Education and Technology

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Abstract[2]

The aim of this paper is to explore what we know about the difficulties from comprehension of digital texts in comparison with traditional texts with a particular focus on new readers. The question we want to investigate is whether the reading of an electronic text is more (or less) difficult than that of a paper text. In the first part of the paper, the object of the study is presented; in the second part research studies in the field are examined through an analysis of the evidence-based literature; in the third and final part, we try to draw some conclusions from data.

Do we read more or read less in the time of digital media? Does reading on the screen change the way we understand meanings? And does the way we write change? These are some of the questions that parents and teachers ask themselves to understand what are the correct spaces and times to leave for devices at home, at school, in free time. Research suggests that the question of time is crucial. Maryanne Wolf, a neuroscientist who has been studying the brain that reads for years, noted that reading on the screen ends up inhibiting deep reading in the long run. We run away, looking for some articulations of the text that allow us to synthetically grasp its meaning without taking the time to weigh every single part: the risk is that the ability to understand exactly the meaning of what is being read is compromised.

Fast thoughts and slow thoughts should both belong to our cognitive economy: the former are useful in some cases, the latter in others. In fact, however, the speed at which we are progressively more and more required in everyday life, at home as well as in organizations, can mean that we tend to resort more and more frequently, especially to quick thoughts.

The real problem, therefore, is not digital, but speed. We need to find a way to slow down because only by slowing down is it possible to activate our slow thoughts.

***Keywords:** Digital Reading; Traditional Reading; Cognitive Processes; Evidence Based Research; Deep Reading.*

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1. Introduction

Between the end of the eighties and the early nineties, the so-called new technologies such as multimedia, telematic networks, hypertexts spread, and for the first time we started talking about "electronic books". It is in these years that we have witnessed a series of phenomena that contribute to creating the conditions for the future diffusion of digital reading: the development of personal information technology, the birth of initiatives for the digitization of texts such as the "Gutenberg Project" (http : //www.gutenberg.org/), the gradual process of miniaturization and portability of devices, the consequent reading in mobility of digital texts.

From the nineties to today, the development of new devices, new textualities, new media and new formats has led to a profound transformation of the reading experience. Re-write sentence to: In this context, characterized by the growing diffusion of online reading on the screen, researchers are called upon to evaluate the strengths and weaknesses of the novel devices, and the risks of the so-called digital reading.

The problems relating to digital reading and their implications on cognitive processes are, as is well known, the subject of lively debate.

Maryanne Wolf (2007), director of the Center for Reading and Languages Research, addressed the issue of changes in reading, wondering whether when apparently complete visual information is provided simultaneously, as in many digital presentations, whoever obtains it has the sufficient time and motivation to process them in an inferential, analytical and critical way. Negative effects on the process defined as deep reading are feared, namely "the variety of sophisticated processes that promote understanding and that includes inferential and deductive reasoning, analogue skills, critical analysis, reflection, and intuition" (M. Wolf, & M. Barzillai, 2009).

Of the same opinion is the journalist Nicholas Carr who in 2008, in a provocative article in "The Atlantic" entitled "Is Google Making Us Stupid?" (N. Carr) and in 2010 in the book "The Shallows: What the Internet Is Doing to Our Brains"(N. Carr 2010), he argued how fragmentation and the immense availability of information affects the ability to concentrate, and threatens the activity of interpretation and understanding of texts online .

PISA (Program for International Student Assessment) brought the issue to the forefront with the survey which, for the first time, assessed the abilities of 15-year-old students to read, understand and use texts in digital format (http://www.ecdl.org/media/PISA_2009_Results.pdf. Pub. 2011). The data showed that only 8% of students in the 16 participating countries achieve the highest level of digital reading performance, while in almost all countries a significant number of students still show skills below the minimum levels.

It happens more and more often to see schools abroad, but also on the national territory, about to make the leap and abandon the paper text for the adoption of electronic textbooks.

European Schoolnet conducted a study on the use of tablet devices in 2012 to understand how they are used by teachers to improve student learning. 263 teachers in 63 schools in eight European countries (Estonia, France, Germany, Italy, Portugal, United Kingdom, Spain and Turkey) were equipped with tablet computers (http://files.eun.org/netbooks/TabletPilot_Evaluation_Report.pdf).
But what do we know about the way a reader, particularly if still inexperienced, reads an electronic book? Does digital text make understanding more difficult and require new skills than printed text?

Here the interest is turned to the pedagogical and formative implications of digital reading, to the reflections on teaching at a time when the debate seems

to be characterized mostly by issues that have very little to do with educational motivations but where practical aspects prevail, commercial and copyright issues, owned by the technologies involved (formats, usability, accessibility), performance of the various devices, fascination factors such as mobile (A. Calvani, 2013).

Evidence-Based Education (EBE) in recent years has, in fact, shown many "mythologies" related to the use of ICT in learning (A. Calvani, 2007) which would seem to question the effectiveness of technologies.

2. Research Methodology and Data Analysis

The aim of this work is to assess whether, and to what extent, the reading of a digital text, especially in non-expert readers, makes comprehension more difficult and requires new skills than that of a traditional text. Once the research question was formulated, the work involved an analysis of the literature, with particular attention to research with an evidence-based orientation. These studies /research and experiments deemed most significant from the point of view of the typology, the methodology used, the size of the analyzed sample. After a survey of the most important Italian texts dedicated to the topic, it was decided to investigate the international sphere.

In order to draw a preliminary picture of the state of the art through the most recent scientific texts, we proceeded with a search through Google Scholar. The search queries were defined: the most used for simple searches was "digital reading", while for advanced searches queries such as "digital reading effectiveness", "digital reading systematic review", "digital reading meta- analysis "but also expressions of a similar area such as" digital text reading "," screen reading "," paper vs screen reading "," electronic book reading "," electronic book effectiveness ".

The collected material highlighted a series of recurring elements in terms of themes and cognitive processes investigated, and it emerged - as Marian Wolf says "The process of learning to read changes our brain, but so does what we read, how we read and on what we read (print, e-reader, phone, laptop)." This is especially important in our new reality, when many people are tethered to multiple screens at any given moment. With much of the world working from home, and millions of students learning at home, developing a biliterate brain – one adapted to both digital and traditional print literacy which has never been more important.

The poet TS Eliot presciently asked: "Where is the knowledge in our information? Where is the wisdom in our knowledge?" Neuroscientists and educators ask similar questions: will different mediums advantage or disadvantage our abilities to acquire information, distinguish what is true, immerse ourselves in the perspectives of others and turn information into knowledge, the precursor of wisdom? The emerging answers will have profound implications for shaping children's intellectual, social-emotional and ethical development and preserving ours.

We are still in the early stages of understanding the impact of digital-based learning on the development of children's reading brains, as well as on the maintenance of reading brains in adults. Transforming new information into consolidated knowledge in the brain's circuitry requires multiple connections to abstract reasoning skills, each of which requires the kind of time and attention often absent in digital reading.

3. Attention, Cognitive Load and Hypertextuality

An important factor to take into consideration when analyzing new behaviors and new reading habits is the transition that, in recent years, has taken from a world with little information to a world with overabundant information. Following the multiplication of devices, the exponential growth of information content, and the

time spent reading digital documents, the discriminating element is no longer information but the management of attention, which is an increasingly limited resource to be administered. That of today's readers is most likely a natural, strategic, adaptive response to the information flood (P. Lévy, Cyberculture, Paris: Odile Jacob. Pub. 1997) of the web; however, many researches have suggested that the constant shift of attention from one medium to another, a phenomenon labeled as "continuous partial attention" (J. Gee, 2003), can increase the cognitive load and therefore interfere in understanding the text (P. Tran, R. Carrillo & K. Subrahmanyam, 2013). The cognitive cost of multitasking, in terms of attention dispersion, has been highlighted in a series of studies (L.L. Bowman, L.E. Levine, B.M. Waite & M. Gendron, 2010).

Some theories such as the Cognitive Load Theory (J. Sweller, 1988) have shown, reporting a large amount of experimental evidence, how hypertextual and multimedia reading is usually less effective than the traditional one and how, especially in non-expert readers, it produces cognitive overload. From some research, it would emerge that during hypertextual reading the reader is highly vulnerable to being captured by other types of stimuli.These stimuli have the opportunity to click our attention is immediately divided between the text we are reading and what we can read, and when we can easily shift our attention to new external stimuli. We are psychologically and biologically inclined to do so, because this requires less mental energy than trying to resist distractions and keep reading (A. Mangen, 2008). The format of the reading material has profound repercussions on the activated reading strategy, comprehension, analysis and evaluation of a text. The contrast of pixels, the arrangement of words, the concept of scrolling with respect to turning a page, physicality of a book against the ephemeral of a screen, the ability to hyperlink and move online from one source to another in seconds makes all these variables translate into a different reading experience.

4. The experience of deep reading according to Maryanne Wolf

Maryanne Wolf invites us to reflect on the dangers that total immersion in the digital ecosystem entails for our cognitive processes. Empathy, imagination and critical thinking are at risk, or those dimensions that define and characterize the so-called "profound reading". Wolf's concerns are not very different from those expressed by scores of European researchers in the recent Stavanger Declaration.

The first postulate of Maryanne Wolf's theory refers to the fact that reading is not a natural attitude or an innate process, but a cultural invention. To read, we make our brains work in a different way than it was genetically programmed to do. "We were not born to read," Wolf emphasized in "Proust and the squid- History and science of the brain that reads". Stanislas Dehaene has agreed as well the brain works in a unique way and not programmed to read accordingly. (S. Dehaene, 2009)

The second postulate is that of "plasticity within limits". It is true that the brain is able to go beyond its original functions, building new connections and new paths, and therefore recycling aspects of its basic structures (Dehaene speaks of neuronal recycling). However, such plasticity cannot exceed certain limits. The brain is not a clean slate, able to receive every stimulus and adapt to do anything. It adapts within the limits of its biology.

Therefore, what sense do we speak of a bi-literate brain? If the brain circuit of reading is malleable, that is, influenced by what we read, how we read and the way we are educated to read, then education itself becomes one of the fundamental factors for modifying the behavior of the brain that reads. Wolf emphasizes the goal is to create readers capable of transitioning flexibly from one code to another (from analog to digital, and vice versa), making the most of both. This "should prevent the atrophy found in adults when digital reading processes spill over into the reading of printed texts, eclipsing the slower processes of reading on paper" (M. Wolf, 2018). The conditional is mandatory, since Wolf herself speaks of an "unproven

hypothesis". Wolf basically proposes to introduce different forms of reading, based on printed texts and digital texts, in the period between five and ten years of age. Before age five, children should be kept away from digital tools as much as possible. At the beginning the role of printed books must prevail, in order to strengthen the peculiar spatial and temporal dimensions of reading:

We want children to learn that reading takes time and comprehension of the story reading is vital. Thus, the five to ten year period requires instilling in children the concept that they must take their time reading and then this will allow children to develop their own ideas.

The question of time is central in the digital ecosystem. The brain tends to suffer from information overload and it has been estimated that on average an adult American has to process 34 GB of information every day, equal to about 100,000 words (R. Bohn & J. Short, 2012).

We tend to respond to this overload in three ways: we simplify; we process information in a faster time, reading "in bursts"; we follow priorities. The experience of deep reading is sacrificed in favor of behaviors more suited to this need for time management, thus there is skimming (superficial reading), skipping (skipping parts of text) and browsing (fast scrolling).

Also, no less important is the relationship of writing the physical dimension which written by hand allows one to explore reasoning without haste. Writing by hand allows one to not skip, not by pass the main experiences needed to understand the concept.

Finally, there is the theme of programming education. Code writing (so-called coding) should be a new form of literacy, accessible to all. While children learn to read and think with the most suitable medium, namely printed paper, they must come into contact with different tools, which are introduced to learn digital creative

skills: graphic art and software programming. Programming helps one organize thoughts, just like writing and reading.

5. Conclusions

Up to ten years of age, paper and digital must have equal space in the educational context, thus neither means must prevail over the other. After the tenth year, the child should have learned a lot, thanks to the use of different tools, each with a specific role. Over the years of educational experience, students will be ready for texts and digital screens to meed the needs of todays communication tools.

Our ultimate goal is to develop a truly bi-literate brain, capable of allocating time and attention to deep reading skills regardless of the medium used. These not only provide effective antidotes to the negative effects of digital culture such as the dispersion of attention and the wearing out of empathy, but also positively complement digital influences.

Wolf summarizes her project in: going from tldl (too long to read) to following: listen, remember, connect, infer, analyze / then JUMP!. We do not know if the educational model proposed by the American scholar is sufficient to contain the drifts of reading in the digital ecosystem. It is certain that the loss of the ability to carry out a profound reading of complex texts would constitute a very serious cultural evolution.

Difficult readings, we know, pose a threefold challenge: 1) they require dedicating time and attention to decode the various layers of meaning of the text; 2) require you to carry out a complex analysis; 3) presuppose the ability to perceive the beauty behind the precision and refinement of writing. Wolf suggests that perhaps there is a way to learn how to overcome these three challenges, regaining time, concentration and a taste for beauty.

In this work we asked ourselves whether reading a digital text makes comprehension more difficult, and requires new skills compared to that of a printed text. From the literature found and from the knowledge that appear to be more reliable at the moment, both opportunities for innovation emerge, as well as many risk factors, impoverishment and lowering of cognitive levels, which push us to be more cautious towards the introduction into the school, often "casual" and regardless of the neurological, cognitive and cultural correlates that sequential reading on paper brings with it, books in digital format. The problem is therefore still open, the changes in technology themselves are likely to lead to its reconfiguration and further investigations will be required.

6. Acknowledgements

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