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Electronic books: children's reading and comprehension

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Abstract

This study investigates the differences in children's comprehension and enjoyment of storybooks according to the medium of presentation. Two different storybooks were used and 132 children participated. Of these, 51 children read an extract from *The Magicians of Caprona*, about half reading an electronic version with an online dictionary, and the rest reading a printed version with a separate printed dictionary. The remaining 81 children read an extract from *The Little Prince*, 26 reading an electronic version, 26 reading the same but with narration and 29 reading a printed version. No dictionary was supplied with this storybook. The type of medium did not significantly affect the children's enjoyment of either storybook, and while it took them longer to read the electronic versions, this difference was only significant for *The Little Prince*. For both storybooks, comprehension scores were higher for retrieval-type questions than for inference ones. The use of the online dictionary in the electronic condition of *The Magicians of Caprona* was significantly greater than that for the printed dictionary in that condition. The provision of narration in the electronic version of *The Little Prince* led to significantly higher comprehension scores than when narration was absent.

Introduction

Techniques to aid and improve children's reading skills and to motivate them towards further reading are always of interest to educationalists and to those involved in educational research. Thus, it is unsurprising that the increased availability of children's storybooks in electronic format should be an area of research interest.

Both Reinking (1987) and Ambrose (1991) emphasise the need for a systematic research to specifically examine the impact of electronic books on children's learning.

Comparisons between reading with and without a computer allow us to understand the ways in which computers may enhance or hinder reading and learning.

But what can computers provide that the ordinary printed book cannot to assist the learning process? Torgesen (1986) suggests that for high-level comprehension processes to take place, lower level processes, like rapid word recognition, must first occur. More recent works by Oakhill, Cain and Bryant (2003) and Stothard and Hulme (1992) have highlighted the role of working memory, text integration and ‘informationally rich text representation’ as important contributors to comprehension skills. In terms of working memory, poor comprehension skills have been shown to relate directly to poor performance on working memory tasks (those tasks that require a switch between storage and processing functions) (Oakhill *et al.*, 2003). Features such as word pronunciation, narration, sound effects and animations, which support the text, all help to remove the effort from decoding individual words and allow the child to focus on meaning (Lewin, 2000; Matthew, 1997; Miller, Blackstock & Miller, 1994). Many electronic books have these facilities. At the most basic level, they may come with some form of digitised speech that provides word pronunciation and definitions to aid comprehension. Others have a fully digitised narration accompanied by highlighting of the relevant text. Page turning is implemented through the use of forward and backward arrows (Figure 1).

Many of the CD-ROM versions are more sophisticated, with actors reading the parts of the different characters so that the story ‘comes alive’. Page turning may occur by clicking on the corner of the page, thus replicating the experience of reading a conven-

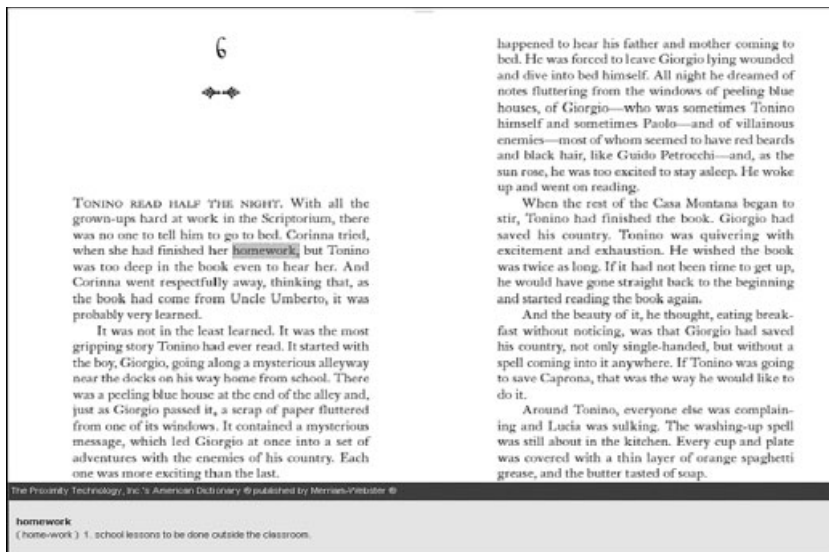


Figure 1: Pages from the electronic version of *The Magicians of Caprona* showing the online dictionary facility

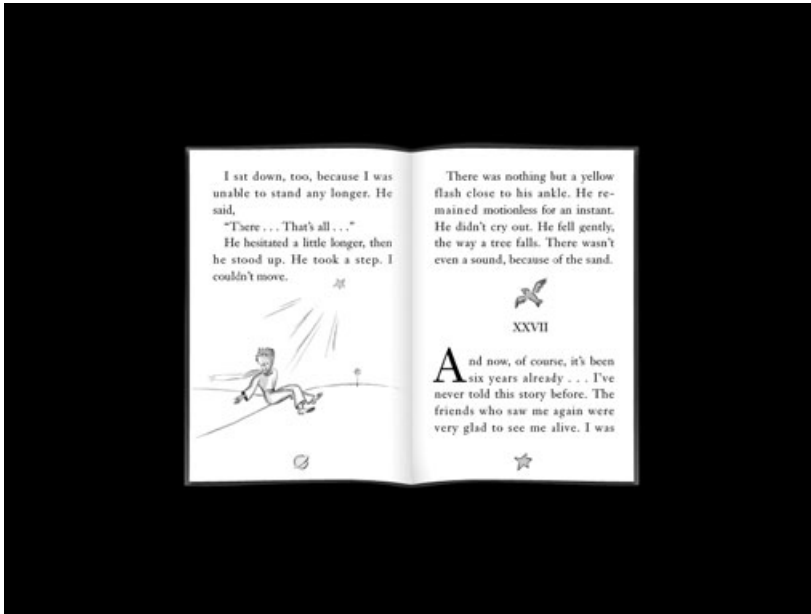


Figure 2: Pages from the CD-ROM version of *The Little Prince*. Narration facility was activated by double-clicking on the swallow

tional storybook. Sound effects and animated pictures may also be features of CD-ROM books. The information provided by these dynamic cues, in terms of illustrating and integrating the meaning of the text, goes beyond that provided by the 2-dimensional drawings found in the printed versions. The interpretation of the text provided by the actors may help overcome any weaknesses that the reader has in terms of decoding the vocabulary, syntactic ability and working memory (Figure 2).

An example of the gains obtained from electronic books can be found in Greenlee-Moore and Smith's (1996) US study. They found that for their sample of 31 9–10-year-olds, when the narrative was long and difficult (as defined by readability using the Fry Readability graph), comprehension scores were higher in the electronic condition. The results were explained in terms of the benefits of instant pronunciation and definition of difficult words in the electronic condition. Although children in the printed condition could have received the same vocabulary help from their teacher, no child made use of this facility. The authors suggest that one benefit of the electronic condition is the privacy of 'failure'; the request for help is private. Further, when children ask for help from the class teacher, this involves a certain amount of 'down time' from the text. Children generally prefer to read on, ignorant of some of the word meanings, than to suffer delay.

The responses in Greenlee-Moore and Smith's study were videotaped. The recordings showed that while both groups were eager to read the books and to answer the

comprehension questions administered after reading, the CD-ROM group showed greater enjoyment and enthusiasm for the task. The link between motivation and reading success has long been recognised by teachers and educationalists ([Adam & Wild, 1997](#); [Gambrell, 2001](#); [Guthrie, Wigfield, Metsala & Cox, 1999](#)). If the added features of electronic books can increase the children's enjoyment and engagement with the text then this, too, may facilitate comprehension as well as their enthusiasm for reading.

A major problem with studies of this type is finding the appropriate ways of measuring the learning gains. This complex process involves separating variables and devising valid and reliable tests for concepts that are difficult to define. Many of the studies previously carried out in this area ([Burrell & Trushell, 1997](#); [de Jong & Bus, 2004](#); [Maynard & McKnight, 2001](#); [Ricci & Beal, 2002](#); [Trushell, Burrell & Maitland, 2001](#); [Trushell, Maitland & Burrell, 2003](#); [Underwood, 2000](#); [Underwood & Underwood, 1998](#)) have been small-scale and have relied on story retelling or multiple-choice questions as a way of testing the children's understanding of the story. The results have been conflicting and often hard to interpret, with memory being a confounding variable.

The present study is an attempt to address some of the shortcomings of previous research. Firstly, it addresses the problem of memory as a confounding variable in the testing process by allowing the children access to the text during testing. Failure to retrieve answers correctly from the text should not, therefore, be because of failure to remember the text. Secondly, in order that deeper processing and integration of the text can be examined, it includes some questions that involve the child having to make inferences rather than just demonstrating a straightforward retrieval of information. Thirdly, the study attempts to tease out any specific factors of the different media that might influence the children's comprehension. For this reason, several different conditions are tested. These include silent reading from the computer screen without additional help, silent reading from the computer screen with a dictionary facility that includes pronunciation, and silent reading from the computer screen with accompanied narration provided by actors and with animated pictures and some sound effects. It should be noted that this last condition differs from the interactive conditions tested in some previous studies ([Maynard & McKnight, 2001](#); [Trushell *et al.*, 2001](#); [Underwood, 2000](#)) in that the animation and sound effects are not controlled by the child. Rather, they are integrated parts of the narrated condition that serve to illustrate the storyline further. Table 1 below describes the features or functions of the electronic storybooks used in the present research and those of other more interactive books used in previous studies.

The main aims of the study are:

- to discover whether the medium of presentation (electronic or printed) affects the children's comprehension and reading speed;
- to discover whether the medium of presentation affects the direct retrieval of information and/or the integration of material as shown by the ability to make inferences;

- to identify the particular features of the medium that might be responsible for any advantage in reading comprehension;
- to find out whether the children's enjoyment of reading is affected by the medium used.

Table 1: Features and functions of the electronic storybooks used in the present research and in previous studies

	Series/Booktitle	Type of electronic book	Research studies
Language	Perfectbound <i>The Magicians of Caprona</i>	Downloadable e-book (Adobe, 2002)	This study
Story interaction modes	English—computerised speech		
Text interaction	Narration by computerised voice can be activated.		
Interactions with graphics	Double-clicking on word activates pronunciation and brings up dictionary definition. Dictionary is of general type and not matched to reading level of storybook.		
Navigation through program	No graphics		
Other features	Forward and backwards arrows		
	Text size, orientation of page, and page view (one or two pages to screen)		
Language	Tivola <i>The Little Prince</i>	CD-ROM	This study
Story interaction modes	English narration by Kenneth Brannagh, child actor, as Little Prince		
Text interaction	With or without narration		
Interactions with graphics	None		
Navigation through program	Pictures and animations illustrate story but are not interactive.		
Other features	When narration is off, clicking corner of page navigates reader backwards and forwards through book. Clicking on swallow at start of chapter starts the animated, narrated version.		
	Pertinent sound effects and music to set mood of story. A different part of the 'menu' allows the child to visit the different planets, listen to the characters, play a game, keep a diary and find out about the life of the author. None of these features is available when the storybook is accessed.		

Table 1: *Continued*

<i>Series/Booktitle</i>		<i>Type of electronic book</i>	<i>Research studies</i>
Language	Discs English and Spanish	CD-ROM	Adam and Wild (1997)
Story interaction modes	Can be customised. In default mode story is read aloud and navigates automatically. There are no opportunities for interaction with text or graphics. In interactive mode, reader clicks on corner to progress through story, sentences can be read aloud and interaction with graphics and text is possible.		Miller, Blackstock and Miller (1994) Greenlee-Moore and Smith (1996) Matthew (1997)
Text interaction	Text highlighted phrase by phrase as read aloud. Readers can have sentence or individual word read again, words pronounced, read in syllables or defined.		
Interactions with graphics	Readers click on 'hot spots' within the illustration, no animation occurs but a picture label appears and word is read aloud. Some hot spots produce sound effects.		
Navigation through program	Dependent on story interaction mode—as described above		
Other features	Many customisation options—including a monitoring and recording option for diagnostic purposes		
<i>Series/Booktitle</i>		<i>Type of electronic book</i>	<i>Researchers</i>
Language	Living Books English and Spanish	CD-ROM	Matthew (1997)
Story interaction modes	Two interaction modes. In 'Read to Me' mode story is read aloud. In 'Let me Play' mode reader can interact with text and graphics after each page has been read aloud.		Underwood and Underwood (1998)
Text interaction	Text is highlighted phrase by phrase as it is read aloud. In 'Let me Play' mode, child can hear page read again or single word read aloud.		Underwood (2000) Trushell, Maitland and Burrell (2003)
Interactions with graphics	In 'Let me Play' mode, reader can click on 'hot spots' within the graphics, which results in animation, sound effects, speech and music.		

Table 1: Continued

	Series/Booktitle	Type of electronic book	Researchers
Navigation through program	Reader chooses mode and language from main menu. Navigation through pages is by arrows.		
Other features	Several of the books offer languages other than English or Spanish.		
Language	LudiMedia / Ubi Soft Multilingual—English version narrated by Ben Kingsley	CD-ROM	Burrell and Trushell (1997)
Story interaction modes	Story appears in text at top of screen and is read aloud.		Trushell, Burrell and Maitland (2001)
Text interaction	Clicking on text activates the read aloud feature.		
Interactions with graphics	Story has 220 click-on animations. Some are incidental to story and some are supplementary.		
Navigation through program	Contents page from which reader selects prologue and then a scene from a choice of 11 different scenes. Alternatively reader can leaf forwards and backwards through scenes once accessed.		
Other features	Well-drawn graphics integrate 3D backgrounds with 3D animations. Music and sound effects. Story offered in five different languages.		

Method

Design

Choice of storybook

There were several constraints on the type of storybook that was suitable for the study. The story had to appeal to 9–10-year-olds, male and female, be of an appropriate reading level and be available in all the different formats—CD-ROM, printed and downloadable. It also had to be a story that the children had not read before, or seen on video, DVD or film as this could affect their scores on the comprehension test as well as their enjoyment of the story.

In practice, it proved impossible to find a single storybook that was available in the three different formats, so it was decided to use two different books, one available in printed form and downloadable format, and the other one available in printed form and CD-ROM. The chosen stories were *The Magicians of Caprona* (Wynne Jones, 1980) and *The Little Prince* (de Saint-Exupery, 1943). Both texts were approved by the literacy adviser for Leicestershire as being suitable for the age group being tested and appropriate for both sexes. They were contrasting in terms of style and storyline but both could be

considered as quality children's literature. (This was ensured by checking entries in *The Horn Book Guide Online* and *The Oxford Companion to Children's Literature* (Carpenter & Pritchard, 1995).

Comprehension tests

The comprehension tests were based on the English Key Stage 2 reading tests for Standard Attainment Tests (Qualifications and Curriculum Authority, 2002) and were approved by the literacy adviser for Leicestershire as appropriate for the age group being studied. The tests contained mostly multiple-choice questions that required the child to ring the correct answer. There were also some questions that required the child to answer with a single word, phrase or a simple sentence. Some questions involved a direct retrieval of information and others required inference, both simple and complex, or the interpretation of imagery in language. The children were allowed access to the extract during testing to ensure that memory *per se* was not being measured. In fact, to ease the process of retrieval, the children were directed to the appropriate chapter or range of pages where the information could be found.

Experimental design and controls

The experimental design of the study used independent measures, with no child being tested on more than one condition. Two conditions were tested using *The Magicians of Caprona*—the printed and the electronic versions of the text. Three conditions were tested using *The Little Prince*: (1) printed, (2) CD-ROM with narration and (3) CD-ROM without narration. Separate analyses were carried out for the two texts.

The children were matched across conditions in terms of reading age, chronological age and, as far as possible within these constraints, in terms of gender. Controls for age and reading age were confirmed by conducting *t*-tests on the two groups for *The Magicians of Caprona* and by one-way analyses of variance (ANOVAs) on the groups for *The Little Prince*. No significant differences were found. It was confirmed with class teachers that neither storybook was present in their school library and that both books were likely to be new to the children. Any child who, on initial questioning, claimed to have previously read the storybook assigned to them was asked to read the alternative text.

Extracts from both storybooks were chosen so that they contained sufficient information for the construction of meaningful comprehension tests while not being too long (2080 words for *The Little Prince* and 1634 words for *The Magicians of Caprona*).

If children had difficulty in reading the questions or needed extra help, this was provided and taken into account at the analysis stage. The exploration of some features of the electronic versions was not encouraged as this would have affected the necessary controls. Thus, page view, orientation and text size were fixed unless real difficulties because of a sight defect were experienced (something that occurred just once throughout the study).

Participants

Altogether, 132 children took part in the study and there were 72 females and 60 males. Of the total sample, 51 children read the extract from *The Magicians of Caprona*, with 25 reading the printed version and 26 reading the electronic version. The remaining 81 children read the extract from *The Little Prince*, with 29 being given the printed version, 26 being given the CD-ROM version without narration and the remaining 26 having the CD-ROM version with narration. The age range was from 9 years and 9 months to 11 years and 2 months. The children were from seven different primary schools in Leicestershire, Nottinghamshire and Derbyshire. The sample included children from a variety of social and ethnic backgrounds, but all the children spoke English as their first language. Reading ages ranged from 7 years and 7 months to 15 years and 3 months.

Procedure

Pilot studies

Two small pilot studies were conducted prior to the main study. These showed that children took longer to read the extract than had been anticipated and became bored with the task before starting on the comprehension test. Both extracts were shortened to take account of this. There was also too much reading on the comprehension tests for those who found reading difficult. The number of questions was therefore reduced from 20 to 15.

Some children also struggled to provide written answers, commenting that they knew what the answer was but could not quite 'put it into words'. The comprehension test was therefore changed to include more multiple-choice questions (8 out of 15). Four of these involved retrieval while the other four involved inference. The rest of the test was a mixture of retrieval- and inference-type questions requiring longer answers, and two 'find and copy' questions that tested the children's ability to identify textual evidence. As some children found the find and copy questions difficult because of lack of experience with questions of this type rather than of failure to comprehend *per se*, it was decided to accept reformulated answers provided that the meaning was retained.

It was also felt that asking the children about their enjoyment of the extract just after they had completed the comprehension test might mean that their answers were biased by their experience of the test. It was, therefore, decided to ask them immediately after reading and before the comprehension test.

The study

The children worked one-on-one with a researcher in a quiet area of their school and only those whose parents had consented took part in the study.

After checking that the child had no previous experience of the text, a short synopsis of the story so far was read aloud while the child followed on a printed copy. The children who were going to read an electronic version of the extract were then familiarised with

the equipment (Toshiba Satellite Pro) and the software. One of the features of the electronic version of *The Magicians of Caprona* was an online dictionary. Double-clicking on a word brought up its definition and activated pronunciation, and this facility was demonstrated. The children reading from the printed version of this text were provided with a printed copy of the Oxford Primary Dictionary (Allen, 2002) which was recommended for their age.

The children who were going to receive the narration of *The Little Prince* on CD-ROM were instructed to read the text on the screen as they listened. They were shown how to activate the narration, and the headphones and sound level were checked for their comfort. No dictionary was available with either the onscreen version or the printed version of this text.

The children were asked to read the extract quietly to themselves and were discreetly timed. When they had finished reading, they were asked whether they had enjoyed it *a lot, a little, or not at all*. They were also asked whether they thought that they would like to read the whole book.

It was explained to the children that they could refer back to the extract when doing the comprehension test, and this was actively encouraged. Children who had received the narration could use the text but were not allowed to activate the narration.

The time taken to complete the test was recorded for each child. No child was allowed to struggle too much, and help or termination of the test was offered when this occurred. The testing was terminated early on only two occasions. All departures from the standard procedure were noted for later analysis.

For the purpose of blind marking, a coding system was used on the scripts, which identified the participants but did not disclose the condition to which they had been assigned.

Results

Computer skills

The children were generally very skilled at using computers and most schools that were visited allocated regular time to the acquisition of information technology skills. In schools where this was not the case, a corresponding lack of skills was obvious in the children and this may have caused some small time delays in completing the tasks.

Time taken to read the extracts (median times are given with the range in brackets)

The Magicians of Caprona

The children took longer to read the extract from the computer than from the printed book, and there was greater variability in the reading times (12 minutes (28) and 10 minutes (13) respectively). The Mann–Whitney test showed that this difference was not significant.

The Little Prince

The narrated condition was not included in this analysis as the time to read the extract in that condition was fixed (14.5 minutes).

The Mann–Whitney test showed that children took significantly longer to read from the computer, 18 minutes (28), than from the printed book, 14 minutes (23.5), $U = 225$, $p = 0.01$.

Time taken to complete the comprehension test

The Magicians of Caprona

The Mann–Whitney test showed that the children who had read the printed version of the text took significantly longer to complete the comprehension test, 20 minutes (34), than did those who had read the electronic version, 16 minutes (22). The results were significant at 0.04 level, $U = 217.5$.

The Little Prince

The Kruskal–Wallis test showed that the children who had read the extract from the CD-ROM without narration took significantly longer to complete the comprehension test than did the children in the other two conditions (printed 19.43 [25.7], CD-ROM with narration 19.56 [16.3], CD-ROM without narration 23.31 [27]). The results were significant at 0.05 level, $\chi^2 = 6.03$.

Scores on the comprehension tests

The maximum score that was possible for children to obtain on either test was 20.

The Magicians of Caprona

The mean scores for the printed and electronic conditions were 13.80 (SD 3.8) and 12.35 (SD 4.3) respectively.

An independent t -test showed that the difference in the scores between the two conditions was not significant, $t = 1.285$, $df = 49$, $p = 0.205$.

The Little Prince

The mean scores for the three conditions (printed, CD-ROM with narration and CD-ROM without narration) were 10.9 (SD 3.97), 13.08 (3.94) and 10.38 (SD 3.97) respectively.

The one-way ANOVA showed that the difference was significant, $F_{2,78} = 3.413$, $p = 0.038$. The Tukey posthoc test showed that the children who had experienced the extract on CD-ROM with narration scored significantly higher on the comprehension test than did those who had experienced the extract on CD-ROM without narration, $p = 0.043$. No other significant differences in the comprehension scores were found between the conditions.

Table 2: Scores for different question types for the two conditions of *The Magicians of Caprona*

Quest type	Condition	Mean	SD	n
Retrieval	Printed	7.68	2.19	5
	Electronic	6.92	2.71	26
Inference	Printed	5.20	2.02	25
	Electronic	4.65	2.11	26

SD = standard deviation.

Table 3: Scores for different question types for the three conditions of *The Little Prince*

Quest type	Condition	Mean	SD	n
Retrieval	Printed	4.83	1.77	29
	CD-ROM no narration	5.08	1.47	26
	CD-ROM with narration	5.85	1.29	26
Inference	Printed	3.59	1.52	29
	CD-ROM no narration	3.12	2.10	26
	CD-ROM with narration	4.27	2.05	26

SD = standard deviation.

Types of questions—retrieval and inference

Across the sample who read *The Magicians of Caprona*, the scores were higher for the retrieval questions than for the inference questions (the mean scores were 7.29 [SD 2.4] and 4.92 [SD 2.1] respectively). A related *t*-test showed that this difference was significant, $t = 7.67$, $p < 0.0005$. For those who read *The Little Prince*, the scores were also higher for the retrieval questions than for the inference questions (the mean scores were 5.23 [SD 1.5] and 3.65 [SD 1.9] respectively). A related *t*-test showed that this difference was significant, $t = 7.92$, $p < 0.0005$ (Tables 2 and 3).

When the analyses were carried out on the different conditions, it was found that while the mean scores were higher for both retrieval and inference questions in the printed condition for *The Magicians of Caprona* (see Table 2), this difference was not significant.

For *The Little Prince*, a significant difference between the conditions was found, $F_{2,78} = 3.353$, $p = 0.04$. The posthoc tests revealed that a significant difference existed between the CD-ROM without narration group and the CD-ROM with narration group, $p = 0.055$. Near significance was reached for comparisons between the printed group and those who had CD-ROM with narration, $p = 0.089$. The scores for both retrieval and inference questions were higher in the narrated condition (See Table 3).

Table 4: Enjoyment ratings for the extracts from the two texts

Book	Condition	Little/Not at all	Lot	n	Desire to finish book		n
					No	Yes	
The Little Prince	Printed	22	7	29	10	19	29
	CD-ROM no narration	21	5	26	11	15	26
	CD-ROM with narration	15	11	26	6	20	26
The Magicians of Caprona	Printed	15	10	25	5	17	22
	Electronic	18	8	26	8	15	23

The medium of presentation and the children's enjoyment of the stories

Enjoyment was measured by how much each child enjoyed reading the extract (*a lot, a little, not at all*), and by the child's desire to read the whole book (*yes, no*). The responses were compared with the different conditions (Table 4).

Out of a sample of 51 children who read *The Magicians of Caprona*, only four children, two from each condition, said that they did not enjoy the extract at all.

Out of a sample of 81 children who read *The Little Prince*, only nine children, two from the CD-ROM without narration condition and seven from the printed condition said that they did not enjoy the extract at all.

For analysis purposes and to meet the requirements of the chi-square test, these children were combined with those who had rated their enjoyment as 'a little'. Although differences in ratings were found for the different conditions (See Table 4) for both texts, the chi-square tests showed that these differences were not statistically significant.

The type of medium did not *significantly* influence the children's desire to finish either book.

The use of the dictionary

The children made good use of the online dictionary, and the analysis showed that there was a significantly greater usage of the electronic dictionary compared with that of the printed dictionary provided for all children who read the printed version of *The Magicians of Caprona*, $t = 4.01$, $df = 25.04$, $p < 0.0005$. The online dictionary was accessed by 18 of the 26 children in that condition, the total number of times accessed being 152. The printed dictionary was used only once by one child out of the 25 children in that condition.

Discussion

Time taken to read the extract

The children generally took longer to read the extract from the computer than from the printed books. In the case of *The Magicians of Caprona*, this might be at least partially

explained by the children's use of the online dictionary. However, no dictionary was available for *The Little Prince*, and yet children took significantly longer to read the extract from the computer than from the printed version. Nor would the problem seem to be one of clarity of text. Apart from one child who had a mild visual impairment and for whom the text was enlarged, no child complained that the onscreen text was too small to read. Also, the quantity of text per page was less for the onscreen version than for the printed version.

One major difference for the children reading onscreen was that they were unable to follow the text manually, eg, using a bookmark or a finger. The children reading the printed versions often used the bookmark for this purpose. This practice is not uncommon in young readers, particularly when fluency of reading has not yet been established. The inability to track the electronic texts may explain the longer reading times for this medium. It is important to note, however, that while onscreen tracking was not available in the present study, some manufacturers of children's electronic texts have addressed this requirement by providing highlighting of individual words as the story is read (for example Johnston, 2004, Start-to-Finish series).

Time taken to complete the comprehension test

The children were encouraged to refer back to the text when completing the test so that errors because of forgetting could be ruled out. The comprehension test guided the children to the appropriate pages of the text and there seemed to be little difference in the ease with which the children located the appropriate passages in the different media.

The children who had read the printed version of *The Magicians of Caprona* took longer to complete the comprehension test than did those who had read the electronic version. In contrast, the children who had read the electronic version of *The Little Prince* without narration took longest to complete the comprehension test. As the problem did not seem to be one of searching, a possible explanation may be that the two conditions, which had slower test times, were the least exciting for that particular book and that the children who had experienced them were less engaged with the task.

Scores on the comprehension tests

The comprehension scores were not significantly different when the children read the electronic versions of the extracts compared to when they read printed versions of the same. Thus, it would seem that although children took advantage of the online dictionary in the electronic version of *The Magicians of Caprona*, this did not produce a significant change in the comprehension scores. If, as Torgesen (1986) suggested, a successful lower level processing of words is essential for a high-level comprehension, it might be expected that providing the definitions of unknown words would help the children's comprehension. This was certainly the finding of Greenlee-Moore and Smith (1996). It could be that in this present study, the children's reading ability was sufficiently matched to the text that the provision of a dictionary made no significant difference to the comprehension scores. The uptake of the dictionary may have been because

of its novelty value rather than of actual need *per se*. This may still be seen as an advantage of the electronic medium, for even if the dictionary usage is because of novelty rather than of need, the habit of accessing it may become established in the young reader. An alternative explanation for the lack of benefit obtained may be that the definitions provided were not suitably matched to the reading level of the children. At present, many of the electronic storybooks for children are accompanied by a dictionary that is not tailored to the needs of the younger reader. That said, the benefits of an appropriate online dictionary, compared with a printed one, are easy to see. It does not require the child to search alphabetically, nor to remember the spelling of the word while searching. Instant access means minimal interruption to the reading flow, and any embarrassment concerning ignorance of the word meaning is private (Greenlee-Moore & Smith, 1996).

While dictionary usage did not produce a significant increase in the comprehension scores, this was achieved by the provision of narration. Narration benefited the children's ability to both retrieve information directly and to make inferences from the text. The narration that accompanied the CD-ROM version of *The Little Prince* was by a well-known actor. It is likely that this provision reduced the load on working memory, and that the use of correct intonation and emphasis served to integrate the text and to provide a richer context to the storyline. If, as Oakhill *et al* (2003) and Stothard and Hulme (1992) suggest, all of these are important factors in the comprehension process, then this extra provision could have led to the benefits observed. Furthermore, the addition of animated pictures and sound effects in the narrated condition will have added to the textual and contextual clues. Although children were not provided with the narration when searching for answers, it is probable that they would have found it easier to identify the relevant parts of the text when the initial input was so much richer and easier to process than in the other two conditions. The added clues to the interpretation of the text may also have assisted the integration of ideas within the storyline, making it more likely that children would make the correct inferences.

Very few children found the narration to be a hindrance to them in their reading and those who did tended to be more able readers who found the narration to be too slow. Many children commented that the narration had been useful when words were difficult to read.

The children's enjoyment of the stories

There were no significant differences in the children's enjoyment of the extracts when they read electronic versions compared to when they read printed versions. The enjoyment ratings were higher for the children who had received the narration of *The Little Prince*, but the effect was not significant. The children's desire to finish either book was not affected by the condition, but many more wished to do this than those who did not.

Conclusion

The children generally took longer to read an electronic version than a printed version of the extracts. However, there was no significant difference in the children's compre-

hension scores when they read the printed version, compared to when they read the electronic version. The provision of narration was shown to significantly improve comprehension, both in terms of the children's ability to retrieve information and to make inferences from the text. The enjoyment of the extract was enhanced by narration, and the use of the online dictionary was significantly greater than that of the printed dictionary.

The study found that the main benefits to children's reading of electronic storybooks, compared with printed ones, were the provision of narration, accompanied by animated pictures and sound effects that related directly to the storyline. Immediate access to the definition of words was a feature that the children seemed to enjoy, but if benefit is to be obtained from this then the definitions must be matched to the reading level of the child. Electronic books that incorporate these features have the capacity to increase children's comprehension and enjoyment of storybooks.

One final point needs to be made, prompted by an online report of recent research using interactive storybooks (Henry & Jones, 2006, *The Sydney Morning Herald*). The report was headed 'Interactive learning fails reading test'. The electronic book used in the study was from the Living Books series (see Table 1). As the variety of electronic books increases, it is critical that a clear distinction is made between the different types in terms of the degree of interaction and animation that they offer and whether those features are supplementary or incidental to the story (Trushell *et al*, 2001). Research has shown that while some electronic books of the more 'edutainment' type may motivate children to read (Adam & Wild, 1997) they can distract them from the story and interfere with story retention (Trushell *et al*, 2001; Underwood, 2000). Failure to differentiate between different types of electronic books can lead to an overgeneralisation of results and selective press reporting. This in turn may limit the adoption of a valuable resource for both teaching and learning.

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