

Analysing Interaction in Children's Digital Books

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Abstract: Pedagogical practices in formal educational settings, together with the nature of communication technologies in a variety of digital media, mean that children will encounter screen-based learning opportunities in both formal educational settings and during their daily recreational pursuits. This research looks to address the lack of research informing best practices for the visual and interaction design of this material for children in a screen-based environment. This investigation provides a survey of interaction methods in on-screen reading material available to children in primary-school, middle-school and public libraries in New Zealand. From the data collected, a database chronicling variables relating to interaction in current digital books for children was created. Specifically, this database houses variables including navigation, orientation functions and in-line linking such as hypertext, as well as other factors that can impact a child's digital book use. Through analysis of the database this research provides insight into current trends in interaction techniques found in material designed for children's on-screen reading and provides recommendations for improvements that may be made to assist in the design of children's digital books.

Keywords: Digital Books, Interaction, Navigation, Orientation, eBooks, Children's Interactivity, Children's Books

Introduction

CHILDREN ARE ENCOUNTERING on-screen reading in both formal educational settings as well as in a variety of other digital communication media in their daily recreational activities. Cooper (2005) describes this as the omnipresence of technology. Internationally, there is a lack of research informing what good reading practice and interaction might look like when teachers use reading material in a screen-based environment. More specifically, there is a lack of research around best practices for the design of this material for children.

Timpany and Vanderschantz (2011) show that children in the classroom can be observed to use a range of technologies during their typical educational pursuits. Today these technologies include digital whiteboards, laptop computers and mobile tablet and personal touch screen interactive devices such as the iPod and iPad. Interaction with these technologies, both at pre-school and school has been shown to be associated with improved cognition development (Li & Atkins, 2004).

This paper does not look at the hardware used within the classroom, but instead looks at the digital books (independent of technology with which they are used) that were available to children for educational purposes in New Zealand in 2011. At the time of investigation the digital books available for survey were designed for use on a computer (either laptop or desktop), and no digital books were available at these schools for use on mobile technology such as an eReader.

Through analysis of the available sample of digital books this research provides insight into current trends in interaction techniques found in material designed for children's on-screen reading and provides recommendations for improvements that may be made to assist in the design of children's digital books. These recommendations should provide design guidelines for digital book creators, which will enable development of reading environments that do not impact negatively on children's ability to read digital books during their learning or recreation.

Interaction in Learning Media

Haugland (1992) considers digital technologies—such as desktop computers, laptops, and personal computing devices—as tools for learning in today's society, equally as much as pencil and paper were in days gone by. Taking this into consideration, children must gain the capacity to successfully navigate and interact with this technology in their learning to be able to use this technology as effortlessly as they use a pen and pencil. According to Cooper (2005) children today are likely to be exposed to technology at times even before they are exposed to print or traditional books. With this in mind children are likely to observe and learn from their parents' technology habits. It is common for children these days to begin school equipped with the technological capability to successfully navigate and interact with the systems they find available to them. However, this is not to say that systems that are poorly designed will not hinder the learning of these children, nor that well designed resources will not enhance their learning.

The types of interaction required within the digital books themselves play a significant role in the ability for the child to successfully search, browse and read within the software. These influential factors include, the layout, presentation and navigation of information; the orientation features of the interface and the consistency of display within the interface. The child's ease, efficiency and ability to move between printed and digital reading environments and understand the similarities, and indeed differences, in the physicality and content of the two environments, such as pagination, page numbering, indexing and tables is also imperative.

Digital material viewed on a desktop, laptop computer or non-touch-screen digital reader, inherently involves additional points of interaction and navigation when compared to its printed equivalent. This is because unlike a physical book, which is directly manipulated with one's hands, a digital book is operated through manipulation with a mouse or other input device. However, research by Landoni and Gibb (2000) concluded that readers have similar expectations of their electronic books as they do their paper books. The equivalent procedure to opening the book, closing the book, turning to the contents page, index or to a specific page requires the pointing to and clicking of a button with a cursor operated by a mouse. Often many of these common physical interactions would have dedicated buttons within the interface of the book software. Nielson (1996) explains that consistency of important navigation features, for example the help button located in the same position throughout the software, is important for ease of navigation.

With the increase of touch screen devices, such as tablet computers and smart phones, there is a return to intuitive physical interaction, by way of swipe and physical presses with fingers, to achieve similar physical results as performed within a printed book. Digital books on touch screen devices were not found in our audit and are thus considered outside the scope of this paper.

This paper is organized as follows; the Methodology section describes our study and details the sample and libraries from which we audited; the Results and Discussion sections detail the interactive features of the digital books we analysed and discuss the relationship of their features to the literature alongside recommendations for improvements for digital books; before presenting our Conclusions.

Methodology

An audit of 3 publicly funded schools, a public library and a university school of education (teachers' college) library was conducted in 2010 to discover the range of digital books or digital reading material available to students intended for learning through reading.

Institutes Audited

Amongst these institutes surveyed were a decile 10 Contributing Primary School (years 1 through 6 of the New Zealand school system), a decile 4 Intermediate School (years 7 & 8) and a decile 9 Restricted Composite School (years 7, 8 & 9). A decile 1 rating indicates a high proportion of students from low-socio-economic communities, while a rating of 10 indicates a low proportion of students from low-socio-economic communities (Ministry of Education, n.d.). The schools were located in two geographically diverse regions in New Zealand, one a city with a population of approximately 143,000 people and the other a city with a population of approximately 40,250. A school of education library and a public library were also surveyed during this investigation to ensure a fair understanding of the full range of material available to teachers and students in these two cities.

Table 1: Institutions Audited

Inst1	Contributing Primary School
Inst2	Intermediate School
Inst3	Restricted Composite School
Inst4	Public Library
Inst5	University School of Education Library

The institutes audited for this study will be referred to according to the table above.

The researchers believe that the material examined was a cross section of the learning material available to students within a primary school or an intermediate school in New Zealand at this time. The schools and libraries audited offer a geographic and socio-economic diversity and therefore give this cross section of available materials.

Sample

Similar to the findings of Vanderschantz (2011), eBooks, in EPUB or other similar contemporary formatting, were not available at any of the schools at the time of this survey. The books available at these institutes were either interactive CD-Rom based or website based reading material and are described in detail in Table 2 below.

Table 2: Books Reviewed

Book Code	Publisher Location	Date of Publication	Recommended Age	Institution Use	Media
P1B1	USA	1994	3–7 years old	Inst2	CD-Rom
P1B2	USA	1993	3–7 years old	Inst2	CD-Rom
P1B3	USA	1994	3–7 years old	Inst2	CD-Rom
P2B4	NZ	ND	7–12 years old or Years 3–8	Inst2	Website
P3B5	NZ	2003	NZ Years 5 & 6	Inst2, Inst5	CD-Rom
P3B6	NZ	2004	NZ Years 5 & 6	Inst2, Inst5	CD-Rom
P3B7	NZ	2005	NZ Years 7–10	Inst2, Inst5	CD-Rom
P3B8	NZ	2006	NZ Years 5 & 6	Inst2, Inst5	CD-Rom
P3B9	NZ	2007	NZ Years 5 & 6	Inst2, Inst5	CD-Rom
P3B10	NZ	2008	NZ Years 7–10	Inst2, Inst5	CD-Rom
P3B11	NZ	2009	NZ Years 5–6	Inst2, Inst5	CD-Rom
P4B12	UK	2001	8–9 years old	Inst4	CD-Rom
P5B13	NZ	2003	4–7 years old	Inst4	CD-Rom
P6B14	USA	2000	6–8 years old	Inst4	CD-Rom
P7B15	UK	ND	UK Entry 3 & Level 1	Inst3	Website
P8B16	Aus	2001/2007	Aus Reading Levels 9–11	Inst1, Inst2, Inst3	CD-Rom
P8B17	Aus	2001/2007	Aus Reading Levels 15–16	Inst1, Inst3	CD-Rom
P8B18	Aus	2002/2006	Aus Reading Levels 19–20	Inst1, Inst3	CD-Rom
P8B19	Aus	2002/2006	Aus Reading Levels 23–24	Inst1, Inst3	CD-Rom
P9B20	UK	2004	7–8 years old	Inst1, Inst3	CD-Rom
P9B21	UK	2004	8–9 years old	Inst1, Inst3	CD-Rom
P9B22	UK	2004	9–10 years old	Inst1, Inst3	CD-Rom

While other interactive learning materials were available at these institutes, the sets of material reviewed were the only digital resources available or intended for learning through reading. It would seem, from the nature of the other material available, that the unlisted resources that were also available were intended for learning through interaction, exploration, and game play, rather than learning through reading, or were intended for another curriculum such as mathematics.

At all schools the digital books described were readily available to the students through a mix of strategies. This included availability within the library environment for use during class-library visits and at lunchtime or after school, as well as availability for class use via Computers on Wheels systems, in computer labs, or on dedicated classroom computers. The resources were often used with ESOL (English for Speakers of Other Languages) students, within Reading Assistance, Remedial Reading and Special Education programmes within the schools and during classes. The freely available web based material was provided by the Restricted Composite School (Inst3) as material students were encouraged to use at home, and was provided for students and parents on the school's website.

As can be seen, in Table 2 above, nine different publishers produced the digital books available for analysis. Two of the series of digital books were published in the US, three series in the UK, one series in Australia and three series in New Zealand.

Books Reviewed

Twenty-two different books were available across the institutes, several were found at more than one of the institutes. Where multiple stories or articles were present in a book, only one of the stories was chosen to analyse in depth, while further stories were assessed for consistency within this book or software. Typically the data discussed in this article refers to interactive principles present in the reading material rather than the application that might house the reading material.

The digital books reviewed for this paper are shown in Table 2 above. This study uncovered material available at the five institutes from nine different publishers with 22 unique books available for survey at the time. To avoid identification of these publishers they will be referred to as publisher P1 through publisher P9. Books are labeled sequentially, independent of their publisher. There were three books, B1 through B3, that were audited from publisher P1, book B4 audited was from publisher P2 and books B5 through B11 were those from publisher P3 and so forth. While other material may have been available at these institutes it was not uncovered in catalogue searches or through interviews with librarians and teaching staff at the time of this study.

The books each quoted a reading age range or educational level range that the material was designed for. In all instances the reading age range of the books reviewed was appropriate for the institution at which the books were being used. No institution was using or offering books that would be above or below the achievable *reading age* of children at that institution. Although, as is typical in educational institutions, there was material available at lower reading levels than children's *chronological age*, these books were often for use with ESOL or remedial students.

Results and Discussion

The results and discussion section of this paper considers interaction and design features of digital books with regard to orientation, pagination, navigation and points of interaction. Table 3 below describes the orientation methods identified in the digital books surveyed.

Table 3: Orientation Features

Book Code	Buttons	Scrolling or Pagination	Page Numbering	Main Menu
P1B1	Yes	Pagination	Yes	Yes
P1B2	Yes	Pagination	Yes	Yes
P1B3	Yes	Pagination	Yes	Yes
P2B4	Yes	Pagination	Yes	Yes
P3B5	Yes	Pagination	Yes	Yes
P3B6	Yes	Pagination	Yes	Yes
P3B7	Yes	Pagination	Yes	Yes
P3B8	Yes	Pagination	Yes	Yes
P3B9	Yes	Pagination	Yes	Yes
P3B10	Yes	Pagination	Yes	Yes
P3B11	Yes	Pagination	Yes	Yes
P4B12	Yes	Pagination	No	Yes
P5B13	Yes	Pagination	No	Yes
P6B14	Yes	Pagination	No	Yes
P7B15	Yes	Scrolling	No	Yes
P8B16	Yes	Pagination	No	Yes
P8B17	Yes	Pagination	No	Yes
P8B18	Yes	Pagination	No	Yes
P8B19	Yes	Pagination	No	Yes
P9B20	Yes	Scrolling	No	Yes
P9B21	Yes	Scrolling	No	Yes
P9B22	Yes	Scrolling	No	Yes

Orientation

Marshall (2009) describes orientation as the “where am I now?” question that a user asks themselves during reading. For the purpose of this study, this question may be asked with reference to either, where the user is within a single story of one of the digital books reviewed, or within the entire software of one of the digital books. Orientation within reading can be achieved via many mechanisms, commonly; page numbering, chapter or section identification, tables, lists etc. Wilson et al., (2002) explain that it is important for these orientation devices to be included in electronic books to give the reader a sense of place.

de Jong & Bus (2003) showed that very few of the books that they reviewed contained orientation tools, such as overview screens with all pages of the book at small size, or an easy method for selecting a particular page. In this audit not one publisher was shown to

offer either of these orientation tools as suggested by de Jong & Bus as providing important orientation mechanisms. The authors do however acknowledge the importance of the main menu screen that all publishers included. This main menu device was used effectively to orient the reader with reference to the entire software. However, none of the books audited gave a book level overview for the reader.

Pagination

Schwartz et al., (1983) discovered that inexperienced computer users preferred pagination to scrolled text. Pagination is a simple mechanism that assists with orientation (Marshall, 2009). Marcial & Hemminger (2011) discuss paging as requiring fewer interactions than scrolling for large documents. Sanchez & Wiley (2009) showed that scrolling in web interfaces can negatively impact the learning outcomes of learners with lower working memory capacity when reading complex topics. This suggests that young readers who are still developing their reading and comprehension skills will be impacted by scrolled interfaces compared to paginated interfaces. According to Wilson et al., (2002) page lengths should be appropriate so that no scrolling is required as this can be frustrating and reduce readers' intake of information. Pagination also becomes important for young readers because it is believed that for children, search and comprehension are closely related cognitive processes (Giulia Cataldo & Oakhill, 2000). Therefore creation of a spacial visual model of the information, and thus page content, will assist with recall and comprehension of text.

Of the reviewed books, 18 out of 22 used pagination over scrolling within the body of the stories. These 18 books were produced by 7 of the 9 publishers. All publishers that paginated in one of their books reviewed in this study, paginated in all of their reviewed books.

Of the 18 stories using pagination only 11 of these stories included page numbering. Page numbers are important in both print and electronic books for providing a sense of place (Wilson et al., 2002). These 11 stories that included page numbering were from only 3 different publishers.

Navigation

Marshall (2009) describes navigation within digital books as being intertwined with the reading process. Navigation must be easy, intuitive and allow for ease of access to the content irrespective of where the user is within the reading interface. Table 4 describes the number of discrete interactions a user must perform once the software has been loaded, and before they can commence reading a chosen story. The number of interaction points has been considered in relation to the number of stories within a book. The information detailed in this paper, and Table 4, specifically assumes the user has inserted a CD-Rom or loaded the software from the operating system desktop and the user is presently viewing the initial page of the software. The first column, 'Number of Clicks', refers to the number of points of user interaction required for a user to navigate to the beginning of a book, story or activity. Column 3, 'Number of Stories', indicates how many stories the software contains. Column 4, 'Main Menu', indicates if the software begins on a main menu page requiring interaction before reading can commence.

Table 4: Points of Interaction Previous to Beginning Reading

Book Code	Number of Clicks	Number of Stories	Main Menu
P1B1	1	1	Yes
P1B2	1	1	Yes
P1B3	1	1	Yes
P2B4	2	5	Yes
P3B5	1 or 2	10	Yes
P3B6	1 or 2	10	Yes
P3B7	1 or 2	10	Yes
P3B8	1 or 2	10	Yes
P3B9	1 or 2	10	Yes
P3B10	1 or 2	10	Yes
P3B11	1 or 2	10	Yes
P4B12	1	11	Yes
P5B13	3	9	Yes
P6B14	1	1	Yes
P7B15	2	4	Yes
P8B16	3	15	Yes
P8B17	3	10	Yes
P8B18	3	10	Yes
P8B19	3	10	Yes
P9B20	3	216	Yes
P9B21	3	117	Yes
P9B22	3	166	Yes

System or Main-menu Navigation

All of the books reviewed, whether containing multiple stories or not, had a main navigation menu or introductory screen before the book was accessed by the user. This main navigation often featured links to “set up” or “preference” setting options, “about” sections, “help” sections or sub-navigation options for books containing multiple stories or articles. It can be noted that digital books containing multiple stories often results in an increased number of points of interaction within an interface before a user may proceed to reading a story.

For Publishers P1 and P6, whose books did not contain multiple stories or articles, this main navigation page served as both the table of contents and the title page or cover page of the book. This also resulted in the fewest number of clicks required to access the content of the book upon insertion of the CD Rom for reading.

Multiple Stories

Of the books reviewed, 18 of the 22 included multiple stories or articles within the applications. Only 2 publishers chose to deliver single stories in a single application.

With multiple stories or articles within an application or book comes the requirement for a multi-layered navigation system. All books with multiple stories contained a main menu navigation system which differed from the internal or in-book navigation system. Interfaces, buttons, icons and metaphors for the main navigation were often different for the internal or in-book navigation systems. This requires the young user to learn multiple interactive styles or metaphors for a single interactive system and may prove more confusing or confounding for the young reader.

This main navigation page is essentially an interactive table of contents. A table of contents is required for the user/reader to understand the orientation, size, and format of the document and how to use the document. Wilson et al., (2002) describe tables of contents as an essential feature for readers to gain an understanding of the content and its structure. They explain that this is an important navigational tool in a medium where readers can easily become lost. Teaching the use of tables of contents at a young age will help with students working in print or digital mediums.

Number of Clicks to Content

As seen in Column 2 of Table 4 above, three of the publishers required users to simply click once to access the story or activity after loading the application. Two of these three publishers created books containing only one story per software.

Publisher P3 is listed as requiring “1 or 2” clicks to read; this is because the interface invites the user to enter their name before they begin using the software. However, this requirement for entering the users name is not a mandatory task and a user can use the software and navigate freely around it without doing so. This name entry option is a part of the main menu interface which also includes accessible buttons leading to each of the 10 stories in the books.

Publishers P5, P8 and P9 all require three clicks from the user before they reach the first page of the story. These publishers require the user to either “log-in”, “enter your name” or “choose a role” (teacher or student). Publisher P9 requires the user to click the “book cover”, similar to the concept of a splash screen on the internet (Nielsen, 2011), before reading can begin. Each of these tasks hinder the initial access to the reading material. If this is a requirement with subsequent reads of the story, this is an unnecessary overhead for a reading task. A log-in procedure, however, in some instances does allow for tracking of learning and comprehension testing by the teacher using an administration or ‘teachers only’ interface in the software.

Points of Interaction (Buttons, Icons & Text Only Points of Interaction)

There is a wealth of literature regarding the use of graphical user interfaces and their points of interaction. However, much of this literature, like the majority of the educational, typographic design, and interface design literature, is based on empirical evidence of studies with adults rather than children. Recent studies have shown that children tend to have lower fine motor skills than adults and this affects their ability to effectively use a mouse during inter-

action with graphical user interfaces for computer software (Hourcade, Bederson, Druin, & Guimbretière, 2004).

This study identified three types of navigational points of interaction; these points of interaction can be referred to as *buttons*, *icons*, and *text only points of interaction*. In this study a button is defined as an image, symbol or illustration, with or without text, or, text on its own that is surrounded by a container shape. Therefore, buttons (as shown in Figure 1) are those navigational items enclosed in a *graphical element* or *containment shape* such as a rectangle or circle. In the context of this research *icons* are defined as a stand-alone image, symbol or illustration, with or without text that is not enclosed in a containment shape (see Figure 2). A *text only point of interaction* is a navigation item that does not accompany an icon or symbol and is not encapsulated by a containment shape (as shown in fig 3).



Figure 1: Buttons

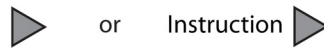


Figure 2: Icons

Description

Figure 3: Text Only Points of Interaction

Points of interaction, as described above, might also include either, *symbolic/iconic* graphical elements, or *figurative/illustrative* graphic elements. We use the terms symbolic or iconic graphic elements to describe points of interaction that use minimal line and flat colour and are representational of an idea. Figurative or illustrative graphic elements are those that we describe as being more realistic pictorial representations. Figure 4 below will be the representation that we use to describe a symbolic or iconic symbol and Figure 5 the representation of a figurative or illustrative image. These may be used with either button or icon interactive devices.



Figure 4: Iconic/Symbolic Graphic Element of a Button or Icon



Figure 5: Figurative or Illustrative Graphic Element of a Button or Icon

The literature describes icon points of interaction as being only useful to children and adults when designed for specific contexts or interface purposes (Horton, 1994; Mayhew, 1992; Raskin, 2000). For example, Cooper (2005) cites research by Liu (1996) as suggesting that points of navigation should include both text and symbol to ensure recognition by readers and non-readers alike. Jones (1993) argues that icons (and therefore all visual points of interaction) must be realistic and meaningful for children and therefore ensure little or no misinterpretation by young users. Metaphors (visual or written) are a common device for points of interaction, however, these will only be successfully understood for a context where a user is familiar with the situation. Ideal metaphors will be those closely related to the mental models of the children and therefore are very much cultural and age dependent.

Consistent placement of navigation features is discussed by Cooper (2005) as also being important. Cooper cites Liu (1996) as saying that icons, “help” and text should remain in the same place from screen to screen within a piece of software.

In the following tables points of interaction that contain text of a *descriptive* nature as opposed to an *instructional* nature are also shown. A point of interaction with descriptive text is one in which the text describes the action of the interaction—for example the name of the story that will be opened when clicked; whereas a point of interaction with instructional text will direct the user as to its action—for example “next”.

Buttons as Points of Interaction

Table 5: Buttons used within the Reading Interface
















Publishers	Buttons			
P3				
P4				Description 
P5				
P6				
P7			 	Description 
P8				
P9				Description 

Table 5 describes the visual features of the buttons used within the reading interface of the books. The navigational points of interaction used within the books varied between the menu navigation tools and the in-book navigation tools, but this detail is considered outside the scope of this paper and thus is not discussed. Therefore, the identified navigational points of interaction within Table 5 relate solely to the visual properties of navigation points within the reading interfaces of the books reviewed.







Nine of the publishers used buttons in their interfaces with 5 of these 9 publishers using multiple types of button within interfaces.

Icons as Points of Interaction

Similar to buttons, as discussed previously, the term *icon* in interface design is used primarily to discuss an image or icon with or without text, or text on its own. Icons are also identified as not being encapsulated in a container shape.

These have similar issues as buttons and require consideration of their design and textual use, however, size also becomes a consideration of importance to ensure that the area where the child can click is appropriately large enough as children have significantly lower motor skills than adults. Hourcade et al., (2003) explain that through the study of Fitts' law several researchers have shown that in graphical user interfaces children require larger visual targets. Icons do not have a container shape and thus may have a smaller target area for the mouse driven cursor. The majority of icons in these interfaces were deemed to be a suitable size at the resolution tested. As can be seen from Table 6, below, three publishers used *icons* within their interfaces. Only publishers P1 & P8 included icon points of interaction that did not have text labels associated with them, however, publishers P2 & P8 also included icon points of interaction with text labels.

Table 6: Icons used within the Reading Interface

Publishers	Icons	
P1		
P2		Instruction  Description 
P8	 	Instruction 

Interactive Text as Points of Interaction

Table 7: Interactive Text used within the Reading Interface

Publishers	Text only Points of Interaction	Hypertext
P3		Yes
P4	Description	Yes
P8	Description	

Table 7 above shows both the publishers that included *text only points of interaction* within their navigational items, and also shows publishers who used hypertext. When a publisher used either interactive mechanism in one of their books they used it in all of their books. It

is interesting to note that only publisher P4 used both hypertext and *text only points of interaction*.

Text Only Points of Interaction

Publishers P4 & P8 were found to include text only points of interaction in their reading interfaces. These were separate to instances of hypertext. These text only points of interaction were used for navigation. Publisher P4 used text only points of interaction alongside buttons and publisher P8 used text only points of interaction alongside both buttons and icons.

Text alone for an interaction point poses issues for children, who are both native speakers and non-native speakers of the language the content of the software is written in. These applications were all English-based programs and therefore text only buttons would only be appropriate to users with the language level or reading age to comprehend the instruction of the button.

In-line Linking

The use of hypertext and in-line linking appears to be a concept that is understood by children when reading on screen. In Walker & Reynolds (2000) study of 10–12 year old children in Reading, England, one subject had this to say, “nearly all the programs have key highlighted words you can click on to find out about loads of specific things” (p. 229–230). The hypertext concept, as is most commonly found on the Internet, traditionally is used as a navigational feature that links related concepts or documents. Hypertext is the non-linear structural organisation of information that communicates relationships and is used for the retrieval of information. Only publishers P3 and P4 were found to include in-line linking or hypertext style textual features within their books. The appearance of the text used by the publishers was stylistically related to the typographic conventions that have been established for indicating hypertext links. However, this interactive feature was not used to navigate the book. Instead when underlined text (P3) or coloured text (P4) was clicked with the mouse a text box was displayed to the right hand side of the interface (P3) or in a text balloon above the currently read text (P4) that contained a word definition which clarified the use of a word in the context of the story. This device was used for the introduction of new vocabulary.

Conclusions

Ultimately the conclusions drawn from this research are similar to that of many others, there is still a dearth of literature to encourage best principles of design for children’s learning material and designers still require education to ensure electronic reading material is created that is useable, enjoyable and readable for and by children.

It would seem from this investigation there is a variety of different digital books, from a range of publishers, both locally and internationally, being used in New Zealand schools, which in and of itself is an interesting discovery. Also of note, is the fact that these are computer based systems, desktop and laptop, as compared to mobile or eReader devices. Understanding the material that is currently in use within the classroom and school, as well as understanding the usage of this material, is of great importance in assisting the design of usable and efficient systems and digital books for children’s learning and reading.

Many of the institutions audited carried multiple books from single publishers. Across the schools this study uncovered only 9 unique publishers with digital books intended for reading as opposed to exploration or learning through play. It was noted that in all cases reviewed the various books produced by a single publisher were designed and interacted with in a consistent manner from one book to the next. Perhaps a template of sorts in most instances was developed by each publisher to maintain a consistent look and mode of interaction for the user from one text to the next.

Pagination is being used by publishers, however, the poor consideration of important orientation features such as page numbering is a particular usability and conventional flaw for many of these books. Numbering is a convention that students will experience in print and should be confident using and referring to during study or learning. For this reason these conventions should be present in all material that a student interacts with in the classroom.

Most books did well to encourage easy access to information without impediment of unnecessary pagination or clicking of the mouse. The simplification of document navigation and structure is imperative to ensure the digital book does not disorientate or impede the young user who needs to reserve cognitive load for reading and processing information, rather than navigation. Some books, however, have retained the unnecessary “title” or “cover” page of a printed book, which in this medium could be treated differently. The authors of this paper would suggest integration of title or cover pages into main navigation pages or as end pages, rather than front pages. Cover and title pages being used as navigation pages, instead of document lead pages, will ensure ease of navigation, instant access to content and simplification of document structure.

Buttons, icons and text only navigational features require greater consideration by the publishers. In many instances there were multiple styles of interaction points used on a single page within a book. In several situations icons would require explanation, either with text or through contextualisation for the young audience. In line linking is used for a purpose dissimilar to that of the hypertext convention, which for users familiar with hypertext on the Internet may prove cumbersome at first interaction. Improved convention, simplification and standardisation of interface interaction features will improve a young readers ability to easily move through a document and will reduce the potential for confusion.

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Nicholas' area of research focus has been in childrens' on-screen reading. These investigations have specifically looked into how typographic spacing could best affect childrens' eye movements during reading. This area of exploration saw him graduate with a Masters in Computer Graphic Design from Whanganui School of Design, New Zealand in 2007. Nicholas is a lecturer in Computer Graphic design at the University of Waikato in New Zealand. As a central part of his teaching and research at the University of Waikato Nicholas pursues his interests in typography for children as well as socially responsible graphic design and graphic design education.

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Claire completed her Masters in Computer Graphic Design at Wanganui School of Design, New Zealand. She is currently a lecturer in Computer Graphic Design at the University of Waikato, New Zealand, teaching both print and screen based papers. Claire's main areas of interest and research are typography, print design and physical interaction design. Because of her love for both printed books and interactivity this is where her research interests lie. Her research is currently focussed on the way in which people interact with printed material and how the benefits of electronic media can be applied to traditional media, such as print, to aid it in developing and become more beneficial and keeping up with the digital age.

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