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Turn on the book: Using affordance theory to understand the adoption of digital textbooks by university lecturers.

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Adoption of digital textbooks in higher education has been slower than was expected. This paper presents preliminary findings from a study conducted at a small Australian university looking into how lecturers use digital textbooks. The pilot research indicated that the slow uptake may be explained by academic perception; participants indicated a strong preference for printed books, particularly related to capacity for accessing content. This pointed to a definitional property in that they largely conceived of an etextbook as a digital replica of a printed book. Not all lecturers were aware of enhanced digital textbooks, but generally agreed that it could be advantageous to have such content integrated into a central resource. Lecturers furthermore acknowledged the need to understand the affordances of educational technologies and their application to learning and teaching. Affordances theory is used to consider the knowledge required to effectively implement the full range of resources available in digital textbooks.

Keywords: eTextbooks, digital textbooks, affordances, enhanced ebooks, higher education, learning and teaching, innovation

Introduction

The textbook has a long established tradition in higher education, but lecturers today have many more choices available to them including digital textbooks, companion websites, and interactive study guides (Martin, 2012). Despite these choices, or perhaps even because of them, the printed textbook remains a popular choice in Australian universities, and even though there is evidence of a subtle shift toward digital resources, these tend to be used as complements to the printed textbook (Horsley, Knight, & Huntley, 2010).

There are obvious benefits to not having to carry around a bag of heavy expensive textbooks, and coupled with the ubiquity of mobile devices, there seems to be good grounds for the early predictions that digital textbooks would gain a significant foothold in education. However, sales of digital textbooks have been steady, but not quite the revolution expected. Despite the advantages of digital books, studies repeatedly find that there is still a preference for print.

One explanation for this preference for print could be that lecturers approach digital textbooks in the same ways as they do printed books, but in doing so, the inherent educational affordances of digital textbooks are not fully realised. The concept of affordances is used to describe the opportunities that objects create for user behaviour. However, these opportunities need to be perceived by the user. Auke Pols' (2011) description-of-affordances model explains how the perception of affordances requires users to possess particular types of knowledge. In the

context of books, for example, O'Brien and Voss (2011) wrote "affordances of digital texts allow viewers to respond to and collaborate on texts that had been previously static and unavailable for interaction" (p. 77). Not only do the features of the teaching tool need to be present, they need to be acknowledged and valued by the teachers and learners.

Academic eBooks have featured in earlier research from the perspective of usability and efficacy for university students and on computer screens in university libraries (Lam, Lam, Lam, & McNaught, 2009). The study presented in this paper contributes to this body of research and offers an empirical and conceptual extension as part of a larger project designed to identify how university educators perceive the affordances offered by digital textbooks. In doing so, it presents new findings blended with emerging literature to predict a flatter, and therefore longer, adoption curve for academic eBooks, or digital textbooks. Slow adoption, we suggest, can be explained by Pols' (2011) description-of-affordances model.

Methods

Semi-structured interviews were conducted with seven lecturers at a small Queensland University between February and April 2013 as a pilot for a larger project. These academics were in various humanities, business and health sciences fields. Their qualifications included both PhD and Master's degrees and all had been teaching for ten or more years.

Each interview lasted for approximately one hour. There were guiding questions; however, the interviews were allowed to deviate in response to participants' answers to the guiding questions. Interviews were transcribed and a preliminary analysis involved cross-questioning of the data in order to identify issues to pursue. The transcripts were subsequently coded. This required that each text transcript was read-through multiple times line-by-line with notes being made in the margins to identify content areas and potential themes. Using a different colour pen, memos concerning reflections, questions, associations with the literature and comparisons and contrasts between respondents were then added (c.f., Kinash, 2006). For this study, themes concerning the description-of-affordances of digital textbooks and their role in learning and teaching were identified.

Understanding and use of ebooks

A simple and perhaps obvious definition of an ebook (electronic book, eBook, e-book, digital book) is an electronic version of a book "that can be read digitally on a computer screen, a special ebook reader, a personal digital assistant (PDA), or even a mobile phone." (Nelson, 2008, p.42). However, describing an ebook as an "electronic equivalent" suggests that ebooks are simply digitised versions of printed text like a PDF, and what distinguishes one from another is the device upon which they are read. In some respects this is accurate; for example, on electronic devices, pages can be turned, bookmarks can be placed, contents pages can be scanned just as in a printed book. The digitised versions retain all the content (text, images, charts and so on) that the printed predecessor contains.

Interviews for our emerging research bore this out. University lecturers in this sample defined digital textbooks in terms of how the books are read- "*it can be read electronically,*" and the design features- "*there are pages that in some sense can be flipped*". There was a strong sense that it was an alternate form, or simply an electronic equivalent of the printed version- "*Instead of buying a hard copy, you are entitled to read the book online*", using descriptors such as "*a version*" or "*a reproduction*".

A persistent preference for print was apparent. Notably, participants did not express a dislike for reading digitally, but did express feeling more comfortable reading print. The preference was explained in terms of the physical feel of the book- "*I really like the tactile experience,*" the ease of taking notes and highlighting on paper, - "*I still prefer to use pencils and highlighters,*" the familiarity of print - "*I feel more comfortable with the paper artefact*", as well as navigation difficulties and eyestrain. One participant said she perceived a lack of dollar value in the digital textbook available for her subject. While it was less expensive than the print version, it was still around \$90, without any extra features and no potential for resale.

With advances in technology, numerous variations to this standard format have emerged with the development of enriched or enhanced ebooks which contain embedded interactive multimedia features allowing the reader to interact with the text through options such as audio, video, hyperlinks to dictionaries, translators, and other websites, manipulation of images, quizzes, and social collaboration. Early in 2013, McGraw Hill announced the release of the SmartBook, an etextbook which incorporates adaptive technology that uses complex algorithms to continually assess students' knowledge, skill and confidence levels, and based on this information,

designs individualized study paths through the content of the ‘book’ to guide their learning. (See <http://learnsmart.prod.customer.mcgraw-hill.com/for-educators/>)

When asked about enhanced digital textbooks there were mixed responses. Two lecturers were clearly aware of the possibility of enhancement, and at the same time disappointed that e-textbooks of this kind were not widely available. One explained, “*That is what they (ebooks) should be, otherwise they’re just PDF versions of a printed book*”. The other said, “*I have only seen one but WOW! that is an ebook*”. Two of those interviewed were not aware that enhanced ebooks were available, but when the features were explained they expressed enthusiasm about investigating this possibility further, and were positive about how they could be used “*I might be missing something amazing here*”. However, one lecturer who was aware that these extra features are available, was cautious about their potential use- “*That side of it I wouldn’t be bothered with. I have some reservations because I remain to be convinced that the quality of learning would necessarily be improved.*”

So, a definition predicated on how these books are read, that is to say they are consumed via an electronic device, is only partially accurate. Actually, “reading” an ebook may involve a quite different experience compared to reading linear printed text, as. In fact, it may be misleading to think of ebooks as “books”, a point discussed by Anne Kostick, writing for Digital Book World (2012), and in fact she goes even further by suggesting that it is necessary to coin a new term to describe “digital, transmutable, readable, platform-agnostic, weightless, immersive, elastic creation hitherto known as a book”. Due to the variations of these digital literary products of which the printed book is the antecedent, she argues that referring to them as books is not only inaccurate and confusing, but may even impede innovation in this area. In the Oxford Companion to the Book, Gardiner and Musto acknowledge that the definition of an ebook is a “work in progress”, and furthermore they state that is probably “less useful to consider the book as an object-particularly as a commercial object-than to view it as a cultural practice, with the ebook as one manifestation of this practice” (p.164). Nelson suggests that because of the changing technology, the future generation will have a quite different concept of a “book” than we do (p.44).

Slower than expected adoption

The Horizon Report first highlighted ebooks in 2010 (Johnson, Levine, Smith, & Stone) and smart objects in 2009 (Johnson, Levine & Smith) as emerging technologies that, when combined, may change both students’ and lecturers notions of reading all together. The 2012 Horizon report, highlighted apps and tablet computers for their capacity to assist with the transition to digital textbooks (Johnson, Adams, & Cummins, 2012). There have been enthusiastic predictions about the role that digital textbooks would come to play in education. Late Apple co-founder Steve Jobs was quoted to have said the textbook industry was “ripe for digital destruction” (The Economist, 2012). In 2011, Reynolds predicted that over the coming five years, sales of digital textbooks would make up more than 25% of combined new textbook sales in the United States (Reynolds, 2011), and a report prepared by PwC for the Department of Innovation and Industry in Australia projected the growth of educational ebook sales to grow to be in excess of 20% of total educational book sales by 2014 (Department of Innovation, Industry and Research, 2011). There are sound reasons on which to base these predictions. Digital textbooks offer many advantages including portability, instant availability, integrated dictionaries, translators, annotation and bookmarking tools, social sharing functions, text searching capabilities, and lower cost (Martin, 2012). Mobile devices allow readers to consolidate all their content into a single portable device. With so many students having access to at least one type of mobile device, not having to carry around heavy expensive textbooks should seem appealing.

Reports indicate that despite moderate growth in the market, when it comes to the adoption of digital textbooks there looks more like a quiet evolution rather than the revolution that was perhaps expected by some. Data from the United States shows that in the higher education textbook market digital sales are around 20% of overall sales, increasing from 11% in 2011 (Bowker, 2013). The Book Industry Study Group (2012) found that print remained the dominant format chosen by college students and faculty in the United States. Even though one third of faculty interviewed had made e-textbooks available as an option for students, only 2% of students selected this as a primary means of accessing content. Between 2012 and 2013, there was a slight increase in the number of students who had purchased a digital textbook from 28% to 31%, but still more than 60% say they prefer print (Bowker). When digital textbooks are recommended by lecturers they are most likely to be complementary rather than sole resources (Horsley, Knight and Huntley, 2010). In the Book Industry Study Group survey 91% of students indicated that print was the primary format for content (Bowker).

Barriers to adoption

While cost and portability are recognised as major benefits of e-textbooks, numerous studies have also identified limitations for both students and instructors (for example, OnCampus Research, 2010; Woody, Daniel, & Baker, 2010; Walton, 2007; Lam, Lam, Lam & McNaught, 2009; Nelson, 2008; Bowker, 2013). Barriers include the necessity of access to an e-reader, lack of durability of e-readers, a limited range of e-textbooks available, the existence of various formats and restrictions on sharing and reading across multiple devices, no potential for resale, difficulties with highlighting, marking up and navigating the book, and pricing. The most common reason for the preference for print is that people like the feel of a book and, in fact, it has been suggested that reading paper was a welcome break from the heavy screen reading that students are required to do (Bowker, 2013).

The role of the teacher

According to Angela Bole, Deputy executive Director of the Book Industry Study Group, lecturers are responsible for any digital shift in classroom textbooks. She explains that even though ultimately it is students who are the consumers of the e-textbook, it is their lecturers who make the decisions about which form of textbooks will be offered (Book Industry Study Group, 2012). Gaffney (2010) also explains how lecturers are considered “gatekeepers” for technology use in the classroom. How lecturers use, or do not use, a technology, has been shown to influence students’ use and perception. In a study looking at digital textbook usage in universities in the United States instructors had minimal engagement with the extra features of course eTexts and this impacted on the students’ experience of the text with students reporting a better experience when their instructors used the extra features (Internet2 eTextbook Spring 2012 Pilot Report). It is therefore useful to understand the reasons behind lecturers’ resistance to the digital textbook. Certainly, technical limitations will impact on their decision to adopt or not, but there could be other less obvious factors as well.

A cognitive perspective

A useful concept for this discussion is the notion of ‘functional fixedness’, a concept first explained by Duncker in 1945. This term is used to explain an individual’s cognitive bias that limits them to using an object only in the way it is traditionally or habitually used (Eysenck, 2001). So, for example lecturers may approach and use the digital textbook in the same ways as they do the printed book, perceiving the functions of both formats to be the same, namely providing text-based content, only with the additional function that the digital version can be read on an electronic device. MacFayden (2011) wrote, “people try to fit the experience of digital reading into mental models derived from print culture” and “the way users understand and describe their experiences of reading on digital devices are shaped by well-established cultural expectations about the abstract as well as the physical affordances of the print book” (pp. 2-3).

Lecturers explained the advantages of digital textbooks in terms of convenience for students, compared with the printed counterpart. *“Why would you lug those heavy textbooks around? They’re heavy, they’re cumbersome and they’re not at your fingertips”.*

Similarly, the disadvantages centred around not being able to do with the digital book what can be done with the hard copy. *“I really like the tactile experience so my preference is for hard copy...I really like to be able to take notes and scrawl on things. They’re really hard to follow. I like to be able to flick back and forward through the book.”*

However, functional fixedness can inhibit the creative use of technologies (Koehler & Mishra, 2008). Heider, Laverick, and Bennett (2009) claim that it is the interactivity of digital books that offers the most potential, not the readability. They argue that digital textbooks are innovative tools which lecturers can use to meet the needs of contemporary students. The affordances of digital textbooks take them beyond that which is possible in a printed book, but for that potential to be realized the affordances must be recognised.

Affordance theory

Affordance is a term first coined in ecological psychology by Gibson in 1979 to describe the potential that objects have for users. They are the potential for actions offered by the particular characteristics of an object, or artefact. Affordances are opportunities for action (Gibson, 1979). For example the design of a chair affords sitting on and a book affords reading. One of the central themes of affordance theories is the role of perception.

It is generally acknowledged that affordances exist independently of perception; in other words, they are available to be perceived (Michels, 2003), but it is the perceived rather than the actual affordances that influence user behaviour (Pols, 2011).

Non-adoption of digital textbooks among participants in our study implied that there is a resistance to adopting digital for digital sake. These responses demonstrate that for these lecturers it is necessary to learn more about the technology before using it with classes. As one participant remarked, "*Potentially, if you understand the technology and the abilities of the technology, there's the potential for great change of appreciating how ... the ebook could be used*".

Pols' description-of-affordances model

Auke Pols (2011) believes that defining affordances as opportunities for actions is too simplistic as it fails to capture the complexity of many cases. For example, a light switch affords the simple action of "flipping", but on another more complex level it affords "turning on the light", which obviously involves more than one action and affordance. Pols describes four types of actions:

- 1) Basic action, which is done intentionally and deliberately; for example pressing a button
- 2) Actions can also be described in terms of their consequences; for example pushing the letter 'A' on the keyboard causes the letter 'A' to occur in a text editor on a screen
- 3) Multiple actions, or the execution of a plan; for example phoning a friend
- 4) Social action, or an action which is intentional under the terms of its social consequences, such as making a promise, running for president. These actions may also be a result of the artefact belonging to a particular socio-technical system.

Affordances correspond to actions. Basic affordances correspond to basic actions; these are referred to as "manipulation opportunities". They are directly perceivable and if a user encountered a completely unfamiliar artefact, the affordance would exist simply in terms of what can be done with this artefact, for example it can be pushed, or rolled. Then through experimentation, or gaining knowledge about the artefact, connections can be made between action and possible effects, Pols calls "opportunities for effect". At the next level affordances can be described in terms of what users can do, as distinct from how they act upon it. So then, I push a letter on a keyboard (level 1 letter appears on screen (level 2), write a paper (level 3). Knowledge at this level could certainly arise through experimentation, but it may also be communicated by designer of particular artefacts, for example in a user manual. Finally, it is possible to describe affordances in terms of their social, rather than physical effects. The user would obviously need abstract social and institutional knowledge in order to perceive such affordances, or activity opportunities.

From these descriptions, it is obvious that not all affordances are directly perceivable, nor are they perceived in the same ways by all users. "Defining affordances as 'opportunities for action' means that our understanding of what affordances are can only be as precise as our understanding of what actions are," (Pols, p. 113). Understanding depends on knowledge of the user, and this knowledge is derived from basic cognition as well as prior experiences and extensive knowledge of the variables of the system in which the artefact is being used. One participant in the present study said "*If you understand the technology that could be amazing, but it needs time and training and just being aware.*"

Pols' description-of-affordances model characterises the complex levels of affordances and the corresponding knowledge required to perceive the affordance of artefacts at each level of description as shown in Table 1.

Table 1: The descriptions-of-affordances model (Pols, 2011, p. 120)

Affordance	Corresponding concept action theory	Knowledge needed	Example (using e-readers as examples)
Opportunity for Manipulation	Basic action	Neuropsychological (low cognition)	Turning on an e-reader, pressing a page-turn button, swiping the screen.
Opportunity for Effect	Action described in terms of effect	Neuropsychological, perhaps knowledge of functions of part or cultural symbols	Change the font, type size, page margins, text colour, brightness, highlighting, bookmarking
Opportunity for Use	Plan	Mental models, use plans	Installing a book
Opportunity for Action	Social action	Abstract institutional and social knowledge	Collaborating with other readers via social bookmarking

Educational affordances

Educational affordances are characteristics of an artefact that determine if and how a particular learning behaviour can possibly be enacted within a given context. It can be seen as the relationship between the learner and the technological intervention, and how learning is enabled through this interaction (Kirschner, 2002). Pols' categories can be understood in terms of educational affordances. The lowest level affordance, *Opportunity for Manipulation* affords the opportunity to read digital materials. At the next level, *Opportunity for Effect* lies in the effects of users' manipulations. Setting exercises around words in textbooks to take advantage of on-board dictionaries and translators is an example. *Opportunities for Use* occur when educators relate the effects of manipulation to curriculum, and innovation migrates from hardware and software to new ways of doing. This level of affordances involves thinking, planning and coordinating complex use for a larger purpose. Educators are already aware of the educational affordances available with various media, and actively incorporate a wide array of media into their teaching. Enhanced or enriched textbooks may incorporate audio, video, simulations, models and quizzes, thus allowing much greater interaction by the user. The newest and most advanced digital textbooks afford the receiving of instant feedback and diagnosis of a user's understanding of the content and the creation of individualised learning paths. However, it is the *Opportunity for Action*, the highest level of affordances in Pols' model, which can serve educational technology policy and practice most powerfully. As e-readers take advantage of social media and crowd-sourcing, the opportunities for action have the greatest potential to re-invigorate the classroom. Opportunity for action is coordinated and social. E-reading devices often afford highlighting and note-taking of texts and being able to manipulate and share these annotations with others remotely creates an opportunity for action which goes to the very notion of constructivist and relativist learning.

While much has been written about how the affordances of digital technologies, including e-textbooks, offer innovative pedagogical application in the context of higher education, in order to achieve effective learning outcomes, it is necessary to perceive how the unique attributes of digital technologies can be used to create learning opportunities, and this goes beyond the fundamental functions. Day and Lloyd (2007) argue that it is counterproductive to view learning outcomes as being dependent just upon the attributes of the technologies. Even though a technology might possess certain attributes which could be perceived as affordances, other factors may interfere with the actualisation of a learning opportunity. The educational context is a complex interaction between lecturers, students, and a range of other factors and learning outcomes result from this interaction. Pols' model demonstrates how knowledge is essential in the realization of affordances, and it is important to recognise that this knowledge extends beyond just that of the basic affordances of the artefact.

Lecturers in this study were mindful of this necessity. As one lecturer stated: "*Digital stuff tends to look like entertainment. Getting it right as to how you set it up, how you make it an activity or make it a component of the entire knowledge environment is not easy.*"

All of the lecturers interviewed for this study were familiar with ereading and had used various devices for ereading. They also actively incorporated digital resources into their teaching, including Blackboard tools, videos, links to websites, online manuals, mapping tools, electronic dictionaries and translators. They expressed

their purpose for doing so in terms of student motivation and engagement, and practical and authentic learning. They further acknowledged that time and effort is required to understand the technology in order to be able to use it effectively. So, on one hand a lack of time to understand the potential for digital books is expressed as a limitation and a barrier to adoption, as expressed in this comment-*“I haven’t fully explored what all the opportunities are here and without dedicating some time to exploring it, I would feel less comfortable promoting the e-version”*.

The importance of integrating any teaching and learning resources with the pedagogy is acknowledged. The lecturers in this study recognise the complexity of decisions around how to best incorporate any resource into the educational context, as exemplified in this comment- *“I dislike the idea of elements of a course being used in isolation. A course should come together as a whole. So a textbook should be integrated as a part of the learning experience.”*

Conclusions and Future Directions

Based on these preliminary interviews and the available literature, the following findings emerge.

- In terms of accessing content in text form, the print book is preferred.
- While not all lecturers are aware that digital textbooks can have extra features embedded, there is generally agreement that it could be advantageous to have such content integrated into a central resource.
- Almost all of the lecturers interviewed believe that enhanced textbooks could have significant potential for learning and teaching.
- Lecturers recognise that extra knowledge is needed to understand educational technologies and affordances and how to best incorporate them.

The role of the etextbook in the broader macrosocial educational context must also be considered in future studies (Figure 1). In 2007, McLoughlin and Lee discussed social software tools and the potential they offer to students to have greater control of their learning through their social affordances. They also argued that if these tools are used with both a detailed understanding of the affordances and with thorough planning, there is the potential for radical transformation in the curriculum. Some years on, it is now evident that transformation is occurring with the emergence of innovative approaches to education. At this broader macrosocial level, the affordances of etextbooks not only lend themselves to use in this changing landscape of higher education, but could in fact be an essential component. For example, etextbooks offer easy access to resources for MOOC participants, student autonomy and interaction in the flipped classroom, interaction and collaboration in gamified classroom, and social sharing and knowledge in constructivist pedagogy.

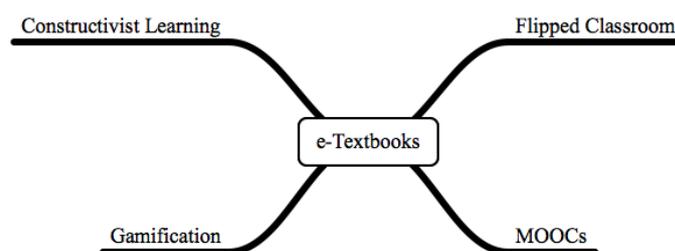


Figure1: Macrosocial educational affordances of etextbooks

Is adoption being thwarted by lecturers remaining conservative? It has been suggested that it is actually the publishers who need to be more innovative in their offerings (Bowker, 2013). While educational publishers continue to offer digital textbooks as little more than digital replicas of a print book, albeit increasingly with companion websites, lecturers will continue to see these e-textbook as having the same function of the printed book. By using them simply as a source of largely textual content, there is no appeal for lecturers to move beyond offering the digital format as an alternate version, and this may impact innovation in pedagogy. While it is agreed that it is lecturers who to a large extent determine which textbooks will be adopted, publishers have a

significant role in moving lecturers beyond their current notion of what a digital textbook is by offering innovative digital textbooks which exploit the affordances possible in enhanced digital textbooks. One lecturer sums it up in this remark: “*I feel there is a missed boat somewhere*”.

This paper has two broad aims. Firstly, it presents preliminary investigations into this topic. Based on the literature and interviews presented here, the larger study will through an iterative approach further investigate lecturers’ attitudes toward digital textbooks. Specifically, Affordance theories and Technological Pedagogical Content Knowledge model (TPACK) (Koehler & Mishra, 2008) will be utilised to analyse lecturers’ knowledge and understanding of digital academic textbooks in terms of how they can be integrated into the pedagogy at both micro and macro levels. Students perspectives will also be sought in order to gain a better understanding of the interaction between teachers, students and their (e)textbooks. It is furthermore a call to action for educational publishers to embrace the opportunities available through the affordances of enriching digital textbooks with more sophisticated technologies.

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