The Impact of ebooks on the Reading Motivation and Reading Skills of Children and Young People

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A rapid literature review

Irene Picton
National Literacy Trust

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Words for life

About the National Literacy Trust

We are the only national charity dedicated to raising literacy levels in the UK. Our research and analysis make us the leading authority on literacy. We run projects in the poorest communities, campaign to make literacy a priority for politicians and parents, and support schools.

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Introduction

The National Literacy Trust recognises the importance of technology as a tool for teaching literacy skills and we are keen to explore this in greater detail. In September 2014, the National Literacy Trust and RM Books are embarking on a joint study to explore the impact of ebooks on the reading motivation and reading skills of children and young people in around 100 primary and secondary schools across the UK. Final conclusions will be published in October 2015. In preparation, this rapid literature review explores some of the research currently available on the role that technology plays in the literacy lives of young people.

Overview

While ebooks have been around for many years, recent rapid improvements in the versatility and affordability of e-readers and tablets, along with increased access to broadband internet, have lead to a dramatic rise in household ownership of these devices. Between 2012 and 2013, the proportion of children responding to the National Literacy Trust's annual literacy survey who owned an e-reader rose from 20% to 30%, while tablet ownership increased from 38% to 65% and smartphone ownership from 38% to 70%. A 2013 Ofcom survey[1] found that tablet use at home by children aged 5 to15 almost tripled between 2012 and 2013, rising from 14% to 42%,. Electronic publishing has also developed during this time, allowing readers access to an ever-growing range and quality of ebooks, whenever and wherever they happen to have their portable device to hand.

Academic and media interest in the difference between reading in print and reading on screen has grown as devices and software facilitating reading on screen become a greater part of everyday life, leading to a growing field of observation exploring the relationship between children's reading on screen and their reading skills and behaviour. While, until recently, the quality and quantity of ebooks for children has not been sufficient to provide material for large-scale longitudinal studies, many aspects of reading on screen have been explored in a range of international and national research. This rapid review draws together findings from studies related to children's screen reading behaviour, enjoyment and skills, both from secondary sources and in (as yet unpublished) findings from the National Literacy Trust's annual literacy survey 2012[2], which included questions allowing us to examine the interplay between children's use of technology and their reading habits.

Main findings

The National Literacy Trust's annual literacy survey questions thousands of children and young people aged 8 to 16 about their literacy behaviours. In 2012, children reported reading more on computers and other electronic devices than in print form for the first time, confirming the central role of technology in young people's literacy lives.
- Almost all (97%) children said they had access to electronic devices such as computers, tablets, phones and e-readers, and almost all (97%) had access to the internet at home.
- Children were more likely to say that they read on screen than on paper outside school. 68.7% reported reading on a computer, phone or tablet, compared to 61.8% reading in print (e.g. a book, magazine or newspaper).
- Children were more likely to say that they preferred to read on screen than on paper. More than half (52.4%) said that they would rather read using electronic devices, compared to just under a third (32%) who said they would rather read in print.

Research by Scholastic US in 2012 also indicated children and young people's increasing preference for reading on screen:

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[1] Ofcom (2013) Children and Parents: Media Use and Attitudes Report, UK.
[2] Clark, C (Unpublished) Redefining or Undermining? The Role of Technology in the Reading Lives of Children and Young People: Findings from the National Literacy Trust's annual survey 2012, London: National Literacy Trust

- The proportion of children who had read an ebook rose from 25% to 46% between 2010 and 2012.
- The proportion who felt that ebooks would have a positive effect on their motivation to read increased from 33% to 49% over the same period[3].

While children and young people feel positive about reading on screen and do so regularly, concern about the potential negative impact of screen reading has been raised by studies indicating that some aspects of reading, such as comprehension and recall, may be worse on screen than on paper. For example:
- A 2005 Swedish study[4] found that students learned better when reading from paper, with researchers concluding "…the e-book presence hinders recall of assimilated information whilst the presence of the paper support tends to facilitate it."[5]
- A trial of Norwegian students in early 2013 found that those who read texts on computers performed less well on a comprehension test than those who read them on paper, leading the researcher to speculate: "The ease with which you can find …your progress in the text [on paper], might be some way of making it less taxing cognitively, so you have more free capacity for comprehension." [6]

Other studies have shown reading on screen may offer particular benefits for some children and young people, for example, those in groups less likely to be reading at the expected level for their age (such as boys, those from less advantaged backgrounds and less keen or able readers). These have highlighted potential benefits for both reading motivation and skills in these groups, for example:
- OECD analysis of the Progress in International Student Assessment (PISA) 2009 found that although the 'gender gap' (a description of the comparatively poor performance of boys in traditional reading assessments) was still in evidence in both the digital and print reading of 15-year-olds across 19 countries, it was narrower for digital reading,[7] suggesting: *"Boys' interest and abilities in digital reading could be exploited to…lead to greater enjoyment of reading and better proficiency in print reading, as well."[8]*
- Scholastic US research found that of children who had read an ebook, 26% of boys and 16% of girls said they were reading more books as a result.
- National Literacy Trust research found that boys were significantly more likely to say that they read on screen (65.7%) than in print (55.4%) outside school. In addition, the gap between boys and girls reading in print outside school (boys 55.4%; girls 68.3%) narrowed significantly in relation to reading on screen (boys 65.7%; girls 72.2%)[9].
- In 2012, the gap between children from different socioeconomic backgrounds reading outside school was also more pronounced in print than it was on screen. 54.8% of children eligible for free school meals (FSM) reported reading in print outside school compared with 64.1% of children who do not receive FSMs). However, 66.8% of children who receive FSMs said that they read on screen compared with 67.4% of those who do not receive FSMs.
- A 2012 study of 36 struggling readers at KS3 found 'substantial gains in both accuracy and comprehension' following an intervention involving both print and enhanced ebooks[10]
- A 2013 study of 103 US high school students with dyslexia found that students offered texts on an iPod touch showed significantly improved reading speed and comprehension compared with reading on paper.[11]

[3] Scholastic (2012) *Kids and family reading report*, USA: Scholastic.
[4] Wästlund, E., Reinikka, H., Norlander, T. and Archer. T. (2004) *Effects of VDT and paper presentation on consumption and production of information: Psychological and physiological factors*, Sweden: University of Karlstad.
[5] Morineau, T., Blanche, C., Tobin, L., Guéguen, N. (2004) *The emergence of the contextual role of the e-book in cognitive processes through an ecological and functional analysis*, France: University of Southern Brittany
[6] Mangen, A (2008) 'Hypertext fiction reading: Haptics and immersion', *Journal of Research in Reading,* 31(4), pp. 404–419 .
[7] OECD (2011), *PISA 2009 Results: Students On Line: Digital Technologies and Performance (Volume VI)*, PISA, OECD Publishing. doi: 10.1787/9789264112995-en
[8] *PISA IN FOCUS* 2012/01 (January) – © OECD 2012
[9] Clark, C (Unpublished) Redefining or Undermining? The Role of Technology in the Reading Lives of Children and Young People: Findings from the National Literacy Trust's annual survey 2012, London: National Literacy Trust
[10] Unpublished study, cited by G Brooks (2013) *What works for children and young people with literacy difficulties?*, Fourth edition: University of Sheffield
[11] Schneps MH, Thomson JM, Chen C, Sonnert G, Pomplun M (2013) *E-Readers Are More Effective than Paper for Some with Dyslexia*. PLoS ONE 8(9): e75634. doi:10.1371/journal.pone.0075634

The variety of age groups, subgroups and reading formats involved in published research to date, alongside changes in technology over time, has made finding areas of consensus among studies relatively difficult. However, it is possible to find some concurrence around the greater advantages of a 'mixed' reading diet (one that includes both print and screen reading), for example:
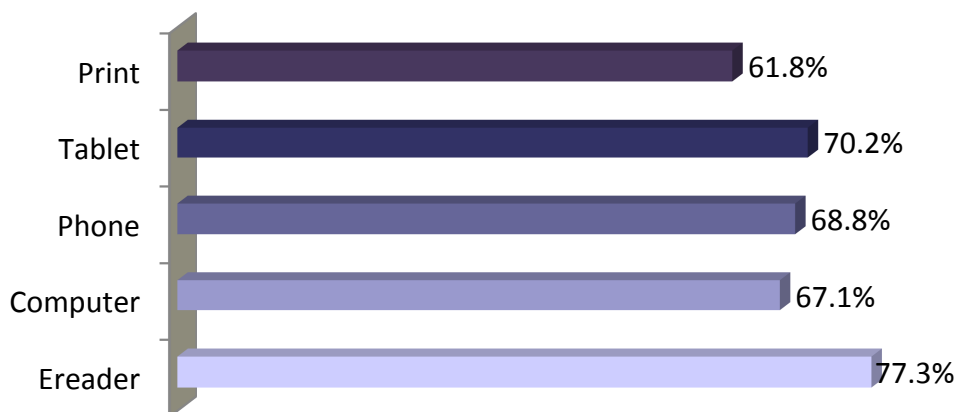
• In the National Literacy Trust's 2012 annual literacy survey, children who included some print reading daily reported greater reading enjoyment than those who read on screen only (51.3% vs. 11.8%) and nearly twice as many children who included some print reading daily read at above the expected level for their age compared to those who read on screen only (26.1% vs. 15.5%)[12].

• This improved performance in those who read a mixture of formats also applied to the range of texts being read, with children and young people who included some fiction, whether in print or on screen, more likely to be reading at above the expected level for their age.

This was also the conclusion of OECD analysis of the Progress in International Student Assessment (PISA) 2009, which found that: *"…although students who read fiction are more likely to achieve high scores, it is students who read a wide variety of material who perform particularly well in reading. Also, students who are extensively engaged in online reading activities …are generally more proficient readers than students who do little online reading.[13]"*

Ebooks and reading behaviour

2012 was the first time that the proportion of respondents to the National Literacy Trust's annual literacy survey reporting reading on screen outside school outnumbered those reading in print.

Figure 1: Proportion of children reading in print and on electronic devices

Print	61.8%
Tablet	70.2%
Phone	68.8%
Computer	67.1%
Ereader	77.3%

(Source: National Literacy Trust's annual literacy survey 2012; N = 34,910)

Children responding to the survey were also more likely to say that they preferred reading on screen, with more than half (52.4%) saying they would rather read on an electronic device, compared with just under a third (32%) preferring print. This was evident in responses relating to reading behaviour, as 38.9% of respondents reported reading daily on screen only, 33.2% reporting reading daily both in print and on screen and only 27.9% reporting reading daily in print alone.

Different materials tended to be read depending on device, with news and non-fiction featuring highly on computers and smartphones and fiction being more popular on e-readers and tablets. Although the proportion of children reading ebooks more than doubled between 2010 and 2012

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[12] The data gathered did not allow us to determine a causal relationship; it is possible that less able readers chose to read on screen.
[13] OECD (2010), PISA 2009 Results: Executive Summary

(increasing from 5.6% in 2010 to 11.9% in 2012), when compared to all electronic devices, print remained the favourite medium for reading fiction for most children.

Figure 2: What children read in print and on electronic devices
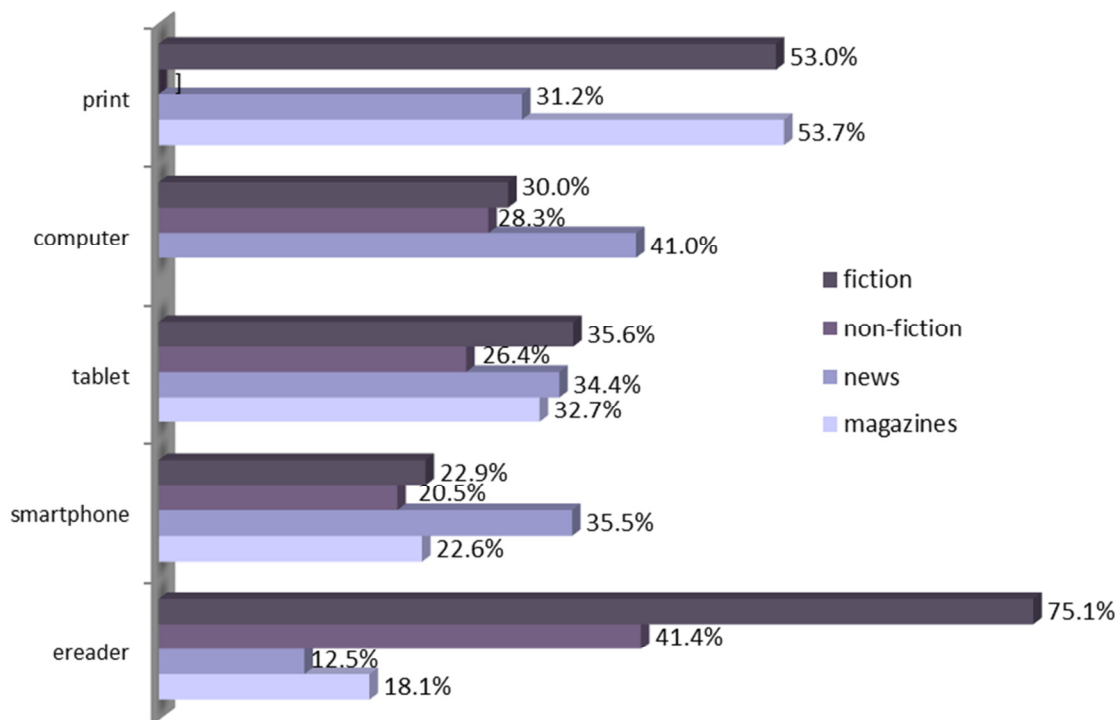
(Source: National Literacy Trust's annual literacy survey 2012; N = 34,910)

A 2012 Scholastic US survey of 1,000 US families[14] found that the proportion of children who had read an ebook had almost doubled from 2010 (from 25% to 46%). At the same time, the number of children who felt that ebooks would have a positive effect on their motivation to read also increased significantly, with half (49%) agreeing with the statement *"I'd read more books for fun if I had greater access to ebooks"*, up from a third in 2010. In terms of reading frequency, of the children who had read an ebook, 26% of boys and 16% of girls said that they felt they were reading more books as a result.

The more pronounced positive impact of reading on screens for boys' reading behaviour was also noted in several other studies around this time. For example, boys responding to our 2012 survey were significantly less likely than girls to say that they read outside school either in print (boys 55.4%; girls 68.3%) or on screen (boys 65.7%; girls 72.2%). However, the proportion of boys reading on screen outside school was considerably higher than the proportion reading in print (65.7% vs. 55.4%). In addition, the gap between the proportion of boys and girls reading outside school was much narrower in relation to reading on screen, reducing from 12.9% for print reading to 5.5% for screen reading.

Further differences for children of different genders can be seen in relation to what children chose to read on different formats. Boys were more likely to read news than girls across most devices (boys 40.8%; girls 34.1%) and girls were more likely to read magazines (33.2% girls; 23.1% boys). However, while a considerably higher proportion of girls said that they read fiction in print (56.1% girls, 47.1% boys), almost exactly the same proportion of boys as girls reported reading fiction on screen (28.8 boys; 30.0% girls).

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[14] Scholastic (2012) *Kids and family reading report*, USA: Scholastic.

Figure 3: Proportion of children reading fiction by format and gender

Format	boys	girls
Print	47.1%	56.1%
Computer	29.3%	29.7%
Tablet	34.7%	36.7%
Smartphone	22.3%	23.5%
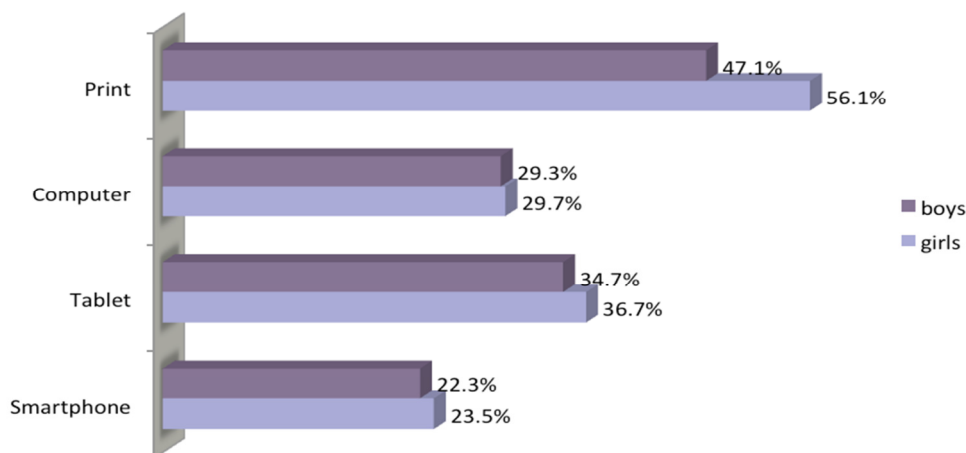
(Source: National Literacy Trust's annual literacy survey 2012; N = 34,910)

Fiction reading has been associated with improved attainment, as noted in a 2012 Department for Education report: "*Frequently reading novels and stories and reading for fun (regardless of whether this is through books, magazines or the internet) is strongly correlated to PIRLS literacy score. However, reading for information (regardless of the source) is much less well correlated. Those who reported the most frequent reading of information texts tended to have lower attainment; those who read for information only once or twice a month score highest and those who read for information every day score the lowest. The PIRLS 2006 data of children aged 9 to 10 shows that those who read stories or novels outside of school 'every day or almost every day' score significantly higher compared to those that do so once or twice a week. It must be noted that this is an association, but does not prove a casual one-way link. It is likely that being a better reader will influence how frequently a child reads.*"[15]

It may also be noted that the prevalence of fiction in assessment might influence the association between reading fiction and attainment; nevertheless, while such assessment continues, increased reading of fiction on screen may have the potential to contribute to increased attainment for some boys.

Differences in reading behaviour on screen compared to print have also been noted in children and young people from less advantaged backgrounds. In the 2012 annual literacy survey, children and young people eligible for free schools meals were significantly less likely to say that they read in print than their peers (FSM: 54.8%; non-FSM: 64.1%). However, this gap of more than 9% almost disappeared in relation to reading on screen (FSM 66.8%; non-FSM: 67.4%). Children from different social backgrounds also chose to read different text types on their devices, with those eligible for FSMs much more likely to read fiction on screen than their peers (FSM: 48.8%; non-FSM: 34.8%). The associations between regular reading of fiction and attainment mentioned previously suggest that this increase in reading fiction on screen by less advantaged children could contribute towards improved attainment.

Similar evidence of the potential benefits of reading on screen as well as in print for the next generation of readers from poorer backgrounds was also noted in more recent National Literacy Trust research on the use of technology in the home learning environment of young children[16]. For example, of children who have a touch screen at home, children of lower socioeconomic status were found to be twice as likely to look at stories daily (16.0% vs. 7.2%).

Alongside gender and socioeconomic background, age is often found to have a significant influence on reading motivation and skills. Our survey of 8 to 16-year-olds found that older pupils were more likely to read on their computer or phone than younger children, but found no

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[15] Department for Education (2012) Research evidence on reading for pleasure, London: Research Standards Team
[16] Formby, S (2014) *Parents' perspectives: Children's use of technology in the Early Years,* London: National Literacy Trust

age differences in the extent to which children and young people said that they used a tablet or e-reader to read.

Table 1: Use of electronic devices to read by age and gender

	Print %	Computer %	Smartphone %	Tablet %	e-reader %
KS2 Boys	56.2	36.1	53.0	65.6	44.7
KS2 Girls	68.6	36.4	58.7	73.5	63.2
KS3 Boys	56.4	27.1	59.9	68.1	54.0
KS3 Girls	68.0	26.7	68.0	74.5	64.8
KS4 Boys	51.9	24.6	69.8	66.1	44.3
KS4 Girls	68.5	27.1	75.6	73.6	65.8

(Source: National Literacy Trust's annual literacy survey 2012; N = 34,910)

In terms of what older and younger children chose to read on screen and on which device, across all devices except e-readers, younger children were considerably more likely to read fiction and older children were more likely to read news. Of those with tablets, younger children were twice as likely to read fiction on them (67.8% KS2; 33.8% KS3; 27.4% KS4) while older children were three times more likely to read news (59.3% KS4; 35.7% KS3, 19.8% KS2). Of all devices aside from e-readers, older children were most likely to read fiction on a tablet.

Aside from groups related to gender, background and age, some studies have examined the impact of reading on screen for less keen and confident readers, and have found that the concept of reading on screen has shown potential to motivate some children reading at below the level expected for their age. For example, a US study of nine first graders in 2010 found that *"below average students had the highest interest in ebooks"*[17]. Another slightly later US study provided older students with e-readers for 15 to 25 minutes a day for a two-month period, and found that, even within this short time *"…reluctant readers demonstrated motivation, engagement and expressed high levels of satisfaction with the e-readers," noting again that "Boys, particularly, benefited from the e-reader use."* Researchers noted that privacy was one of the top reasons given as to why these students enjoyed reading on screen: *"Many low-level readers would prefer for their peers to not know the level of books that they are reading, and e-readers could easily house a wide variety of texts on appropriate levels."*[18]

A 2010[19] review of the impact of technology on English attainment by UK-based ex-NGO Becta also found that technology could contribute to improving literacy outcomes for some children at risk of falling behind, noting a study showing that the spelling performance of children with literacy difficulties could be enhanced by programmes that include text-to-speech feedback or multi-sensory associations with letters and sounds. However, the review also noted another study linking ebooks with more negative behaviour, which found that when reading an ebook with a parent, children spent less time using them compared with printed books, although they engaged in more talk around the story which was abstract and cognitively demanding.[20] `As mentioned, there is a lack of consensus in this area, however, with other studies finding that children interacted longer with parents when looking at ebooks compared to traditional paper books.[21]

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[17] Strout, K. (2010) 'Average, Below Average, And Above Average First Grade Students' Beliefs about Using E-Books to Activate Interest and Motivation in Reading', [Online]. Available at: (Accessed: https://etd.ohiolink.edu/).
[18] Miranda, T., Williams-Rossi, D., Johnson, K.A., McKenzie, N. (2011) 'Reluctant Readers in Middle School: Successful Engagement With Text Using the E-reader ', *International Journal of Applied Science and Technology* , 1(6).
[19] Becta (2010) *The Impact of Technology on Children's Attainment in English: A Review of the Literature*, UK.
[20] Kim, J.E. & Anderson, J. (2008). *Mother-child shared reading with print and digital texts*. Journal of Early Childhood Literacy, 8, pp. 213-245.
[21] Moody, A. K., Justice, L. M. & Cabell, S. Q. (2010). Electronic versus traditional storybooks: Relative influence on preschool children's engagement and communication. *Journal of Early Childhood Literacy*, 10 (3), pp.294-313 / Parish-Morris, J., Mahajan, N., Hirsh-Pasek, K., Michnick Golinkoff, R. & Fuller Collins, M. (2013). Once upon a time: Parent-child dialogue and storybook reading

Another international study of 9 to 19year-olds also found negative associations in relation to screen reading behaviour, noting *"…a negative association between the amount of time spent reading stories and articles on the internet and reading achievement in most countries."*[22] This study took place in 2006, however, when internet access and the quantity and quality of texts available was considerably lower than in later years. Nevertheless, the possibilities for ebooks to improve outcomes for gifted and advanced readers were noted in the same year, with one academic article citing increased access to a wide range of titles as offering potential for confident readers to read more widely: *"Gifted readers can be exposed to ideas and issues appropriate to their own rate of learning and continue to pursue answers to questions beyond what might be considered in an allotted span of time. A reader can often find related titles, such as other books in a series or by the same author, which may not be available at either the school or local public library."*[23]

In conclusion, in terms of the evidence regarding the impact of reading on screen on reading behaviour, it would appear that in 2012-14, many children and young people preferred to read on screen and most read more regularly on screen. Children from groups most associated with poorer literacy performance (boys, children eligible for free school meals and older children) also reported more frequent reading on screen, behaviour associated with better reading attainment.

Ebooks and reading enjoyment

National[24] and international research[25] has long recognised the strong association between reading for pleasure and improved academic performance. Our annual literacy survey in 2012 found that children and young people who read in print daily were nearly three times more likely to say that they enjoyed reading "very much" than were those who read on screen only. However, children who read using a mixture of formats had better overall reading enjoyment, and were also more likely to self-identify as a reader and to have a favourite book.

Table 2: Reading attitudes and enjoyment in children who read in print and on screen daily

	Consider themselves 'a reader' %	*Have a favourite book %*	*Enjoy reading overall %*	*Enjoy reading very much %*
Read both in print and on screen, daily	87.4	77.2	82.2	51.1
Read in print only, daily	87.3	76.1	81.3	51.4
Read on screen only, daily	59.3	59.2	44.5	18.1

(Source: National Literacy Trust's annual literacy survey 2012; N = 34,910)

National Literacy Trust research on the use of technology with children in the early years also found that looking at stories both in print and on a touch screen was found to be associated with greater reading enjoyment, even when compared with using books only (77.4% vs. 70.8%)[26].

A 2013 study looking at the impact of reading on iPads on 30 struggling adolescent readers in Birmingham found that some of the features of reading on screen contributed positively to young people's enjoyment of reading, concluding that *"…the iPad (with features deployed) had*

in the electronic era. *Mind, Brain, and Education*, 7(3) pp.200-211. Cited in http://www.hanen.org/Helpful-Info/Articles/E-Book-or-Paper-Book-Whats-Best-for-Young-Child.aspx
[22] Twist, L., Schagen, I. and Hodgson, C. (2007) *Readers and Reading: The National Report for England 2006*, Slough: NFER
[23] Weber, C.L., Cavanaugh, T.W., (2006) 'Using eBooks With Gifted and Advanced Readers', *Gifted Child Today,* 29(4)
[24] Institute of Education 2013
[25] OECD (2002) *Reading for Change: Performance and Engagement across Countries*.
[26] Formby, S (2014) *Parents' perspectives: Children's use of technology in the Early Years*, London: National Literacy Trust.

a significant, positive impact on the state of enjoyment of struggling adolescent readers. Although some of the impact is likely attributable to the novelty of the iPad, the focus groups suggested that the dictionary, narration and the size of the font were important for struggling adolescent readers." [27]

Increased reading enjoyment on screen was also noted in a 2010 US study comparing reading experiences on a PC, Kindle 2, iPad 1 and print. After reading a passage of text on each format to test reading speeds on different formats, (adult) test subjects were asked to rate their satisfaction with each reading experience. The iPad came out top, followed closely by the Kindle and the print book (scoring 5.8, 5.7 and 5.6 out of 7 respectively). The PC trailed at 3.6 out of 7. Comments from participants highlighted that many felt "more relaxed" when reading in print, however, and one participant said that reading on the PC reminded them of work[28]. This seems to be less of an association for tablets, which are, in 2014, primarily used in the home and for personal, rather than work-related, reasons[29]. Perhaps reflecting this, a 2014 US study of more than 1,000 adults found that the percentage of tablet owners who had read ebooks on their device (55%) almost matched that of e-reader owners (57%)[30]. As a note, the 2010 study found that reading in print was not only easier for test subjects, but that they were also considerably faster when reading in print compared to the PC, Kindle and iPad. With the technology available at that time, average reading speeds were more than 10% slower on the Kindle 2 and 6% slower on the iPad 1.

Ebooks and reading skills

Most of the research on children and young people's reading on screen to date has focused on its impact on reading skills, with studies examining a variety of aspects of reading on screen and their outcomes for children's reading abilities.

The OECD's triennial Programme for International Student Assessment (PISA) is one of the largest studies of children's academic achievement, testing the literacy, science and maths skills of more than half a million 15-year- olds in 65 countries. In 2009, 19 countries participated in PISA's first digital reading assessment[31], allowing comparisons to be made between young people's performance in digital and print reading. Student performance in both types of reading was found to be closely related in most countries, but there was some evidence that digital reading had a positive impact on the skills of some young people. Researchers found that: "…*students who are extensively engaged in online reading activities, such as reading e-mails, chatting on line, reading news on line, using an online dictionary or encyclopaedia, participating in online group discussions and searching for information on line, are generally more proficient readers than students who do little online reading*." [32] They also noted that the positive impact could be seen specifically with boys. For example, while the 'gender gap' was still in evidence in results for both digital and print reading, it was narrower in digital reading in all participating countries, leading researchers to suggest: *"Boys' interest and abilities in digital reading could be exploited to start a 'virtuous cycle' through which more frequent reading of digital texts would result in better digital reading proficiency, which, in turn, would lead to greater enjoyment of reading and better proficiency in print reading, as well."[33]*

A US academic review of 30 studies examining the impact of ebooks on decoding and comprehension with children aged 4 to 11 published between 1997 and 2007 found that the use

[27] Hughes, T (2013) *Understanding the impact of an iPad on the reading experience of struggling adolescent readers*: University of Birmingham
[28] Nielsen, J. (2010) 'iPad and Kindle Reading Speeds', [Online]. Available at: *http://www.nngroup.com/articles/ipad-and-kindle-reading-speeds/* (Accessed: September 2014).
[29] Titlow, J. P (2013) Cited in 'Tablet Owners Read More Than Everybody Else', [Online]. Available at:*http://techpageone.dell.com/downtime/how-tablets-change-our-reading-habits/#.VAbcZfldX1Z* (Accessed: September 2014).
[30] Zickhur, K. and Rainie, L. (2014) *E-Reading Rises as Device Ownership Jumps*, US: Pew Internet Research Project.
[31] OECD (2011), *PISA 2009 Results: Students On Line: Digital Technologies and Performance (Volume VI)*, PISA, OECD Publishing. doi: 10.1787/9789264112995-en
[32] OECD (2010), PISA 2009 Results: Executive Summary
[33] OECD (2012) *PISA IN FOCUS* 2012/01

of ebooks had a positive impact on comprehension (the effect was small, but statistically significant) but did not appear to aid decoding. The meta-analysis also concluded that ebooks were likely to be most effective when teachers played an active role in their use.[34]

A review of UK studies looking at the impact of technology on English attainment by Becta in 2010[35] also found some evidence that technology could contribute to improving literacy outcomes. For example, one study showed that multimedia ebooks could foster collaborative learning between peers, with children who used ebooks in peer tutoring contexts gaining significantly more in terms of phonological awareness and emergent reading skills than a control group[36]. Another concluded that multimedia ebooks were "...*just as effective as a one-to-one adult tutor in terms of the improvement observed*"[37] in the vocabulary of children aged 5 to 6.

In terms of the interaction between reading on screen and attainment for subgroups of children, recent National Literacy Trust research looking at technology use with early years found that children from less advantaged backgrounds who used both books and touch screens to look at stories were less likely to perform below the expected standard for their age than if they only looked at books[38]. Studies looking at the benefits of ebooks for less confident readers have also shown some benefits for this group. For example, one 2012 independent pilot study in Neath and Port Talbot examined the benefits of the 'Rapid Plus' reading intervention involving print books and ebooks (with features allowing students to hear a word or story read aloud) on 36 struggling KS3 readers. Although the programme was relatively short, running between February and May 2012, results showed "substantial gains in both accuracy and comprehension".[39]

Inclusivity consultant Alex Strick considered what ebooks may have to offer readers less able to engage with print in a 2012 blog[40] for Booktrust, *"E-books and children's book apps are rapidly proving that they have the potential to actually enhance the reading experience - for all children. Some of the best ebooks and apps offer exciting new ways to engage children (including those with additional needs) in books and stories. They can open up new opportunities for children who have difficulty accessing physical books. Indeed e-books can be invaluable for children who are blind or partially sighted and may otherwise wait months or even years for books in audio, large print or braille. They can offer powerful possibilities for supporting learning and communication. They can support the development of speech and language, social skills, decision-making and fine motor skills. Teachers talk regularly of how iPads have transformed classroom activity, particularly for children with additional needs. There have been many powerful accounts of the influence of the iPhone on people's reading. I remember a fascinating article in the Guardian[41] in which a 50-something man with dyslexia described the impact of his new iPhone. Having struggled with reading and spelling for his entire life, he suddenly found himself able to race through various classics in a matter of days. His story is not unusual - many dyslexics report that the shorter pages, generous 'spacing' and background lighting has transformed the reading experience for them."*

The benefits of ebooks for young people with dyslexia were also highlighted in a 2013 study of 103 US high school students. Results showed that a small handheld e-reader device (in this case, an iPod touch), formatted to allow only short amounts of text to appear on screen, significantly improved reading speed and comprehension for those who struggled with phoneme decoding or efficient sight word reading, or had limited visual attention spans, when compared

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[34] Zucker, T.A., Moody, A.K. and McKenna, M.C. (2009). The effects of electronic books on pre-kindergarten to grade 5 students' literacy and language outcomes: A research synthesis. *Journal of Educational Computing Research* 40, no. 1: 47–87.
[35] Becta (2010) *The Impact of Technology on Children's Attainment in English: A Review of the Literature*, UK.
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[40] Strick, A. (2012) *The e-future looks bright*, Available at: http://www.booktrust.org.uk/books/children/bookmark/blog/285 (Accessed: September 2014).
[41] Hill, H (2010) *My iPhone has revolutionised my reading*, Available at: http://www.theguardian.com/education/2010/apr/06/iphone-makes-reading-books-easier (Accessed: September 2014).

with paper. However, researchers concluded that, due to prior eye tracking studies, it was more likely that the short lines facilitated reading for those with dyslexia than the device per se.[42] Nevertheless, electronic devices can more easily present text in a range of formats, including shorter line formats, than printed books.

US academics noted this early potential of the particular features of ebooks to provide practical assistance for struggling readers in a 2006 article: *"The display offered through ebook programs and devices can provide reading scaffolds for many students through their ability to change the displayed text size. Students who struggle with reading, regardless of the reason, can benefit from changing to larger font sizes. The reason for using large print is not necessarily because these children have visual difficulties. Larger font sizes and spacing actually cause the eyes to move more slowly while reading, allowing students to track their reading more easily (Bloodsworth, 1993) and giving them more processing time. All students, especially those susceptible to visual stress, were found to make more errors when using smaller text sizes than with larger text. From this research Hughes and Wilkins (2000) concluded that the reading development of some children could benefit from larger text sizes and spacing than is currently the norm. Reading miscues, including misreading syllables or words; skipping syllables, words, or lines; rereading lines; and ignoring punctuation cues, were found to be virtually eliminated when students read large print books. For most ebook programs, creating a large text format is just a matter of sliding a text size bar to a larger setting."[43]*

However, researchers are by no means unanimous about the positive impact of technology on children's reading skills. The Progress in International Reading Literacy Study (PIRLS), a survey comparing the reading attainment and habits of more than 200,000 primary-aged children in 49 countries, introduced a new question in 2006 to measure the extent to which children read stories and articles on the internet. Results showed *"a negative association between the amount of time spent reading stories and articles on the internet and reading achievement in most countries."[44]* An analysis of the same question did not appear to have been included in the 2011 PIRLS report,[45] which appeared to focus on other factors associated with better reading attainment, so it is not possible to compare results for subsequent years.

One further international study to highlight at this stage is the *European Evolution of Reading in the Age of Digitisation* (E-READ)[46]. This empirical research will explore the impact of digitisation on the reading experience of young people in 15 European countries from 2014 to 2018. The study aims to assess the degree to which screen devices might negatively impact cognitive and emotional aspects of reading and will use findings to provide guidance for practitioners, policy makers, publishers and designers. Anne Mangen of the University of Stavanger is Chair and one of the lead researchers, and has many years of experience studying the cognitive implications of new media, investigating the haptics of reading on screen and how this contributes to comprehension, recall and the 'immersive' reading experience. Exploring "what kinds of texts are likely to be less hampered by being read digitally, and which might require the support of paper,"[47] several of her studies have noted negative impacts of reading on screen, echoing the thoughts of developmental psychologist and cognitive scientist Maryanne Wolf: *"There is physicality in reading, maybe even more than we want to think about as we lurch into digital reading - as we move forward perhaps with too little reflection. I would like to preserve the absolute best of older forms, but know when to use the new[48]."*

[42] Schneps M.H, Thomson J.M, Chen C, Sonnert G, Pomplun M. (2013) *E-Readers Are More Effective than Paper for Some with Dyslexia*. PLoS ONE 8(9): e75634. doi:10.1371/journal.pone.0075634
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[47] Flood, A. (2014) 'Readers absorb less on Kindles than on paper, study finds', *The Guardian,* 19th August. http://www.theguardian.com/books/2014/aug/19/readers-absorb-less-kindles-paper-study-plot-ereadereReader-digitisation
[48] Cited by Jabr, F (2013) 'The Reading Brain in the Digital Age: The Science of Paper versus Screens', *Scientific American,* 11 April, The Reading Brain in the Digital Age: The Science of Paper versus Screens.

In a 2008 study[49] of fiction reading online, Mangen suggested: "*One main effect of the intangibility of the digital text is that of making us read in a shallower, less focused way. As shown by numerous studies of screen reading, we tend to scan text on screen. Such a reading mode is highly vulnerable to distractions, particularly when these distractions are as easily available as a click with the mouse. These hardwired dispositions also help explain why the computer, as a reading device, seems to be poorly suited for the contemplative and deeply focused reading we associate with the book. When reading a book, the text in the book as a static and fixed perceptual phenomenon simply does not provide us with options for attentional switching and for autostimulating our attentional response.*"

Mangen published the results of a trial of students in early 2013[50] that found that those who read texts on computers performed less well on a comprehension test than those who had read them on paper, leading her to speculate: "*The ease with which you can find out the beginning, end and everything in-between and the constant connection to your path, your progress in the text, might be some way of making it less taxing cognitively, so you have more free capacity for comprehension.*" [51] In a trial the following year, Mangen gave 50 readers a short story, half on a Kindle and half in paperback form, before testing subjects on various aspects of the story. Researchers predicted differences in levels of immersion and emotional responses based on an earlier study comparing an upsetting short story read on paper and on iPad, in which paper readers reported higher measures related to empathy, transportation, immersion and narrative coherence. However, in this study, little difference was found in any area aside from plot reconstruction, in which Kindle readers performed significantly worse than paper readers, leading researchers to suggest that "*the haptic and tactile feedback of a Kindle does not provide the same support for mental reconstruction of a story as a print pocket book doe*s". Mangen speculated on the contribution that the physical sense of turning pages might make to helping a reader develop awareness of the sequence of the story: *"When you read on paper you can sense with your fingers a pile of pages on the left growing, and shrinking on the right, [and] this very gradual unfolding of paper as you progress through a story... is some kind of sensory offload, supporting the visual sense of progress when you're reading. Perhaps this somehow aids the reader, providing more fixity and solidity to the reader's sense of unfolding and progress of the text, and hence the story."*[52]

This better recall on paper was picked up in an earlier Swedish study[53] that found that students seemed to learn better when reading from paper, with researcher Erik Wästlund concluding that "…*the e-book presence hinders recall of assimilated information whilst the presence of the paper support tends to facilitate it.*"[54] In this study, researchers determined that the most influential factor was the ability to see pages in their entirety, and scrolling was identified as one of the main reasons for students' poorer performance when reading on screen for two reasons. Firstly, using a mouse commanded a greater investment of attention than turning a page, and secondly, the vertical movement of text disrupted visual attention, requiring a constant refocusing to find a new starting point on the scrolled text. A 2013 study of younger children's interactions with interactive ebooks and a parent also showed better learning from print, finding that while children learned some information about the story from an ebook, those who read a printed book knew more details from the story as well as the order of events.[55]

[49] Mangen, A. (2008), Hypertext fiction reading: Haptics and immersion. Journal of Research in Reading, 31: 404–419. doi: 10.1111/j.1467-9817.2008.00380.x
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[55] Parish-Morris, J., Mahajan, N., Hirsh-Pasek, K., Michnick Golinkoff, R. & Fuller Collins, M. (2013) 'Once upon a time: Parent-child dialogue and storybook reading in the electronic era', *Mind, Brain, and Education,* 7(3), pp. 200-211.

Developments in technology have improved the on-screen reading experience dramatically in recent years; however, scrolling remains a feature of much online reading, if not of ebooks themselves. Recalling the papyrus scrolls that preceded the modern book format, one is reminded that the book has had hundreds of years to evolve into the perfect form in terms of reading comfort and effectiveness (in the words of Douglas Adams: "*Sharks are old, there were sharks in the ocean before the dinosaurs and the reason there are still sharks around is that sharks are better at being sharks than anything else is. Physical books are tough, hard to destroy, bath-resistant, solar operated, feel good in your hand – they are good at being books and there will always be a place for them.*")[56] [Note: this comment preceded the announcement of a waterproof e-reader[57]].

Ebooks, unlike other forms of screen reading, have the advantage of being able to recreate many of the best features of printed books, such as the ability to see whole pages, and (with some devices and software) to 'turn' pages with the flick of a finger. As technology finds better alternatives to eye-straining backlit screens, many popular devices are providing an ever-more 'paper-like' reading experience. To be able to more closely replicate these features while providing other useful features that print cannot, such as text resizing, instant dictionary look up and text-to-speech options, alongside instant access to new titles, portability, privacy and for some young people, the 'cool' factor that paper books may not have, is surely an advantage. However, technology is unlikely to solve the problem of the tactile cues provided by the build up of physical, paper pages read. Perhaps the familiarity with format that a paper-rich generation has may be less of an issue for the next generation of readers – it will be interesting to see whether, for those children and young people already reading more on screen than paper, they will need to use the movement of paper as a comprehension prop less than test subjects featuring in studies to date.

This has been touched upon in a few studies to date, for example, a 2011 Israeli study[58] found that, although students reading on paper seemed to have a better sense of their own understanding than those reading on screen, those that expressed a preference for reading on screen learned less when required to read on paper and vice versa. A more recent 2013 study found no difference in students' reading comprehension on paper, screens and ereaders, concluding that reading was "*really a matter of personal preference.*"[59]

This is also indicated by results from our 2012 annual literacy survey, which found stronger associations between reading content and attainment than between reading format and attainment (in other words, it mattered more what children chose to read, than how they read it). Table 3 shows that whether children read on screen or in print made little difference in terms of their overall reading attainment, with 92.9% of children reading in print reading at or above the level expected for their age and 91.8% of children reading on screen reading at or above the expected level. However, there were clear differences in what children reading at different levels chose to read, with those reading below the level expected for their age more likely to prefer magazines, followed by newspapers, poems, non-fiction and fiction. Children reading at the level expected for their age favoured magazines, followed by newspapers, non-fiction, fiction and poems and, curiously, this pattern is reversed for children reading above the level expected, with poems at the top of the table, followed by fiction, non-fiction, newspapers and magazines. [Note: Social networking and instant messages have not been considered in these examples as they have no print comparison. However, these were the favourite text types for below average readers, about in the middle for average readers and least favoured, aside from magazines, for above average readers]. There were no significant differences to be found in relation to how children reading at different levels read their preferred content, with very close proportions of each of the text types read in print and on screen.

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[59] Margolin, S.J, Driscoll, C., Michael J. Toland, Jennifer Little Kegler (2013) 'E-readers, Computer Screens, or Paper: Does Reading Comprehension Change Across Media Platforms?', *Applied Cognitive Psychology,* 27(4), pp. 512-519.

Table 3: Reading content and reading attainment in print and on screen

(N = 11,000)	Below expected level %	At expected level %	Above expected level %
Fiction – print	4.4	73.3	22.3
Fiction – screen	5	73.4	21.6
Non-fiction - print	5.2	73.9	20.9
Non-fiction - screen	5.4	73.8	20.8
Newspaper – print	8.8	75.1	16.1
Newspaper - screen	8.4	75.7	15.9
Magazines – print	9.6	75.7	14.7
Magazines - screen	9.9	75.7	14.4
Instant messages - screen	10.3	74.4	15.4
Messages on social networking sites - screen	10.9	74	15.1

(Source: National Literacy Trust's annual literacy survey 2012; N = 11,000)

Looking at reading frequency and format together, nearly twice as many children that read daily either in print, or both in print and on screen, read at above the expected level, compared with those who read daily on screen only (26.1% vs. 15.5%). However, as the data gathered did not allow us to determine a causal relationship, it cannot be inferred that on-screen reading leads to lower reading ability; it is possible that less able readers chose to read on screen.

Table 4: Reading frequency and reading attainment in print and on screen

(N = 11,000)	Below expected level %	At expected level %	Above expected level %
Read both in print and on screen, daily	4.0	69.4	26.6
Read in print only, daily	4.9	69.0	26.1
Read on screen only, daily	11.9	72.6	15.5

(Source: National Literacy Trust's annual literacy survey 2012; N = 11,000)

Exploring the link between reading enjoyment and attainment with different reading formats, Table 5 shows that, apart from print, only e-readers were associated with both greater enjoyment and greater attainment. Curiously, tablets were associated with greater reading attainment but not with greater enjoyment.

Table 5: Enjoyment of reading and reading attainment in print and on screen

(N = 11,000)	Enjoy reading %	Reading below expected level %	Reading at expected level %	Reading above expected level %
Reading in print	60.4	7.7	75.8	16.5
Reading on an e-reader	72.1	6.7	74.2	19.1
Reading on a tablet	46.2	9.9	72.4	17.7
Reading on a computer	47.3	11.4	73.5	15.2
Reading on a mobile/smartphone	45.1	12.0	74.1	13.9

(Source: National Literacy Trust's annual literacy survey 2012; N = 11,000)

It is possible that e-readers may be associated with greater reading enjoyment and attainment by virtue of what children and young people tend to read on those devices, which (unlike the other devices) tends to be solely fiction and non-fiction – genres that continue to form the backbone of assessment.

To summarise survey findings relating to reading on screen or in print and reading attainment, while many children and young people reported positive feelings about reading on screen, and read more frequently on screen than in print, fewer children who read on screen reported high levels of reading enjoyment. In addition, those who included some element of print in their reading outside school were generally more likely to read at, or above, the expected level for their age. However, most children for whom we had attainment data were reading at the expected level for their age regardless of the reading format, and some association with higher reading attainment was visible for those reading on e-readers and tablets.

Conclusion

Children's reading motivation and skills may be influenced by many factors. Gender, age and social background consistently feature as influencing factors in children's literacy achievement; for example, girls generally outperform boys on reading assessments, and children from more advantaged backgrounds tend to outperform those from poorer families. However, children and young people who enjoy reading, and read frequently, are known to be more likely to perform better academically. Finding ways to help children to enjoy reading more, and motivating them to read more often therefore has the potential to address long-standing achievement gaps.

It would be optimistic to predict that ebooks will offer a route into reading for all those previously unlikely to pick up a printed book, but some studies would appear to suggest that they could be considered alongside other reading interventions to address long-standing gaps between less keen or able readers and their peers. Our 2012 survey showed that while many children and young people have positive feelings about reading on screen, and read more frequently on screen than in print, most achieved better when they had a mixed reading diet, both in terms of format and content. Regardless of whether the reading was on a screen or on paper, children who read fiction and non-fiction, but particularly fiction, were more likely to be reading at or above the level expected for their age. This concurred with the conclusion reached by the OECD analysis of PISA 2009: *"There has been considerable debate as to what type of reading may be most effective in fostering reading skills and improving reading performance. The results from PISA suggest that, although students who read fiction are more likely to achieve high scores, it is students who read a wide variety of material who perform particularly well in reading. Also, students who are extensively engaged in online reading activities, such as reading e-mails, chatting on line, reading news on line, using an online dictionary or encyclopaedia, participating in online group discussions and searching for information on line, are generally more proficient readers than students who do little online reading.[60]"*

As the literacy world adapts to the transformation of reading options offered by ebooks, the choice of reading on paper or screen seems rarely to be an 'either/or' situation for most readers, with each form of reading suiting a different situation. However, it is important to recognise that the use of electronic texts is becoming an increasingly important part of students' literacy learning, and the number and quality of ebooks available for children and young people to read for pleasure is increasing year on year. Questions relating to technology and reading behaviour will again be featured in our 2014 annual literacy survey, recognising that the expanding reading opportunities offered by smartphones, e-readers and tablets make continued research into the relationship between ebooks and how much, and how well, children and young people read, both timely and necessary. With RM Education, we look forward to exploring which groups and sub-groups of readers may benefit most from access to ebooks in much greater detail. In this way, we hope to contribute to the body of research on this issue, and to assist educationalists in making informed choices when considering the potential of an ebook programme as a reading intervention.

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[60] OECD (2010), PISA 2009 Results: Executive Summary

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Appendix A: National Literacy Trust survey sample characteristics

Overall, 34,910 young people participated in this survey in November/December 2012. There was an equal gender split in the sample, with 50% boys (N = 10,484) and 50% girls (N = 10,466) participating.

Table A1 shows that the majority of pupils were 11, 12 and 13 years old. To investigate the impact of age, three broad categories were identified according to key stages: KS2, KS3 and KS4. The KS2 category (31.1%, N = 6,468) refers to pupils aged 7 to 11, KS3 (54.2%, N = 11,261) refers to pupils aged 11 to 14, while KS4 (14.6%, N = 3,045) refers to pupils aged 14 to 16. Although some young people aged 17 (N = 94, 0.4%) and 18 (N = 82, 0.4%) also took part, the sample was too small and they are therefore not part of the analyses by key stage.

Table A1: Sample age

	%	N		%	N
8	5.6	1,180	13	17.1	3,702
9	6.7	1,410	14	8.5	1,785
10	6.9	1,441	15	4.5	950
11	23.6	4,937	16	1.5	310
12	24.1	5,059			

The percentage of pupils who receive free school meals (FSM), which is frequently used in educational research as a crude indicator of socioeconomic background, was 15.2%. The percentage of FSM uptake in this study is slightly lower than the national average (18.2%[61]).

When asked how they would describe their ethnic background, most pupils said that they were White British (76.7%, N = 14,176). The second and third most frequent ethnic categories in this sample were Asian or Asian British Pakistani (3.3%, N = 604) and White other (3.2%, N = 593). See **Table A2** for a full breakdown of ethnic background. Please note that 11.8% (N = 2,476) of the sample chose not to answer this question. Overall, the ethnic make-up of this sample is representative of that found nationally[62].

Table A2: Ethnic background

	%	N
White British	76.7	14,176
White Irish	1.5	270
White Traveller	0.3	58
White Romany	0.6	115
White other	3.2	593
Mixed White and Black Caribbean	1.3	243
Mixed White and Black African	0.8	146
Mixed White and Asian	1.2	214

61 http://media.education.gov.uk/assets/files/pdf/s/sfr10-2012.pdf ; primary and secondary. Primary 19.3%, secondary 16%

62 http://media.education.gov.uk/assets/files/pdf/s/sfr10-2012.pdf

	%	N
Mixed other	2.1	387
Asian or Asian British Indian	2.1	379
Asian or Asian British Pakistani	3.3	604
Asian or Asian British Bangladeshi	1.0	190
Asian or Asian British Chinese	0.6	105
Asian or Asian British Other	1.0	180
Black Caribbean	1.1	205
Black African	2.5	463
Black other	0.8	147

(based on N = 18,474)