in the Muir, Veale and Nichol (2009) research a student found a sentence continued two pages after it had started (separated by a table) – this meant she had to navigate back twice, scroll down to the bottom of the page and then navigate forward twice to continue reading. After this problem recurred the student in question put an end to the session. The Information Automation Limited (2009) study concluded that “most e-textbook interfaces make poor use of the available screen space” with “too much given over to distracting navigational tools” which resulted in “a poor reading experience.”

One area where the results of the three studies differed was in the likelihood of users reading extended passages online. The Information Automation Limited (2009) study found that “there

is a clear suggestion that e-textbooks are not being used for extended reading.” This contradicts the findings of this study and the Muir, Veale and Nichol (2009) research, where results demonstrated that, in practice, students read consecutive pages online.

Whereas in the pre-task questionnaire in this study, the Quantum Mechanics students declared they were willing to read consecutive pages online and did so during the observed task, the students in the Muir, Veale and Nichol (2009) study said beforehand they were more likely to use e-books for quick reference. However, during the observed task, the students read pages sequentially “for a considerable period of time.” One student read 60 pages consecutively over a period of more than one hour. This suggests that students will read e-books online at length where they perceive the value of doing so. In the Information Automation Limited (2009) focus group, students and academics were reporting on general use, whereas in this study and that of Muir, Veale and Nichol (2009) extended online reading was undertaken by students during an academic assignment.

Note-taking

As students began to read information pertinent to answering the task set for them, they also began to take notes with the objective of constructing a written solution to the problem. The act of beginning to take notes varied widely in terms of time-scale: Student C was taking notes within four minutes, while Student L waited until he was 24 minutes into the task before he began to do so. This spread of approaches did not necessarily reflect students’ progress; some students preferred to record information as they read, whereas others (for example, Student L) preferred to fully understand and be able to answer the question before putting pen to paper.

Putting pen to paper was indeed the way in which most students took notes from the e-books and set out their solutions to the task. Ten students (Students C, E, F, G, H, J, L, M, N & P) made hand-written notes only. Three students (Students A, D & K) made a mixture of typed

and hand-written notes. Students F & G offered similar explanations (in their reflective interviews) for why they preferred to use hand-written notes:

“It’s easier to write things down because then I don’t have to flick between two windows and type things up.” [Student F]

“You can copy something down [by hand] without having to swap windows.” [Student G]

Student B, who generally struggled to use e-books, copied and pasted text into Word just to make the reading experience easier. She was the only student who did not take hand-written notes and she did not complete the task during the time set for the observation. The researchers were unaware of any special learning requirements for the students taking part in the study but this behaviour raised concern that accessibility issues could arise for students with additional learning needs (such as Dyslexia or Dyspraxia).

None of the students used the facility to annotate and take notes within the e-book. However, it could be argued that extensive annotation within the e-book was not particularly helpful during this short task.

Student F discovered the note-taking feature towards the end of the observed task and noted that it was “nice”, although she “hadn’t thought of that before”. However, it was not a feature that students regarded as being of primary concern. Student M perhaps summarised the student opinion on note-taking within the e-book when he stated that although he knew you could take notes he would “prefer to scribble it down on a piece of paper.”

More of the students in the Muir, Veale and Nichol (2009) study took the time to access the full features of the e-book but slow system response and difficulty mastering the tools led to problems for students trying to use the functionality for highlighting, bookmarking and note-

taking. This might be explained by the longer task in their study or that students were made aware of these features prior to the observation.

In the Information Automation Limited (2009) focus group there was little appetite for using extra features, with “little evidence” of downloading or online note-taking. All three studies found that most students preferred their own handwritten notes.

Access issues during the observed task

As previously discussed, students stated that they were afraid of being locked out of e-book sessions while navigating rapidly from page to page, and this worry was a barrier to use. Towards the latter stages of the observed task, eight of the fourteen students encountered access issues. While using NetLibrary, Student A was asked for Athens authentication after 23 minutes (even although the access was on-campus), Student M received a message (after 36 minutes) that “The previous session has timed out. A new session has been started for you.” and Student K was warned that the session would be ending and clicked the option to ‘Continue Session’ but was timed out anyway. In MyiLibrary, Student B was timed out after 31 minutes with no information to indicate that this is what had happened (or why).

The students did not understand why they had encountered such difficulties. Many had difficulty in re-accessing their e-book sessions, especially if they tried to re-enter via the Virtual Learning Environment (WebCT) where they received a message saying that a session was already running.

Downloading and printing

In the pre-task survey, only 31% of the physics class reported having downloaded a part or a chapter of an e-book and 13.8% said they had printed pages from an e-book.

During the observed task none of the students downloaded any part of the e-books being used and only one student (Student B) printed some pages. This may be attributed to the fact that the task undertaken was fairly short in nature and involved a 'manageable' proportion of text within the e-books.

Despite downloading and printing not being widely used during the observed task, the students commented on these features. Students A, M and N made very similar points about downloading sections of the e-book: it was a feature they appreciated but it relied on first finding the relevant sections of the text. Finding the appropriate page numbers to download was seen as a challenge.

On reflection, Student M was far more positive about downloading sections of e-books, something he reported having used previously:

"The other thing that is quite good, which I think was on the [My]Library one was that you can download, like, sections of it, which I have used for my Maths, so that I could then copy them and print them out and highlight them, which was quite useful, rather than just have the book there."

Only Student B, who had difficulty reading onscreen, printed any pages from the e-books. She then used these to annotate and make notes on by hand.

Student C stated that he would only print if it was a "highly relevant" journal article and that he would not print from an e-book. Student A said she liked the facility to print and although she did not do so during this exercise she would do where there were "dense equations" to be understood. Student D commented that she would print from an e-book if she had to "memorise" text or study it in "a detailed fashion."

Task progress

In this study, it was clear that the students' interactions with the e-books, both smooth and cumbersome, played a significant part in their perception of how they were making progress with the task. Although students did comment on their understanding of the Physics, and some took longer than others to come to terms with the concept of 'sudden approximation', the differences were mainly due to the students struggling to find the information they required from the e-books. The question was not a difficult one, in terms of the Physics involved, but it did require effective use of the e-books to discover the answers.

Difficulty with searches, page to page navigation, reading, page views and access to the e-books for the duration of the task contributed to the variation in student progress. After 15 minutes Student A felt she had made "no progress", while Student D had by this time answered two-thirds of the questions set in the task to her satisfaction. Much of this variance was simply due to the success with which students were able to effectively interact with the e-books.

By the end of the time allowed for the observed task six of the students had completed the task, four had partially completed the task and four students still had significant work to do. Of the latter, two (Students B & P) struggled to find the information they were looking for in the e-books and the other two (Students E & H) interpreted the task as being more complex than it actually was.

Suggestions for improving e-books

It is argued that putting the user at the centre of the design experience is crucial if e-books are to continue to attract new users. The post task reflective interview invited students to comment on how e-books could be improved. In response to the question, "Can you think of any helpful features that would encourage you to use e-books in the future?" students identified the features they would like to use in e-books.

An improved interface and multi-media features were two of the new features students suggested would make them more likely to use e-books in the future. They wished for: improved search results, better and more flexible page viewing, easier navigation and removal of the access problems. More specifically, they called for improved context in search results including the inclusion of section and chapter titles. Students felt that viewing should be made more flexible, for example a collapsible interface which would allow a full screen view (Student A). Three students (G, N and P) stated that the ability to view two pages at once would be very important in attracting users: this was “the major thing” for Student N.

Navigation was another area for suggested improvement, with the ability to scroll through pages (Student F) or faster loading of pages (Students G & H) specifically identified. Student H wanted to see navigation using “something like with a Mac touchpad where there are gestures and so on, that kind of thing would be really nice.”

Getting rid of access issues was also important: “I would like *not* to get locked out” said Student D succinctly.

The most popular multimedia feature that students wanted to see was hyperlinks. These would be used to quickly navigate from one part of the text to another; so, for example, where a paragraph referred to a figure or section from another chapter there would be a hyperlink for the student to quickly jump to the relevant section. Four students (C, J, L and M) clearly identified such a feature as being desirable, although Student C qualified this with a view that such features might be “subjective” and “difficult to engineer.”

Interactivity was another multimedia function that would attract users – for example animations, or links to visualisations in order to explain difficult concepts. Student M gave an example of the Hyperphysics website (Nave, 2005) as having the sorts of features he would like to see in an e-book: “It has sort of example calculations where you can put in numbers, under, like, certain parameters and it will give you an answer, so that would be useful [in e-books].”

Another feature mentioned in response to the question was the use of a 'mouse over' function, where a box would appear to give the meaning of a particular term (the appeal of this is clear in the context of a subject such as Quantum Mechanics).

The e-book business model

Although the focus of this study was on the user experience of e-books it is important that this concern is not considered in isolation. As Muir, Veale and Nichol (2009) state: "evaluating e-books from a student (user) perspective is only the first step towards making e-book content usable and accessible for scholarly activity." E-books are not only an information resource for students and other users but also a means of making money for authors, publishers and aggregators. Both ends of the supply chain need to be re-examined. "A solution which addresses user requirements but is not commercially viable is of no value," surmise Muir, Veale and Nichol (2009).

The study by Pomerantz (2010) reported that provision of academic books in e-format was limited and reading lists for courses and modules in Higher Education could not be populated by e-book collections alone. JISC (2009) concluded that an effective e-book platform should offer "a critical mass of relevant course text e-books" with "the most recent edition available...without embargo."

Publishers may be encouraged by findings such as those by Springer which concluded that electronic and print books can co-exist and the growth of the former represents more of an opportunity than a threat (Ernst and Van Der Velde, 2009). The move by Springer to forego DRM restrictions and allow unlimited concurrent user access is what users want. JISC (2009) argues that "staying still is not an option. The pressure to find viable and sustainable business models for course text e-books is likely to intensify." These business models are not a separate issue but are central to meeting the needs of the end user. As Muir, Veale and

Nichol (2009) argue: “the solution to the problem of meeting the needs of students using e-books is addressed in the context of a viable business model for delivery.”

Providing easy access to a wide range of relevant and up to date electronic textbooks and scholarly monographs on a simple to use, standardised platform (with flexible interface) built on principles of user-centred design could go a long way to ensuring a healthy future for e-book publishers and aggregators.

Availability is only part of the issue, however. Librarians have a role to play to effectively market and promote collections and make e-books easily discoverable via Library OPACs – perhaps even at chapter level, as Abdullah and Gibb (2009) contend. Additionally, the importance of the role of the academic was reported in the research by Information Automation Limited (2009): “It was apparent that academics need to do more to embrace and integrate use of e-textbooks, and some students expressed frustration at the consequent under-use of valuable resources.”

CONCLUSION

Students using e-books for academic coursework experience problems with access, insufficient context in search results, awkward navigation tools, an unpleasant reading experience and interfaces that are not intuitive to use. Despite these, e-books are regarded as being a potentially valuable educational resource.

Comparison with other recent studies of user experience confirms that the problems identified in this case study are consistent with results obtained in different academic settings. While new e-book platforms offer possible solutions to some of these issues, major studies undertaken by JISC point to the need for improvements in the end-user experience to be married to changes in the whole e-book business model, with the onus on publishers to focus on workable pricing models, better availability of texts, and well-designed e-book platforms.

For librarians and academics, the onus is on developing skills for effective use of e-books. This study has revealed that current approaches to training students to use e-books effectively for scholarly activity is generally lacking. Instruction tends to be focussed on locating the e-books for study rather than on their use to achieve students' study goals. We propose a typology (Figure 7) of e-book interactions based on the experiences of students in our study and from previous studies by Muir, Veale and Nichol (2009) and Information Automation Limited (2009). The main purpose of the typology is to provide a structural representation of the types of scholarly activity for effective use of academic e-books and the requirements of library/academic instruction to develop the necessary 'e-book literacy' skills to achieve this. It is also relevant, more widely, for content designers and publishers who require a classification, of users' e-book interactions during scholarly activity, for prioritisation and design of features which will enable users to achieve their academic goals.

A Typology of E-book Interactions and the Skills and Tools required for using Academic E-books Effectively

Information seeking task	E-book literacy skills	E-book features or tool(s)
1.0 Define 1.1 Define or interpret task 1.2 Identify information need	Identify the academic goal/aim. Identify objectives and methods for achieving them. Awareness of e-books.	Study planning tool for listing objectives and keywords and for bringing e-books and tools into a study space/window. Critical mass of relevant e-books in academic subjects.
2.0 Access 2.1 Discover resource(s) 2.2 Broad search/scan and navigate content 2.3 Narrow search and locate information	Using library platforms for resource discovery. Formulating and applying a search strategy. Using ToCs and indexes and scanning/flicking through content. Rapid browsing. Navigating content in one or more e-books Identifying specific search terms. Conducting a search. Finding and interpreting the search results. Refining a search based on results.	Unlimited concurrent user access. Discoverability at chapter level as well as for whole e-books. Multiple simultaneous e-book access. 24/7 instant access. Clear user instructions/help. Gesture interface option. Consistent intuitive and user-friendly interface. Simple uncluttered interface to reduce cognitive load. Rapid navigation through content (summaries). ToC, index, page turner with positional information. Fine navigation controls with positional information. Index navigation by letter. Smooth page transition and scrolling. Navigation by number or description. Hyperlinks for navigation. Clearly signposted Google-type whole book and cross book search engine facility. Better search result information including section and chapter titles. Contextual location information for the search results.

2.4 Read information	Sequential page reading. Reading for reference (targeted reading). Dealing with lost access.	Intelligent search capability to find closest match to entered search text. Backlit e-paper display option Ability to enlarge sections for in-depth reading. Scrolling to avoid content (e.g. sentence, equation, table) split over pages. Flexible page views (whole page, zoom and selected pages) without distorting content. Clear information when access issues/ errors arise. Downloadable version for off-line reading to avoid fear of being 'locked out'.
3.0 Evaluate		
3.1 Understand information	Relating information to study objectives. Exploring meaning and visualising concepts.	Study planning tool and checklist. Visualisations for 'difficult' concepts – multi-media interaction, animations, example calculations with number input to equations. Mouse-over option for terminology. Dictionary and thesaurus. Selection of different (non-sequential) pages to view together.
3.2 Extract relevant information	Summarising content and note taking. Downloading/printing content – selecting content and methods.	Page and text markers. Simple tools for highlighting text. Integrated note-writing window (not separate windows for e-books and tools). Copy and paste option for limited percentage of text Ease of storage of content for download/storage and clear indication of 'budget' or allowance used.
3.3 Use information	Sorting retrieved results. Interpreting information. Analysing relevance. Synthesising from multiple sources. Evaluating findings.	Facility to store and reuse saved searches and mark 'favourites'. Integration with content analysis tools.

4.0 Manage 4.1 Organise content 4.2 Manage references 4.3 Monitor task progress	Maintaining saved retrieval results. Referencing whole e-books and parts of e-books to acknowledge sources and support assertions in academic task output. Reviewing the check list for task completion.	Facility to store and reuse saved searches and mark 'favourites'. Tool for managing content references. Task checklist tool and visualisation of progress through e-book materials.
5.0 Integrate 5.1 Combine results for the study task.	Reviewing results across all searches and platforms.	'Work space' for the management and integration of findings from e-book searches and other electronic resources.
6.0 Create 6.1 Create the solution for the task (report, essay etc)	Producing the output for the study task.	Link to task output from the e-book 'Work space'.
7.0 Communicate 7.1 Present, disseminate or submit results, conclusions and recommendations.	Delivering the output for the study task.	Link with text processing and social media tools for creating, sharing and discussing outputs.
8.0 Review 8.1 Reflect 8.2 Learn from experience 8.3 Revise behaviour	Reflecting on the success of the search strategy and completion of the task, for further e-book literacy skills development.	Store searches for reuse and develop intelligent and personalisable systems based on user behaviour and preferences.

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