

THE IMPACT OF DIGITAL AND PRINT READING ON COGNITION

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Abstract: *This article written as part of the project "The Digitization of the Initial Training Process for Teaching Staff to Ensure an Efficient Educational Approach, in Line with the Demands of the Labor Market" analyzes digital and print reading from three complementary perspectives: epistemological, phenomenological, and ethical. From an epistemological standpoint, digital environments provide rapid access to vast amounts of information, but they also contribute to cognitive overload making it necessary for readers to apply filtering and evaluation strategies. From a phenomenological perspective, digital reading is characterized by fragmented attention and nonlinear navigation, whereas print reading supports a more embodied and tactile experience that enhances reflection, memory retention, and deep understanding. Ethically, digital reading shifts responsibility to the individual, as the circulation of information within networked environments shapes collective behaviors and identities in the contemporary Infosphere.*

Additionally, the article presents findings from an experimental study involving university students that compared comprehension and recall in digital and print reading conditions. The results suggest that print-based reading is associated with improved concentration, stronger memory performance, and deeper analytical processing, while digital reading tends to promote faster interaction, multitasking, and more superficial engagement with texts.

Key-words: *digital reading, online reading, electronic reading, print reading, screen reading, e-reader.*

A Philosophical Inquiry into Digital and Print Reading

Reading today is not just about books. It is about screens, which change the way people speak, think, argue, feel, and behave (Baron, 2015: 4). The process of reading can be interpreted in three ways: 1. from the point of view of epistemology i.e. how it gives us knowledge; 2. from the point of view of phenomenology i.e. how we experience it;

Epistemology helps us to understand the process of reading through building awareness. The abundance of information from digital media changes the way people think and behave (Hayles, 2012: 4). Digital content generates an excessive amount of data that burdens the brain; as a result, people must learn to process information in a different way –

identifying and selecting the most appropriate knowledge for their daily use. This skill can be strengthened through digital reading (Floridi, 2012). Digital reading changes the focus and the ability to filter and decode relevant information.

Phenomenology is about the experience of reading in digital or sensory action. In the process of digital reading the words from the screen circulate not only in the brain but also in the body (Merleau-Ponty, 2012). eReading is scrolling through the text on the screen, which gives a different feeling of control and power, in turn, this authoritative processing shapes the construction of meaning (Baron, 2015: 6).

In print reading, the senses of touch and smell are engaged (when holding and turning over the paper pages), which increase focus and attention. From the cognitive perspective, the reader processes the text and images independently, connects ideas bridging relationships to get the author's message. Emotionally, the book reader develops empathy, imagination, and personal reflection.

Ethics is about moral responsibility in digital and print reading. In the digital world, reading is about how information influences the morality of people and society. Morality, nowadays, is a "distributed" responsibility of what every individual reads and spreads in networks (Floridi, 2013). This means that digital readers today must engage as critical thinkers evaluating the digital text, the origin, the authenticity of the text, and the power of digital message. Moral behavior of the digital reader is influenced by the cultural norms and the agreement made between the machine and the human being. This moral agreement depends strictly on the rules and ethical principles programmed into AI and how the person applies the information responsibly (Rahwan et al, 2014).

Print reading is a formative practice as the printed pages create space for solitude and introspection developing a private inner identity and continuity between the text and the reader; while electronic reading promotes fragmented identities focusing on responses to external stimuli (Birkerts, 1994). Print reading cultivates linear, sustained and reflective thinking; in turn, digital reading or electronic reading develops discontinuity, speed, and surface-level engagement, which can lead to a decline in memory, imagination, and individual depth (Birkerts, 1994).

Print reading provides a mode of consciousness through slow, deep, sequential thinking encouraging memory, logic, and reflection; in contrast electronic reading, which is fast and fragmented, fosters hyper-attention, disruption, and immediacy changing how is perceived time and thought flow (Heidegger, 1977; Merleau-Ponty, 1962). Reading should remain a collective cultural act that connects generations by preserving intellectual traditions; however, electronic reading often risks to flatten the culture, as speed and easy access can replace depth and meaningful engagement (Birkerts, 1994).

Among the three historical "revolutions" that changed how humans see themselves, *the first-* Cosmic decentering of Copernicus that reveals that "we are not the center of the universe"; *the second-* Biological decentering of Darwin with the idea that "we are not the center of life"; *the third-* Psychological decentering of Freud based on idea that "we are not fully aware of our thoughts"; *the fourth,* the Digital Revolution claims that "we are not the only agents capable of knowledge" meaning that information-processing systems (computers, AI) are also capable of knowing (Floridi, 2014:25).

The Infosphere-the digital environment in which humans read, learn, communicate and make sense of the world with the help of digital technologies-plays a crucial role, because it alters the human behavior (Floridi, 2014: 26). Knowledge in digital era is not scarce as in the print era, but is in overload. The Infosphere reshapes how people

engage with knowledge; the process of learning moves from analysis, evaluation and synthesis towards navigation, interpretation, and information management.

The Digital Identity, developed consecutively with personal identity in the fourth revolution, is in constant change; it is “informational” built of “inforgs” (informational organisms), who exist within globalized and automatic world through digital exchanges. Digital Identity is the collection of data, characteristics and digital traces that define an individual or organization in the online environment. Digital Identity portrays the information, the activities and the technologies used in the digital environment that mirror the online existence (Ong, 1982).

Digital communication reshapes human consciousness toward fast, interactive, multimodal communication grounded in immediacy, interactivity, fragmentation, but also new forms of community. Communication technologies impact Orality and Literacy (Ong, 1982). Orality or oral cultures rely on memory, storytelling, spoken word and thinking; literacy enables analysis, abstraction, linearity and reflection creating more individualized consciousness. The “Technologizing of the Word” reshapes consciousness entering in secondary orality characterized by immediacy, communal interaction, fluidity.

Digital Reading in Transformations

In today’s interconnected world, reading has moved beyond paper- based pages, towards digital “pages”, where turning over the pages of the book has changed into scrolling up and down the screen. Digital reading takes place on electronic platforms with the help of digital devices, where adults and children retrieve, share, and make use of information for their personal or professional purposes (Wolf, 2018).

Print reading and digital reading represent two distinct processes, each involving different mental strategies, cognitive functions and modes of interaction with text. Digital or online reading as a language skill consists of accessing, navigating and interpreting texts through reading methods such as: digital skimming, scanning, meanwhile print reading is based on mental and reflective decoding of the text and print-based literacy practices (Leu et al. 2019; Coiro 2020).

There are identified the four key dimensions of digital reading that are in an interconnected relationship highlighting its multifaceted, multimodal and self-regulated nature (Coiro, 2020). The first dimension is the *Reader* with his amalgam of specific cognitive capabilities, strategies and language competences, reading dispositions and motivation, and specific sociocultural identity. The second dimension is the *Text*, whose processing methods vary according to its format. The text could be categorized as: on-screen text, hypertext, hypermedia, internet text, augmented reality text, informational text, literary text, the multimodal or media-rich features text. The third dimension is the *Reading Activity* or *Task*, which involves the process of constructing meaning through interaction with the text. The reading activity includes: decoding, vocabulary analysis, checking credibility of information, navigating hyperlinks, producing content, integrating or synthesizing information across sources. The fourth dimension is the *Context*, the framework in which the reading process occurs. It can be sociocultural or situational and it depends on factors such as the type of platform, the size of the device, and the reader’s spatial location (Coiro, 2020).

It is also important to emphasize the essential dimensions of effective digital reading, which include the following (Coiro, 2020):

- Cognitive dimension that incorporates the mental strategies used by the digital reader to construct meaning;

- Strategic dimension that incorporates problem-solving and decision-making strategies when navigating hypertexts integrating multimodal information;
- Self-regulated dimension that incorporates control and monitorization strategies that are pivotal when critically evaluating the source for comprehension and retention.

In the process of digital reading the essential components include:

- the social aspect i.e. the digital interaction of the reader with others while being on a digital gadget;
- the participatory aspect that imposes the digital reader to become an active creator of digital content;
- the collaborative aspect that motivates the reader to take active participation in the act of creation and sharing the information (Leu et al, 2019).

Digital reading can be viewed as a set of culturally situated literacy practices that involve interaction, content sharing and ethical decision-making (Leu et al., 2019). This definition stipulates that digital reading is both an individual cognitive activity and a socially embedded activity. So, digital reading has two distinct facets: 1.) cognitive, strategic and heuristic-driven (Coiro, 2020) and 2.) social, collaborative and participatory practice (Leu et al. (2019)).

Table 1. Defining Digital Reading (Coiro, 2020; Leu et al., 2019)

Dimensions of digital reading	Coiro, 2020	Leu et al., 2019
Conceptual	Cognitive, multifaceted, self-regulated process.	Social and cultural practice.
Strategic	Hypertext, navigation, multimodal comprehension and self-regulation.	Networked, interactive, and collaborative reading including commenting and remixing.
Evaluative	Evaluates credibility and bias as part of comprehension and retention.	Evaluates credibility and bias within social, participatory and ethical contexts.

Digital reading is a complex process, which is a nonlinear scanning of sections, hyperlinks, frequent skimming with a tendency toward shallow reading and selective attention (Liu, 2005: 701).

The retention of knowledge in the process of digital reading is lower than in print reading and it depends greatly on digital media (Dong and Potenza, 2015: 8). Analyzing functional magnetic resonance imaging (fMRI) of individuals engaged in digital reading elucidates that the brain processes and stores information differently compared to print reading due to reduced activity in the temporal and frontal brain cortices (Dong and Potenza, 2015). So, it can be assumed, the first key feature of digital reading is the *Shallow Processing Engagement*, in which learners tend to engage in less deep and analytical thinking when interacting with digital content, often resulting in weaker comprehension and reduced memory retention.

Another aspect that affects the retention of knowledge within the digital reading is the location of the information (Sparrow, Liu, and Wegner, 2011: 778). Digital readers are more likely to recall information stored in specific “places” or personal folders than information that is accessible online (Sparrow, Liu, and Wegner, 2011). This phenomenon

can be referred to as *Technology-Assisted Memory*, the second key feature of digital reading, which reveals the high reliance on digital storage that ultimately affects memory retention. Within this context it can be mentioned that individuals tend to remember the location of information better than its actual content (Sparrow, Liu, and Wegner, 2011).

The psychological and behavioral aspects of digital reading such as inattention, irritability, anger may cause the digital amnesia having the tendency to forget what has been read or done as a part of the digital conduct (Robert and Kadhiravan, 2022).

Electronic reading and online searching can create an illusion of knowledge assimilation, as digital behavior is characterized by passive engagement such as: scrolling, clicking, browsing or navigating compared to active learning i.e. thinking critically, mapping concepts, operationalizing, transferring knowledge (Fisher, Goddu, and Keil, 2015: 681). This is the third key feature of digital reading, *The learning mirage*, highlighting the shallow engagement in digital reading environments.

Another effect of digital reading is the rapid acceptance of new ideas without deep thinking, identified as *Unreflective Information Acceptance*, the fourth key feature. This refers to the tendency of accepting information without evaluating it in the process of reading. Readers may also exhibit a 'bias toward unreflective copying,' automatically assimilating facts, actions due to modern trends, habits, or cognitive limitations, rather than carefully engaging in meaningful reflection (Rahwan, Krasnoshtan, Shariff, & Bonnefon, 2014).

Here must be considered the collective intelligence, decision-making, and moral behavior of the e-reader while being absorbed by digitalized environments. In collective digital readings the network directly impacts the digital reader forcing him to adopt the behavior consistent with the social trends. The electronic reader follows the social orientation by copying the dominant social pattern instead of adopting the personal reflexive strategy (Rahwan, Krasnoshtan, Shariff, and Bonnefon, 2014). In this context, the digital reading can be defined as *Ethical Collective Decoding*, the fifth key feature, that refers to digital adaptation when taking ethical decisions in electronic networks or multi-agent screen systems. Online social networks have a great power on opinions and behaviors in the process of digital reading, but do not promote morally responsible actions.

Thus, the equivalent terms such as "Digital reading", "Screen reading", "Electronic reading" or "Hyper reading" are characterized by fast, speedy movements through the text, with limited depth processing and reduced semantic processing (Hayles, 2012: 64). Print reading conversely is "Deep reading", "Analytic reading", "Reflective reading" because it engages the brain in slow, focused and reflexive processing based on reflection, meditation, empathy, sustained attention (Wolf, 2018). The physical process of "touching and smelling" the pages, closely deciphering the meaning of the text supports comprehension and recall.

Print reading, called symptomatic reading, enhances memorization and recall of the information, reduces distractions, supports better focus and deeper comprehension, while digital reading comes together with multitasking and is more convenient for short texts, quick access and searching for specific information (Hayles, 2012: 59). Print reading makes the reader more concentrated and engaged when decoding longer and complex texts; conversely, digital reading is characterized by speed and efficiency that negatively affect comprehension (Baron, 2015). Therefore, it is pivotal to train the young generation to engage in both print and digital reading as this develops the "bi-literate brain" with the ability to switch from fast screen processing to deep, reflective reading (Wolf, 2018).

Methods

The *Print vs. Digital Reading Comprehension* experiment conducted within the Analytical Reading course, aimed to investigate how undergraduate students of a language education program decoded academic texts in print versus digital formats ensuring that both versions were identical in length and level of complexity. Twenty-two undergraduate students (aged 20-31) with pre-intermediate to intermediate English proficiency participated in the study and engaged in academic reading tasks in both print and digital formats.

Participants were divided into two groups: Group A (Print Reading) and Group B (Digital Reading) alternating the reading formats and being exposed to SQ3R (Survey, Question, Read, Recite, Review) reading comprehension method. The SQ3R method encourages active, reflective, and structured reading and consists of five sequential steps:

1. Survey – students activate prior knowledge by skimming the text to get an overall sense of its structure, headings, subheadings, and key concepts.
2. Question – students generate questions based on survey analysis and get motivated with the material.
3. Read – decoding the written texts in print or digital formats focusing on understanding the main ideas, supporting details and relationships between concepts.
4. Recite – students summarize the key points in their own words orally reinforcing comprehension and memory retention.
5. Review – students recap the lectured material consolidating understanding.

Table 2 provides an overview of the experimental procedure including the sequence of steps, time allocation and tasks. After the reading phase, both groups completed a series of retention tests to measure recall and understanding across formats.

Table 2. The Experimental procedure of *Print vs. Digital Reading Comprehension* experiment

Step	Activity	Duration	Details
0	Group assignment	–	Group A- PR (Paper Reading) and Group B- DR (Digital Reading) alternate reading formats across sessions.
1	Introduction	5 min	Brief instructions on the SQ3R (Survey, Question, Read, Recite, Review) reading comprehension method and the reading contents, formats.
2	Reading	20-25 min	Group A reads the article on paper; Group B reads the same text digitally following SQ3R reading comprehension method.
3	Tasks	30-40 min	Both groups complete the following tests after the reading sessions: - Comprehension test (20 min) - Translation/interpretation task (15-20 min) - Metacognitive questionnaire (5 min).
4	Collection & debrief	–	Sessions debrief.
5	Retention test	10-15 min	48 hours later, groups switch formats for a new text: Group A reads digitally, Group B reads on paper, then take the retention test online.

Discussion

This study investigates whether reading the same source material on screen versus on paper affects students' analytical comprehension, memory retention, and translation/interpretation performance.

It is hypothesized that students who read the same material on paper will achieve higher scores on deep comprehension and retention tasks compared to students who read digitally. Conversely, students who read digitally are expected to complete translation and interpretation tasks more quickly but with lower accuracy producing more spelling and grammatical errors than their peers reading on paper. After reading, students answered comprehension questions and completed a short reflective survey on their reading strategies, reading comprehension and application of new vocabulary in new contexts.

After the tasks, the students had to discuss digital and print texts through SQ3R reading comprehension method. Through think-alouds there were recorded short verbal protocols to examine strategy use, to measure internalized reasoning and to follow the social group trend.

During the experiment *Print vs. Digital reading comprehension*, students showed different reading behaviors:

- In print reading, students applied the SQ3R method by surveying the text, generating questions and underlining and annotating key points. They recited and reviewed the material slowly, which enhanced comprehension, and retention through deliberate, reflective processing.
- In digital reading, students followed the SQ3R steps more rapidly scrolling through the text, clicking on hyperlinks and completing tasks faster. The recitation and review steps were often abbreviated leading to more surface-level processing, and reduced depth of comprehension compared to print reading.

Results

There have been measured the mean comprehension, retention, and translation rates that scored higher for print texts than for digital texts. Survey qualitative data indicated that 86% of students understood the print text better, and 84% of students admitted to being involved in multitasking-navigating to other platforms while reading digitally. Qualitative comments showed that students perceived print reading as more deep, focused and purposeful activity, while digital reading was more scattered and shallower (See Table 3).

Table 3. *Print vs. Digital Reading Comprehension* experiment results

Measure / Variable	Print Texts	Digital Texts	Qualitative Observations
Comprehension Score	64%	36%	86% of students reported better understanding of print texts
Retention Score	81%	19%	Print reading perceived as more focused and purposeful
Translation Score	32%	68%	Digital reading perceived as more scattered
Multitasking Frequency	–	74%	84% of students admitted multitasking when reading digitally
Overall Perception / Reading Experience	96%	–	Print: deeper focus, purposeful; Digital: scattered, less immersive
Text Format	Print	Digital	–

Conclusion

The findings suggest that print reading supports deeper comprehension and critical engagement in academic contexts. Paper readers are achieving higher deep-comprehension and retention rates and make better translation choices for nuance. Digital readers are faster, exhibit a higher frequency of clicks, scrolling, and have a higher illusion of learning, but exhibit a lower objective retention. Digital readers duplicate the facts seen in the digital group failing to internalize reasoning strategies.

Digital reading offers convenience and accessibility, but it is often characterized by shallow processing engagement and unreflective information acceptance. It relies heavily on technology-assisted memory, which can create a learning mirage and influence ethical collective decoding.

It is recommended to develop bi-literate reading strategies that integrate careful attention management, moderated digital reading speed and the transfer of deep reading skills to online contexts that is essential for fostering critical, reflective and effective engagement with texts in both print and digital environments.

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