

## **Is Google Making Us Stupid? *The Impact of the Internet on Reading Behaviour***

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### **Abstract**

*This study explored the impact of the Internet on our reading behaviour. Using an exploratory survey, it examined the online and offline reading behaviour of individuals, and determined the underlying patterns, the differences between online and offline reading, and the impacts of the online environment on individuals' reading behaviour. The findings indicated that there were definite differences between people's online and offline reading behaviours. In general, online reading has had a negative impact on people's cognition. Concentration, comprehension, absorption and recall rates were all much lower while reading online than offline.*

Keywords: Online reading, Comprehension, Concentration, Content absorption, Content recall

### **1 Introduction**

When Nicholas Carr published his article "Is Google making us stupid?" in 2008, it evoked a stream of debate in the various media. Although Carr targeted Google, he was using Google as a proxy for the Internet. Carr's motivation to write the article was the increasing difficulty he was experiencing in concentrating on reading a piece of text for a long time, and the decrease in his ability to immerse himself in contemplative reflection of the content. Carr posited that the Internet would have a far-reaching negative effect on our capacity for comprehension and contemplation and thus learning.

It is undeniable that technological advances and the Internet have altered conceptions of certain activities and businesses (Cheong & Park, 2005). Statistics indicate that the number of people accessing the Internet grew by 566% between 2002 and 2012 (Internet World Stats, 2013). The implications would thus be significant if, as Carr (2008) implied, Google was making us stupid.

Reading on the Internet presents many advantages, such as enhanced user experience through media rich content, efficiency, increased reading capacity, flexibility, cost effectiveness, and

comprehension (Fidler, 2004; McPherson, 2005). It also presents disadvantages such as a negative impact on short and long term memory, lack of concentration, and lack of comprehension (Leu & Zawilinski, 2007).

Despite the growing interest in reading online, limited research has been conducted to assess the changes to human reading behaviour in the online environment (Liu, 2005). While some such as Coiro and Dobler (2007) have explored new literacy approaches, these have been targeted at young children learning to read. Others (Siegenthaler et al. 2011) have explored the impact of specific technological aspects such as text display.

The aim of this research was thus to explore both offline and online reading and determine the impact of the online environment on people's reading behaviour. The research objectives were: [i] to explore the online reading behaviour of individuals, and the underlying motivations [ii] to explore offline reading behaviours, and the underlying motivations, [iii] and to determine the differences between online and offline reading, [iv] and the impact of online reading on the relevant cognitive functions.

This paper is structured as follows: a literature review provides the background knowledge and theoretical underpinning as well as an indication of the gap in knowledge. The subsequent section consists of a description of the research methodologies used. The findings are reported next. A discussion section follows and the article concludes with an indication of the major findings of this study, their implications, and possible future research directions.

## **2 Literature review**

According to Transaction Theory, a person interacts with reading content like a river connects with its banks, each working its effects upon the other (Rosenblatt, 1994). Therefore, it can be expected that the online environment would have an effect on the way in which people read, and consequently on their information processing and memory – and, by implication, learning.

A significant advantage of online reading is its relative efficiency in delivering content (Shaikh, 2004). Interactivity, ability to search the content, better information structures and the ability to embed multimedia in reading content are further key benefits of digital media (McPherson, 2005). The amount of accessible information appears unlimited, but hyperlinks provide more control over the way readers access material (Reinking, 1992). This enriches the reading experience by allowing the reader to obtain necessary background information (Fidler, 2004; Moje & Pugh, 2009). Readers also have the flexibility to decide how they will read the text; and the availability of one or more entry points to the same page encourages users to access the same information through different paths at different phases of reading. There is thus the freedom to read in whatever way best suits the reader's purpose, and this results in better comprehension. In addition, comprehension can be increased by means of sound connected to visual formats (Fidler, 2004). The online reading experience is thus more sophisticated than offline reading in many ways, and helps to promote literacy and learning by making reading enjoyable, fostering the use of critical reading skills and promoting reading fluency (McNabb et al., 2002).

Online media also have disadvantages which impact human reading behaviour negatively. Hyperlinks can distract readers (McPherson, 2005), while the fragmentary hypertext threatens sustained reading (Birkerts, 1994). Advertising on web pages can be distracting and even unethical due to uninvited disruption of reading by pop-up adverts. In general, readability on the web is also regarded as poor in comparison with reading on paper (Moje & Pugh, 2009). Despite the apparent increase in online reading, many users print online material to read on paper (Liu & Huang, 2007) and generally it seems that readers prefer to read longer documents, and those that need annotation, on paper (Liu & Huang, 2007) and shorter material online (Shaikh & Chaparro, 2004).

However, reading on the Internet may well have changed readers' behaviour by increasing browsing and scanning, increasing on-time reading (Liu, 2005). People tend not to read online in the traditional sense but rather to skim read, hop from one source to another, and "power browse", thereby exhibiting new forms of reading patterns (University College London, 2008). Many readers scan through search engine generated lists of information in a ruthless and impatient manner (Burke, 2000). Reading online can thus detract from the ability to read deeply, or from prolonged engagement with reading (Liu, 2005; Birkerts, 1994). Some, such as Carr (2008), perceive that it has detrimental effects on cognition, has decreased the ability to concentrate and contemplate, and has altered our reading patterns and memory. In fact, Wolf (2007) believes that the 'reading brain' is endangered. Wolf's notion of the "reading brain" draws on the actual physiological reading mechanism whereby the brain forms new circuits with existing structures in the brain every time something new is learnt.

Studies into online reading, such as that of Liu (2005) are limited in terms of the age group (30-45) sampled and the US context. Coiro and Dobler (2007) focused on school children. Although D'Haens and Jankowski (2004) found no difference in recall between reading online and offline, digital media do differ from offline media, and authors such as Coiro and Dobler (2007) and Carr (2008) have called for greater attention to how readers actually engage with different media, their reasons for choosing one format over another, and their satisfaction with each format in terms of concentration, comprehension and recall.

Two theoretical approaches have informed our research. The theoretical perspective of "new literacies" purports that the nature of literacy is changing rapidly (Lankshear & Knobel, 2003). New skills in comprehension and reading strategies are required (Leu et al., 2004). Although traditional reading skills are necessary as a point of departure, new skills are required for Internet reading. Because of the different presentation of material on the Internet, such as hyperlinks and interactive diagrams, the reader needs to acquire cognitive flexibility in order to transition the difference between offline and online reading (Spiro, 2004).

The Staged Model of Information Processing (Atkinson & Shrifin, 1968) presents a clear explanation for possible low content absorption and recall levels of online readers. The model explains how information gets processed and stored in the human memory. Learning and memory are viewed as discontinuous and multi-staged. The information is processed and stored in three stages: sensory, short term and long term memory. The sensory memory is formed when an initial stimulus is "translated" by the brain into something comprehensible. The process takes only a few seconds. If incomprehensible, the stimulus is usually discarded but if processed, the information moves to the short term, or working, memory. Initially of only a few seconds' duration, the information is rehearsed until, after about ten minutes, it is transferred to the long term memory. There are two major aspects of retaining information in

the short term memory: organization and repetition. If the information is not properly coded and organized, rehearsed or repeated, it gets forgotten. Otherwise it will pass into the long term memory. The long term memory has an unlimited capacity and holds information indefinitely (Huitt, 2003).

There are many techniques to improve information retention. “Chunking” of information is particularly important in transferring information to the long term memory (Huitt, 2003). Most online materials are designed to be read in small chunks to assist the memory processes. However, when readers skim read they tend to skip some of the words, and therefore the content that gets absorbed to the short term memory is not complete. Furthermore, skim reading and speed reading can lead to a surfeit of stimuli so that often vital information is discarded (Miller, 1956).

While some researchers have identified powerful advantages of reading digital media, others have criticised the effect of the Internet on human cognition and reading capabilities. However, only a few studies have examined the fundamental issue of the Internet’s impact on broader reading behaviour, and studies such as that of Liu (2005), Coiro and Dobler (2007) and Siegenthaler et al. (2011) are limited in terms of the age group or technical aspect studied. Very few, if any, studies have explored the perceived differences between online and offline reading of adults. This study sought to address that gap and gain a greater understanding of the perceived effect on their memory and, by implication, on their learning.

### **3 Methodology**

The study was exploratory and built on the findings of four focus group interviews. An interpretive research paradigm was adopted, and an online survey with open-ended questions was used to complement the findings of the focus groups. This technique was employed to gain additional insights into the topic (Pickard, 2007).

For the purpose of this study, online material included material that people accessed via the Internet and read whilst connected. Offline material included paper-based material or that which had been downloaded from the Internet but was being read electronically without being connected to the Internet, e.g. with e-readers.

A snowball sampling procedure was employed. The sample consisted of participants who were over 18 years of age and who used the Internet and online materials frequently (read online for an average of >16hrs per week). The survey invitation was initially distributed via e-mail to acquaintances of the researchers and via the social medium, Facebook. The survey was active for 14 days. Out of 500 survey invitations, 281 responses were received. Among the 281 that were received, 79 had incomplete data, so only 202 were included in the analysis.

Respondents hailed from a variety of countries and possessed various levels of education and industry background. The majority (31%) of respondents were between 30-39 years of age, with the rest being evenly dispersed across other ages groups, the highest being 50+. Females made up 65% of respondents.

The rest of the data were analysed according to themes and sub-themes that were guided by the research questions (Pickard, 2007).

## 4 Findings

By way of introduction, respondents were initially asked why they read. The question allowed for multiple answers, and for respondents to indicate which medium they preferred for each reason. In general, information seeking, commitments whether for work or study, and pleasure were the top three reasons identified. Reading for information or commitments was predominantly online but for pleasure, paper/offline was preferred. The reasons for reading fell into two groups: those pertaining to the individuals' dispositions and those pertaining to attributes of the medium. More common choices for the former group were for inspiration, lifestyle choice, relaxation, escapism, to have personal space, as a personal reward, and to change mood. Attributes of the mediums included accessibility, availability, time saving and extent of choice, and were more relevant for information seeking and meeting commitments.

### 4.1 Reading Practice

In comparing reading behaviours offline and online, on average most reading time was spent reading books offline (7.23 hrs/wk), with respondents using a mixture of paper-based and e-reader material. The second largest amount of time was spent on reading web pages (6.17 hrs/wk), and then online business documents (4.34 hrs/wk). Generally, most offline reading was done at home whereas most online reading was done at work. Most reading, irrespective of medium, was done in the morning – probably because of work pressures - although a lot of reading on paper was done before bedtime.

Offline, by far most reading was straight through from beginning to end (82% of respondents), whereas by far the most frequent online reading pattern was to scan for interest (87% of respondents). Skim reading was also very popular with online readers (59% of respondents), but less so for offline readers (41% of respondents). Most respondents (72%) printed out the materials they wanted “to read”.

### 4.2 Online Reading Compared With Reading Offline

Given that the most commonly cited online reading behaviour was skim reading, many respondents indicated that they read online primarily for work and to seek information. Therefore, they wanted to get through a lot of content and get to the point within the shortest time possible. Scanning the content was also repeatedly recorded as an online reading behaviour. Some respondents indicated that they felt impatient while reading online. Others indicated that they tended to be browse online rather than getting involved with the content.

The majority of respondents commented that they read much more quickly online and that their speed reading had improved over time. Some implied that this was due to the large amount of information that was available and could be accessed in electronic format. A few respondents indicated that they were more ‘selective’ when reading online.

Cross referencing occurred a lot when reading online materials. The availability of hyperlinks on some online content encouraged this behaviour. However, the questionable integrity of online content had also been a reason for people to cross reference information. The cross referencing and consequent jumping between pages seemed to have affected the linear reading pattern of many respondents who reported that online reading was more fragmented. Several read in small chunks and did not read long articles online, preferring to print articles

that caught their interest. Using the Search/Find feature of various applications was also reported as a common behaviour while reading online. Many respondents tended to multitask when reading online (i.e. read e-mails, check news, listen to music), and got distracted as a consequence.

In terms of reading offline, the respondents reported that they read more slowly and in greater detail than online. They were also inclined to read every word in a linear fashion. A few respondents highlighted and annotated content when reading on paper. These reading behaviours seemed to contribute to better information retention levels, a phrase that was used repeatedly.

### **4.3 Changes To Reading Behaviour**

One of the research objectives was to identify changes to reading behaviour and to determine the impact of the online environment on people's reading. The most common comment was that respondents read more due to the exponential growth of online materials. The majority of respondents (66%) had increased the amount of their reading due to the availability of online materials. The speed of their reading and their ability to skim read had also improved.

Some respondents noted changes in their patience as readers, and a number acknowledged that they read much more quickly to get through large amounts of content, especially work related material. This indirect pressure might have contributed to the change in patience in readers, which was noted as a negative consequence by some.

Figure 1 presents a comparative consolidated view of the effect of the two reading environments. Respondents reported much higher levels of comprehension, concentration, content absorption, content recall, and relaxation while reading paper materials as opposed to reading online.

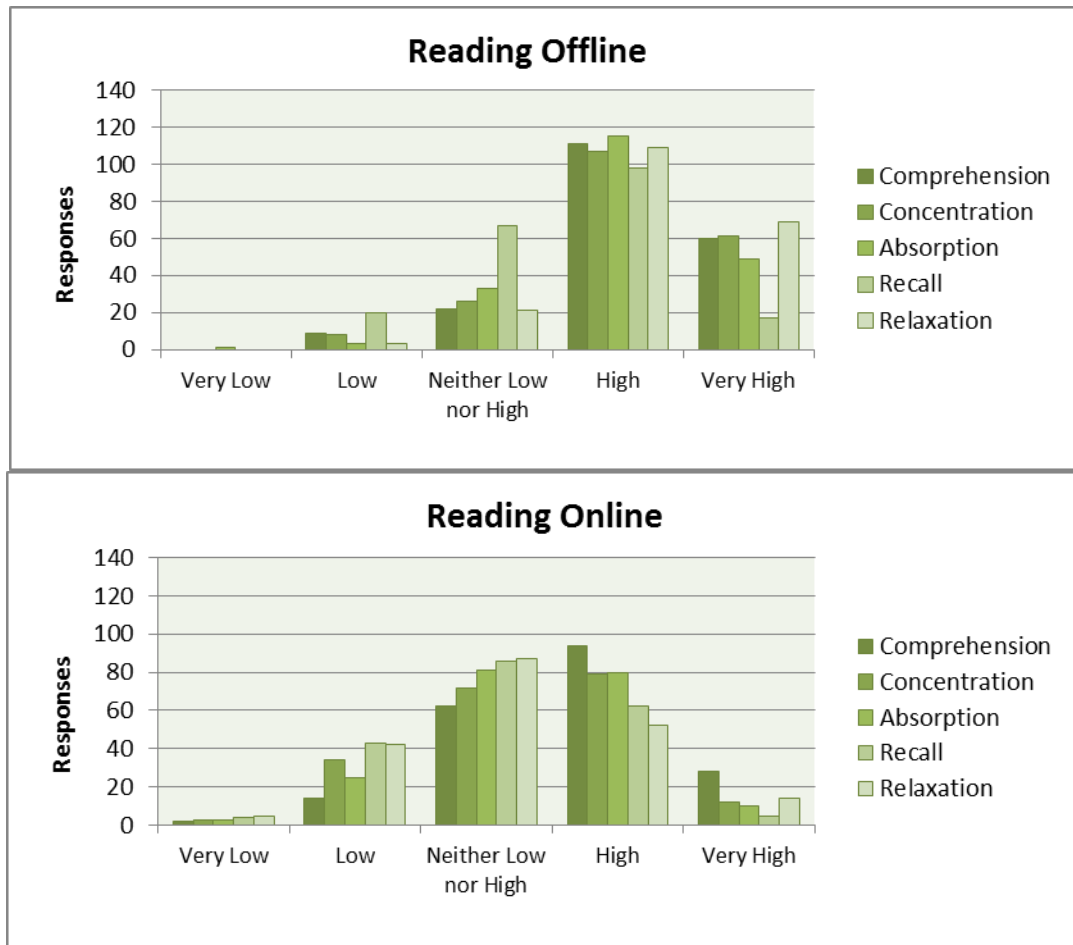


Figure 1: Impact of reading offline compared to reading online

Short attention span emerged frequently in respondents' comments. Many admitted to low levels of concentration and shifting focus, thereby missing out on many words during reading. This could lead to missing crucial information in important documents such as work related documents. A few respondents described this as 'less engrossed' and 'less careful' reading behaviour.

As a result of low concentration levels, some respondents noted that they did not seem to absorb content as they used to. A few argued that this change was due to the vast amount of information they dealt with daily. The lack of concentration and the fragmented nature of online reading thus had a negative impact on some readers. In particular, their ability to recall information they had read was severely decreased. Reading a book generally requires discipline to focus on the material. The continuous skimming and fragmented nature of online reading affected the discipline of reading. However, some respondents indicated signs of adaptation to the new medium – becoming more accustomed to the online medium which they preferred over traditional paper materials.

Nevertheless, most respondents indicated that they did not enjoy reading online as much as on paper. Only 10% preferred the online medium, while the remaining 44% had no preference.

One respondent concluded that he/she had started appreciating reading on paper as opposed to reading on screen.

Overall, the survey data provided a comprehensive comparative overview of people's reading behaviour in the online and offline environments.

## **5 Discussion**

The findings indicated that various benefits provided by the online environment were unquestionable. Aspects noted largely reflected the literature such as: much more information being available and accessible (Liu, 2005). Such demands resulted in an increase in reading speed, and more selective and more discerning reading (Flavian & Gurrea, 2007). However, the demands also resulted in skim reading, scanning, browsing, and hopping hither and thither between different sites and even on the same site. The consequence was shorter attention span, shifting focus, low levels of concentration, and overlooking important words or text. This accorded with the views of Zhang (2006, p.71). As Miall and Dobson (2006) had found, less careful reading and reduced absorption in the content resulted, as well as lower recall of content increased impatience, as well as eyestrain, which reflected the findings and views of Liu (2005) and Carr (2008).

The internal requirements refer to the subjective desires of the individual without any obligation other than to satisfy their own personal needs. These motivations were reflected in statements referring to relaxation, and rewarding oneself, personal space and escapism.

The distinction between the two types of reading motivation seemed to be linked to the time of day when the reading occurred. Most reading for relaxation was done before bedtime. Coupled with the fact that most reading for relaxation was done offline, there is a consequent connection with reading on paper/offline appearing to be more personal than reading online. Such a concept has much deeper roots in the reading history of the individuals sampled. The traditional concept of a parent reading a bedtime story to their child conjures up images of love, caring, bonding, mutual involvement, pleasure, peace, dreamland.

Furthermore, the reference to printing out material that was intended for "reading" implied both aspects of interaction and ownership. People liked to be able to annotate documents, in other words personalizing them, co-creating the memorable content, and placing one's stamp of ownership on the documents (O'Hara & Sellen, 1997). Akin to the notion of co-creation, typically the online environment provides many more illustrations and animations, whereas offline reading material is often less so, allowing the reader to imagine much more. This form of co-creation between the author's words and the reader's images facilitate the memory of such material.

While there was acknowledgement of the benefits of online reading among, the respondents in this study seemed to harbour a definite preference for paper-based/offline reading, identifying many of the benefits to their attention span, concentration, comprehension, and recall abilities.

The findings provide strong support for the Staged Model of Information Processing (Atkinson & Shrifin, 1968). Clearly the respondents perceived their online reading load as being too large to allow for the deep reading experienced offline. However, it might also have



been due to a lack of techniques to deal with this relatively new information environment, an environment which the majority of them entered with their traditional offline reading techniques. They thus skim read online, scanned, hopped from place to place and, in general, noticed a reduction in their attention span. This reflects the sensory stage of the model and seems to indicate that less information is being passed through to the short term memory - or that what is passed through, has been carefully selected. However, when the information passes through to the short term memory, the abundance of information and the time pressures to process information quickly seem to result in reduced concentration, and a reduction in the capacity for the absorption of that information into the long term memory. This might possibly be for the reasons noted above. Needless to say, optimal organization and rehearsal of the information does not take place in the short term memory before it is passed through to the long term memory. Even when it is passed to the long term memory, if neither the organization nor the repetition has been optimal, then low levels of recall result.

However, the findings reflect the experiences of those who had been trained in the traditional models of reading and learning. As Wolf (2010) noted, reading is not a genetically inherited ability. It has to be learnt. More recently researchers have found that online reading involves different reading mechanisms to traditional offline reading. It has been noted that users picture online documents as networks of nodes and links (McEneaney, 2006), which means that readers define text structure by choosing links, which are based on their internal knowledge structure rather than on an author-defined text structure (McEneaney, 2003, 2006). However, the majority of the respondents would have learnt to read in the traditional, linear manner. There were, nevertheless, those who appeared to have mastered online reading techniques and preferred reading on the Internet in comparison with reading offline. As Coiro and Dobler (2007) and Spiro (2004) indicated, they had mastered the flexibility required to transition from traditional offline reading strategies to different online reading strategies. Notwithstanding, most adults learnt to read in the traditional linear manner. They can be regarded as a transition group who will need to acquire different reading skills for the online environment in order to avoid a possible negative impact on their reading and relevant cognitive skills.

## 6 Conclusion

This study addressed an under-researched area: the impact of the Internet on our reading behaviour. It explored the online and offline reading behaviour of individuals, determined the underlying patterns, examined the differences between online and offline reading, and assessed the impacts of the online environment on individuals' reading behaviour.

The findings indicated that there were substantial differences between people's online and offline reading behaviours with more online reading being done during the day – often at work – while offline reading was usually done more in the evening and at home. The underlying motivations were particularly important, with external motivations driving online reading more and internal motivations driving offline reading more. Definite differences between on-and offline reading behaviour emerged – often prompted by the underlying motivation. In general, online reading has had a negative impact on people's cognition. Concentration, comprehension, absorption and recall rates were all much lower online than offline. That is not to say that certain benefits of online reading were not experienced.

This research has benefitted academics in that it has applied the Staged Model of Information Processing to the online environment and found that, without adaptation to readers' paper-based learning styles, the progress through the various learning stages will be impeded, with a negative effect on attention, concentration, comprehension, and recall. As a result, educators, compilers of online material and suppliers of relevant technology would benefit from an awareness of this impact and devise methods of addressing the potential negative impact of online reading and facilitate the benefits that can be derived from reading online. Individuals, too, will benefit from an awareness of the possible effect on the reading, concentration, information absorption and recall, and be more conscious of the need to endeavour to overcome any negative impact of online reading, and acquire the necessary online reading skills.

In addition, given that most of the respondents in this research were nouveau digital natives, further research should explore the reading behaviours of the younger generation who were raised in the digital age. Their online reading behaviour might well provide pointers of how to overcome the negative influences of the online environment on our reading. Alternatively, it might indicate a need to address the reading habits of this generation as well. There is scope for future research to confirm the findings of this exploratory survey. However, there is also opportunity to explore other aspects of this research such as the motivational aspects of our reading, and the psychological influences of other desires such as those of ownership of content.

## **References**

- Atkinson, R. & Shiffrin, R. (1968). Human memory: A proposed system and its control processes. In K. Spence and J. Spence (Eds.). *The psychology of learning and motivation: Advances in research and theory* (2). New York: Academic Press.
- Birkerts, S. (1994). *The Gutenberg Elegies: The Fate of Reading in an Electronic Age*. Boston, MA: Faber and Faber.
- Burke, J. (2000). Caught in the Web: Reading the Internet. *Voices from the Middle*. 7(3), 15-23.
- Carr, N. (2008). Is Google Making Us Stupid? *The Atlantic Monthly*. 302(1), 56-63.
- Cheong, J. & Park, M. (2005). Mobile internet acceptance in Korea. *Internet Research*. 15(2), 125-140.
- Coiro, J. & Dobler, E. (2007). Exploring the online reading comprehension strategies used by sixth-grade skilled readers to search for and locate information on the Internet. *Reading Research Quarterly*. 42(2).
- D'Haenens, L., Jankowski, N. & Heuvelman, A. (2004). News in online and print newspapers: differences in reader consumption and recall. *News Media & Society*. 16(3), 363-382.
- Fidler, M. (2004). Reading and Studying Culture with Electronic Materials. *Canadian Slavonic Papers*. 46(1/2), 83-99.
- Flavian, C. & Gurrea, R. (2006). Reading newspapers on the Internet: the influence of web sites' attributes. *Internet Research*. 18(1), 26-45.

- Hsieh, P.H. & Dwyer, F. (2009). The Instructional Effect of Online Reading Strategies and Learning Styles on Student Academic Achievement. *Educational Technology & Society*. 12(2), 36–50.
- Huitt, W. (2003). The information processing approach to cognition: Educational psychology. Interactive valdostaga. Retrieved 2 December 2012, from <http://www.edpsycinteractive.org/topics/cogsys/infoproc.html>
- Internet World Stats. (2012). The Internet Big Picture: World Internet Users and Population Stats. Retrieved 22 December 2012 from <http://www.internetworldstats.com>
- Lankshear, C. & Knobel, M. (2003). New technologies in early childhood literacy research: A review of research. *Journal of Early Childhood Literacy*. 3(1), 59-82.
- Leu, D. J., Kinzer, C. K., Coiro, J. L. & Cammack, D. W. (2004). Toward a theory of new literacies emerging from the Internet and other information and communication technologies. *Theoretical Models and Processes of Reading*. 5(1), 1570-1613.
- Leu, D. & Zawilinski, L. (2007). The New Literacies of Online Reading Comprehension. *New England Reading Association Journal*. 43(1), 1-7.
- Liu, Z. (2005). Reading behaviour in the digital environment: Changes in reading behaviour over the past ten years. *Journal of Documentation*. 61(6), 700-712.
- Liu, Z., & Huang, X. (2007). Gender differences in the online reading environment. *Journal of Documentation*. 64(4), 616-626.
- McEneaney, J. E. (2003). A Transactional Theory of Hypertext Structure. In 52nd Yearbook of the National Reading Conference (pp. 272-284). Oak Creek, W.I.: National Reading Conference.
- McEneaney, J. E. (2006). Agent-Based Literacy Theory. *Reading Research Quarterly*. 41(3), 352-371.
- McNabb, M. L., Hassel, B. & Steiner, L. (2002). Literacy learning on the Net: An exploratory study. *Reading Online*. 5(10). Accessed 3 February 2014 from [http://www.readingonline.org/articles/art\\_index.asp?HREF=mcnabb/index.html](http://www.readingonline.org/articles/art_index.asp?HREF=mcnabb/index.html)
- McPherson, K. (2005). Reading the Internet. *Teacher Librarian*. 32(5), 60-61.
- Miall, D. S. & Dobson, T. (2006). Reading hypertext and the experience of literature. *Journal of Digital Information*. 2(1).
- Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for information processing. *Psychological Review*. 63, 81-97.
- Moje, E.B. & Pugh, K. (2009). R U Reading Online? *Time for Kids*. 14(24), 6.
- O'Hara, K. & Sellen, A. (1997). A comparison of reading paper and online documents. In *Proceedings of CHI'97 Conference, Atlanta, GA.*, 335-342.
- Pickard, A.J. (2007). *Research methods in Information*. London, UK: Facet.
- Reinking, D. 1992. Differences between electronic and printed texts: An agenda for research. *Journal of Educational Multimedia and Hypermedia*. 1(1), 11-24.
- Rosenblatt, L. (1994). *The Reader, the Text, the Poem*. Carbondale: Southern Illinois University Press.
- Shaikh, A. D. (2004). Paper or Pixels: What are People Reading Online? *Usability News*. 6(2).
- Shaikh, A.D. & Chaparro, B.S. (2004). A survey of online reading habits of Internet users. In *Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting*, 875-879.
- Siegenthaler, E., Wurtz., Bergamin, P. & Groner, R. (2011). Comparing reading processes on e-ink displays and print. *Displays*. 32, 268-273.

- Spiro, R. J. (2004). Principled pluralism for adaptive flexibility in teaching and learning to read. *Theoretical models and processes of reading*, 654-659.
- University College of London. (2008). Information behaviour of the researcher of the future. Retrieved 10 December 10 2012 from <http://www.bl.uk/news/pdf/googlegen.pdf>
- Wolf, M. (2007). *Proust and the squid: the story and science of the reading brain*. New York, US: Harper Books.
- Wolf, M. (2010). Our “deep reading” brain: Its digital evolution poses questions. *Nieman Reports*. Summer, 7-8.
- Zhang, P. (2006). *Popup Animations: Impacts and Implications for Web Site Design and Online Advertising*. Retrieved 22 November 2012 from [http://melody.syr.edu/pzhang/publications/AMIS\\_HCI\\_06\\_Zhang\\_Animation.pdf](http://melody.syr.edu/pzhang/publications/AMIS_HCI_06_Zhang_Animation.pdf)