



Reading on paper and screens: advantages, disadvantages, and digital divide

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Received: 01 September 2021; revised: 06 January 2022; accepted: 27 January 2022

The paper studies reading in the digital age and grounds characteristic reading features on paper and the screen. We studied various scientific points on the uniqueness of reading activities in various formats, effectiveness, and perception of readers about printed and electronic texts. The study concludes that screen-reading practices keep evolving. Digital reading dynamically changes the communication environment, speeding up and simplifying access to information. The new reading format has many opportunities and advantages, and it transforms the reading skills and habits of society. Although it revives social reading, it intensifies the digital divide, leading to a secondary mental cognitive digital divide, and modifies the personal reading experience of contemporaries.

Keywords: Reading; digital reading; social reading; digital divide; libraries

Introduction

Reading is "a specific form of linguistic communication between people through printed, handwritten and electronic texts, one of the forms of mediated communication"¹.

The emergence of new formats and reading practices rapidly and dynamically changes the communication environment and has far-reaching consequences. The COVID-19 pandemic has accelerated the shift to digital technologies, and there is a need to study the transformation of reading practices, awareness, acceptance and understanding of new reading formats.

The study of reading practices as a social phenomenon has always been of great interest to scientists in connection with the constantly occurring changes in the ways of reading and perception of the text². The transformation of reading is greatly influenced by cultural, social, economic, and demographic factors. Modern digital technologies have greatly simplified access to a large flow of information, which has led to the development of a new reading format—reading from the screen, reading online, electronic and digital reading. Scholars and practitioners draw a line dividing reading into traditional, paper, or analogue reading and digital reading^{3,4}. Currently, both reading formats have

become firmly established in our everyday life and are quite actively used.

However, back in the 2010s, digital reading was inaccessible to social groups with low income and sharply marked the digital divide problem (digital inequality, digital gap)⁵. The COVID-19 pandemic, starting in the spring of 2020, exacerbated the situation and scientists made it the subject of much discussion, placing on the agenda many issues related to the functioning of all sectors of the book industry before governments, public organisations and cultural, scientific and educational workers.

With the further development of digital technologies, the current issues will not only not disappear but, on the contrary, will intensify⁵. The world community is entering another period of deepening digital inequality. It is associated with economic (communication and technological) reasons - a low or uneven degree of computerisation, internalisation of certain regions, and the cognitive level of digital media literacy.

In studies of reading culture, one can find different points of view on the role and prospects of development of traditional and digital reading. Optimistic views of digital reading include accessibility of content of interest to the reader from several electronic devices, quick search, the ability to

read at any time and in any place, etc. The pessimistic views include digital reading being detrimental on the cognitive abilities of the reader.

Technological innovations contribute to the transition from episodic to regular digital resources, and electronic reading is becoming an everyday reality. Today, the situation has turned out to be not as straightforward as it seemed in the first years of the 21st century. To understand modern reading, we examine related studies worldwide and identify the advantages and risks of digital and traditional reading.

Review of literature

An understanding of digital reading continues to emerge. Many researchers believe that digital reading is a new type of text perception⁶. According to Merkoski, the creator of the Kindle e-reader, digital reading is reading texts that have been digitally processed and placed on electronic media. Reading from the screen contrasts with paper-based, traditional or analogue reading⁷.

Digital reading is the most important means of mastering digital resources today. It differs significantly from traditional reading both physiologically and technologically. At the beginning of the 21st century, French book historian Chartier predicted that "the revolution that electronic text brings with it will also be a revolution in reading. Reading from a screen is not the same as reading a codex book. The electronic representation of texts completely changes the conditions of their existence"⁸.

Liu noted that digital reading behaviour is characterised by a large amount of time spent viewing and scanning, searching for keywords, reading one-time, non-linear, more selective, less in-depth and concentrated. The author noted a decrease in sustained attention while annotating and highlighting during reading remains a common activity in the printed environment; however, this "traditional" model has not yet migrated to the digital environment⁹.

Leu and Maykel proposed the following types of reading:

1. Reading to find information;
2. Reading to critically evaluate information;
3. Reading to summarise information and solve a problem;
4. Reading and writing to convey information.

They stressed that the source of the differences between offline and online reading comprehension is not fully understood, and there is significant evidence that they are not identical. Given the increased importance of online information, researchers focus on the need for digital reading skills, which are particularly important for student learning and education¹⁰.

Many researchers adhere to the idea that non-linear reading, such as hyperlinked text, reduces the possibility of deep, thoughtful comprehension of information and changes both the level of understanding and the degree of pleasure from reading. Digital reading is losing linearity. It is reported that netizens do not read the text but scan it. The advantages of reading-scanning are the fluency of finding information, saving paper, implementing multiple tasks, quickly comprehending the multidimensional text, the ability to switch attention, and the speed of recognising the potential significance of content².

The main purpose of this study is to examine the change in reading habits. In a digital environment, the text is more likely to have hyperlinks and will become multimodal. The new properties of digital text, such as intangibility, fluidity, inconstancy, most likely, lead to a different emotional and social status of texts and reading, stimulating fragmentary changed attention and reading shorter some texts. Scanning and skimming texts from the screen become the reader's digital skills¹¹. However, it must be said that multitasking does not contribute to reading efficiency¹².

Digital interaction and traditional practices: reader preferences

According to Pleimling⁴ and Allcott³, reading books is an activity that requires solitude; it is associated with leisure or rest. Scientists regard traditional reading as "deep reading", allowing the reader to devote time to complex thought processes. In contrast, digital reading can quickly find a solution to a problem or answer a question. Both ways of reading are useful, but there is a strong case for the deeper impact of the text. Its meaning and understanding come from reading long-form printed books. The preferences of modern readers can be judged by research conducted over several years in New Zealand, covering the entire population of the country and revealing changes in the reading practices

of its inhabitants. In the second decade of the 21st century, the spread of online content in New Zealand was so significant that the country's population was considered one of the most Internet-addicted in the world by 2018. Digital platforms have become new reading channels for young people, but high levels of digital interaction did not replace traditional reading forms. Only some of them were forced to step back, a new blended reading behaviour¹³.

This confirms previous findings such as that contemporaries read more on the Internet, but the timing, nature of reading, and engagement level of reading online or in print differ significantly. The researchers noted that the rise in online sources contributes to reading in general.

About the effectiveness of the perception of text read from paper and the screen: results of research projects

Could it be argued that the new digital reading practice is conducive to the thinking and thoughtful reading needed to evaluate and make deeper sense of data?

Nine out of 10 American parents believe that only a paper book contributes to deep reading¹⁴.

Psychologists and neuroscientists note that the transition from traditional reading to digital or paper to screen changes the reading format. Its properties affect the depth of perception and understanding of texts. Not all the information read is impartial, rich and necessary for us. Today, the various sources, primarily digital, social networks, the Internet, etc., leave no time for critical analysis, balanced reflection, and objective source estimates.

Comparing the effectiveness of reading from paper versus reading from screens, scientists give preference to printed texts while noting that in the future, contemporaries will inevitably have to reorganise to the regular consumption of the digital environment. The challenge for digital reading will be an attempt to preserve the level of comprehension of the information content and intellectual content characteristic of analogue or traditional reading. So, according to the neurobiologist Greenfield, "The problem is that information is not knowledge. Of course, you can be bombarded with endless information, endless facts, but if you cannot understand them, one fact will be the same as any other fact. You can surf YouTube or Google saying 'yuk' and 'wow', but you don't understand anything"¹⁵.

American psychologist L. Rosen draws attention to new skills of online readers, such as dynamism, multitasking of reading, the divergence of thinking, the ability to search for multiple solutions to the same problem, speaks of the possible risks of digital behaviour of contemporaries. "Children of the Internet generation can simultaneously listen to music, chat, surf the web, edit photos while doing their homework. But, of course, the price to pay for multitasking is absent-mindedness, hyperactivity, attention deficit, and a preference for visual symbols for logic and delving into text"¹⁶.

A professor at the Reading Center in Norway's Stavanger University instructed one-half of the subjects to read a long story on paper and the other on an Amazon Kindle. Subsequent testing showed that the degree and quality of assimilation and understanding of the story in different groups differed. Those who read from the gadget's screen understood the essence of the story worse and could not reconstruct the sequence of events from memory¹⁷.

The benefits of reading from a sheet or a screen, and the peculiarities of reading by contemporaries, are evidenced by the data obtained during the E-READ project carried out under the European COST research program in November 2014-May 2019, involving 180 experts from Europe in a variety of disciplines. One of the most important tasks of the project was to determine the extent to which the difference between the screen and paper substrates affected reading comprehension.

Two major outcomes from the E-READ project were a meta-study of 54 existing scientific studies involving 76 print versus screen comparisons and 171,055 respondents from 19 countries¹⁸. This research resulted in the publication of the Stavanger Declaration Concerning the Future of Reading¹⁹.

The conclusions reached by the experts of the meta-study include:

Firstly, reading a text on paper increases reading comprehension, and the effect is higher in understanding more complex texts - educational texts, popular science literature, non-fiction.

Secondly, the so-called "surface hypothesis" was supported, which means that the habits of schoolchildren and students to read from the screen affect the depth of understanding of the text. Moreover, screen skills of fast, superficial, scanning and less concentration on the text change the

understanding of the context read by the learners, do not improve comprehension and limit cognitive abilities.

Thirdly, the 'screen disadvantage' has increased over the last twenty years, concluding that digital natives do not exist. This makes it unlikely that the screen disadvantage will diminish.

Researchers have been studying how screens affect reading quality for years. *Scientific American* reported that since the 1980s, at least 100 studies have been published on this issue. The negative impact of digital technology is on the rise, regardless of age group or previous digital experience. The study concluded that digital environment does not promote deeper assimilation of information. Another meta-study²⁰ found a "small but significant" difference in reading text on the screen compared to paper. The author brought together some of the most recent discoveries in reading skills, productivity, speed, and reading comprehension. The scientist analysed dozens of previous experimental projects in which the features of the perception of texts from paper and a screen were considered. The meta-analysis confirmed the position already known by that time that reading from paper, as a rule, leads to a better understanding of the text and improves a person's work with tests online^{18, 21}. Researchers found that readers from electronic media were more confident in understanding the information they read than readers who used only printed editions²⁰. It turned out that "digital readers" overestimate their ability to perceive text on the screen, unlike text readers on paper²².

The authors of the three meta-studies, Singer and Alexander²³, Clinton²¹, Delgado¹⁸, Kong, Seo and Zhai²⁰ came to similar conclusions. The screen disadvantages probably arise due to the accessibility of the digital environment (especially its infrastructure) and can hypothetically be included in it. This forces scientists to identify the ranks of these shortcomings and take into account the following categories:

- The need for evaluation of the quality of the text, which is greater in the digital infrastructure than on paper;
- The perceived unreliability of the digital text, which follows from the lack of (e.g., editorial or publisher) control on publication (anyone can be an author) and the ephemeral nature and fluidity of the digital text;
- The distractive nature of the digital infrastructure, offering a multitude of potential

activities competing for attention (especially involving modalities that are less or differently cognitively demanding than reading);

- The misleading sense of agency and control users experience in the digital infrastructure contributes to overconfidence¹¹.

Siagian and Marianti argue that, although the Internet, social networks and gadgets have made our life easier in education, there is still a reverse side of the influence of the development of information and communication technologies on reading—the oversaturation and easy accessibility of information. These reduce interest and curiosity, creating bored students²⁴.

However, other studies provide more optimistic predictions. They are confident that technological advances have improved the quality of screen reading and have a major impact on digital reading efficiency.

Roscos and Neumann²⁵ argue that reading in a digital environment is an incentive for low-performing students because feedback in e-books and applications plays an important role in maintaining interest.

Neuroscientist Wolf²⁶ discussed the formation of a "bi-literate" brain in readers and predicted the existence now and in the future of both forms of reading and understood how to get the most out of each, depending on the goals. The author sees the reader's future as harnessing the optimal skills of each reading style so that learners can read digitally and traditionally²⁷.

Screen capabilities: social reading

The on-screen reading format creates new reading behaviour and forms diverse reading skills and habits. It increases the likelihood of constant interaction and communication, revives the so-called "social reading"²⁸. From the virtual possibilities of communication, the new concept of "social reading" emerged like almost any conversation about books²⁹.

Stein identifies several types of social reading, two of which can be attributed to the traditional. Real discussion of books when meeting with friends and acquaintances and a more specific, deep and lively discussion of books in the classroom or book club. Other types of social reading have become products of the virtual world. Stein includes online discussions about books on social networks, on the websites of book and reader communities, and commenting on what has been read "in the margins" using services specially created for this³⁰.

According to researchers, social reading is the revival through digital services of a forgotten or extinct practice of discussing books; specific communication activity, the rapid development of which is determined by the emergence of computer technologies, electronic publishing, and digital reading. In the online environment, the role of users in the creation and distribution of texts in the form of reviews, criticism, reviews, and ratings is becoming more and more important. The authors of *Social Reading: Platforms, Applications, Clouds and Tags* argue that thanks to the growing diversity of digital opportunities, reading is gaining a "new dimension", and through the Internet, it has become a global trend and goes far beyond traditional reading clubs³¹.

A similar position is taken by Pleimling, who looks at future reading practices positively, pointing to the success of social reading. Books that are currently talked about in chats, forums, social networks or platforms "will be read at some point"⁴. The researcher claims that social reading in its current form has many different analogue and digital relatives. First of all, she singles out book clubs since it is in them that traditional meetings of readers take place and discuss the books they have read offline, for example, at libraries, educational institutions, or clubs of interest. These discussions are rarely documented and distributed. They are also not part of a wider discourse, analogy to casual conversations about literature at dinner, on the train, and other everyday situations. And finally, online communities that discuss books on forums, blogs, and social networks - wherever people connect. In this case, the exchange of opinions is generally less structured than in book clubs and rarely goes beyond a simple assessment of the book read⁴. However, online communities have many more benefits. They are usually open to the wider public, are not location or time-dependent, and member comments are stored online and available to new members. In addition, online communities help the reader find like-minded people to exchange ideas, and the publisher opens up a communicative space for advertising the book³².

The digital divide and its consequences

Having discovered the emerging digital divide in reading, scientists began to ask questions. How will this affect the educational process? And in what direction should scientists who study reading need to move. Let's look at the main issues that need to be

considered to conduct further research on digital reading. As we have already seen, digital reading on screens, along with the previously mentioned opportunities and advantages, also has the other side of the coin. These individual digital disadvantages, which deepens the digital divide, affect the cognitive processes of reading activity, giving rise to "absent-mindedness, hyperactivity, attention deficit and a preference for visual symbols for logic and delving into the text"¹⁶.

Today it is impossible to exclude screens from our lives. It is necessary to consider the social impact of the screen infrastructure on the individual reading experience³³. It can be compared with the Gutenberg revolution, the impact of which was not that it became more convenient to read printed text, but on the development of the book industry and making mass reading possible^{11,33,34}.

We may consider the following three hypotheses to explain the social consequences for humanity of the transition to digital technologies that are currently taking place.

The first hypothesis is based on the digital divide and its consequences. Two types of the digital divide may be distinguished.

The first digital divide is associated with economic factors. It is still ongoing and lies in the economic, financial and, most importantly, technological opportunities for access to digital technologies¹¹.

According to statistics, access to digital technologies is still limited. The primary digital divide thus increasingly refers to a global ('North-South') technological divide. The problem of access to the Internet, information and communication technologies at the moment not only persists but continues to worsen.

The global pandemic COVID-19 has shown the danger of the primary and secondary digital divide and, in general. It has exacerbated the digital divide around the world. Schools have been closed in 191 countries due to the coronavirus. One and a half billion students worldwide, 63 million teachers in primary and secondary schools have switched to telecommuting. The difference in online education opportunities has become very visible, especially in the developing world. It turned out that 90% of Central Africans do not have access to a computer, and 82% have no way to connect to the Internet. Fifty-six million people (half of those living in this region) do not have mobile phones or the Internet.

The difficulty of access to mobile and digital technologies in many developed countries, including the USA, was discovered. The teachers were not ready for distance education. It became clear that they needed to be trained in working with digital resources, digital reading, and librarians should help them in this situation.

The 'secondary digital divide' may be a mental/cognitive gap. This refers to the fact that the global digital space is becoming difficult to understand the environment. It brings new difficulties for readers, who, in the face of an increasingly complex digital media environment, must be more (digitally) literate and be more critical about the information they want to receive. This factor becomes decisive for children from disadvantaged backgrounds, as they are the first to experience the negative consequences of the secondary digital divide.

The existence of a secondary digital divide is suggested, for example, by evidence that students from low-income families spend twice as much time watching gadgets, watching TV, and playing video games than children from higher-income families. Students from low-income families spend an average of three and a half hours a day behind screens. And this, according to Petrilli, partly explains why they learn worse (Fig. 1)³⁵.

The second hypothesis is we are living in an era in which digital screen infrastructure is emerging. One of the notable consequences to which digitalisation leads can be called the "filter bubble" effect, or the "popularity" effect as familiar from the major digital platforms (such as Google, Facebook, Amazon, YouTube). They follow from business models that rely on user data. Their algorithms are intended to induce users to spend as much time and attention on

their platform as possible by offering the most popular (or controversial) information. Such effects are demonstrated, for example, in science and music³⁶. The emergence of streaming platforms led to the fact that residents of certain countries, for example, Scandinavian ones, began to prefer international popular music to the detriment of traditional and other local music. Serious transformations await the global book industry as it adopts digital technologies.

The third hypothesis is related to reading habits. Digital technology removes the habit of reading thick volumes of ordinary paper books and instils reading from screens. These include impatience with the long-form book and a tendency to skim-read texts and prefer less time-consuming and/or less cognitively alternative modalities such as audio and video.

Transformation of the reading habits of contemporaries

Digital communications greatly affect the cognitive patience (concentration, discipline) of readers/users, social cognition, and the readers' personal and cultural changes. The latest (2019) PISA results also suggest a strong connection between young people's changing reading habits and lower comprehension scores.

From 2012 to 2016, in the Netherlands, the number of residents who do not read books increased from 11% to 21% (Fig. 2). At the same time, the percentage of active readers (20+ books per year) decreased from 19% to 12% (Fig. 3)³⁷.

A similar trend is observed in the loan statistics of the public libraries of the Netherlands. From 1994–2016, the issue of books in the country has decreased from 180 million to 61 million copies in 2019. A particularly

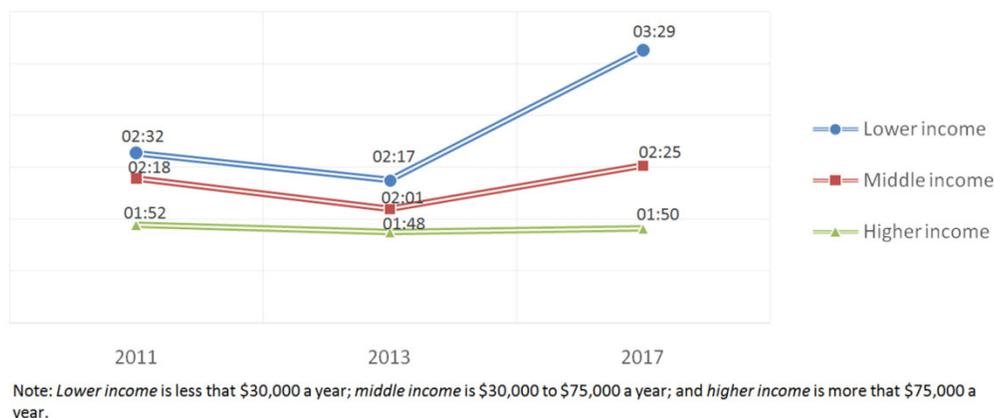


Fig. 1 — Statistics of reading on digital media, depending on family income in 2011–2017

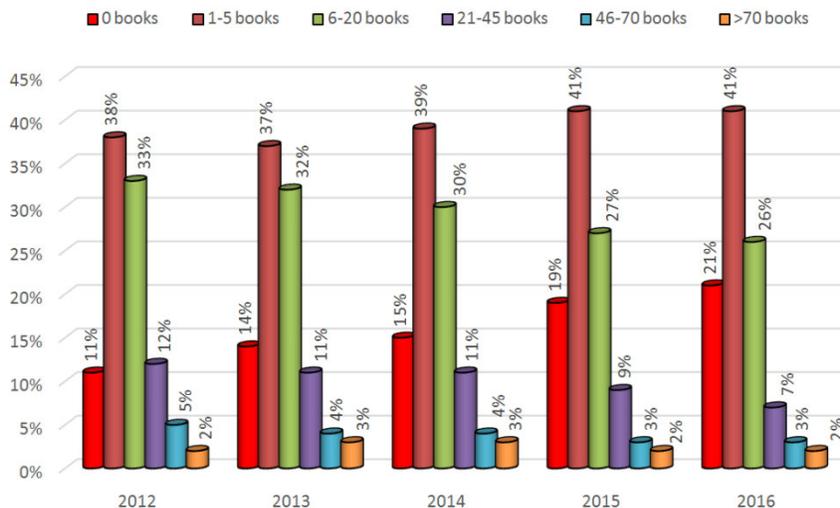


Fig. 2 — Changes in reading: percentage of the population reading 0 books per year in 2012–2016.

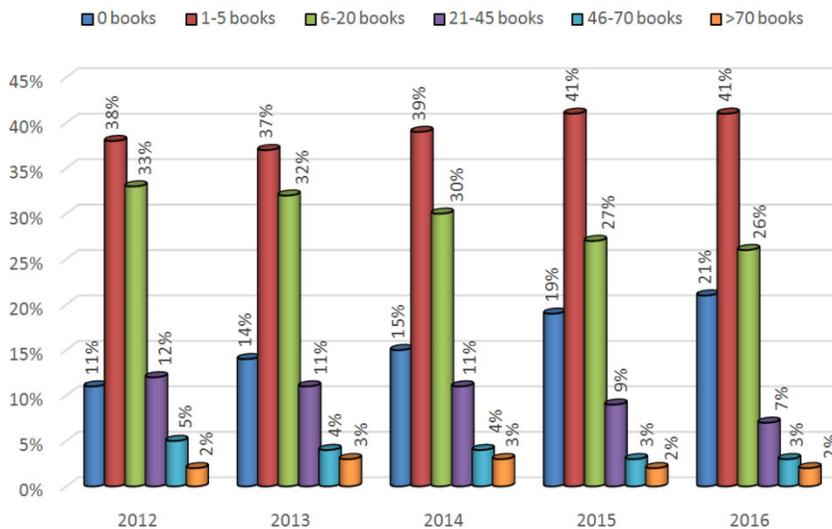


Fig. 3 — Changes in reading: percentage of the population reading 21 books per year or more in 2012–2016.

sharp decline occurred in the decade of transition to digital screens - from 2005 to 2016, from 130 to 70 million, but the trend has continued since (Fig. 4).

Similar trends are observed in Germany and Russia. Purchase of books in Germany for the five surveyed years in 2013–2017 indicates a steady decline in the number of buyers of all ages. The number of buyers of books aged 40–49 decreased especially quickly, by 37%, while their spending on publications decreased by 33%. There was also a sharp decline in the number of buyers aged 20–29 and 30–39-year-old readers on average by 25% (Fig. 5). This testifies to the crisis of traditional reading, paper

reading, and the possible adherence of young people to screens.

According to the sociological service "Levada-sentr", Russia's attitude towards traditional reading has changed dramatically in the last decade. Twenty seven percent of Russians surveyed reported that they read fiction once a year and about the same percentage - 28% - do not read it at all. The share of Russians actively reading fiction (daily or weekly) has halved from 1994 to 2019 from 23% to 14% and from 26% to 14%, respectively (Fig. 6)³⁸. In recent years, Russian readers' discussions have been actively drifting into the digital environment³².

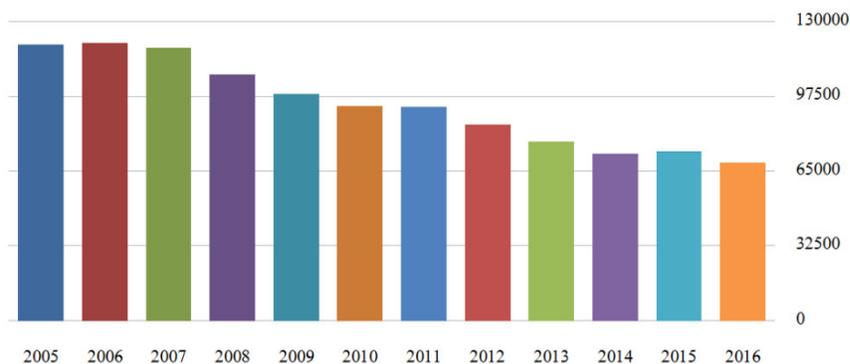


Fig. 4 — Library loans from the public libraries of the Netherlands

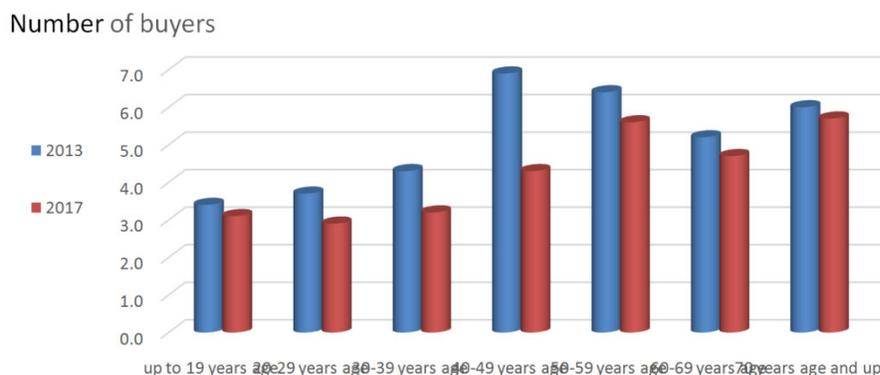


Fig. 5 — German book market: graphic information on book purchases in 2013–2017

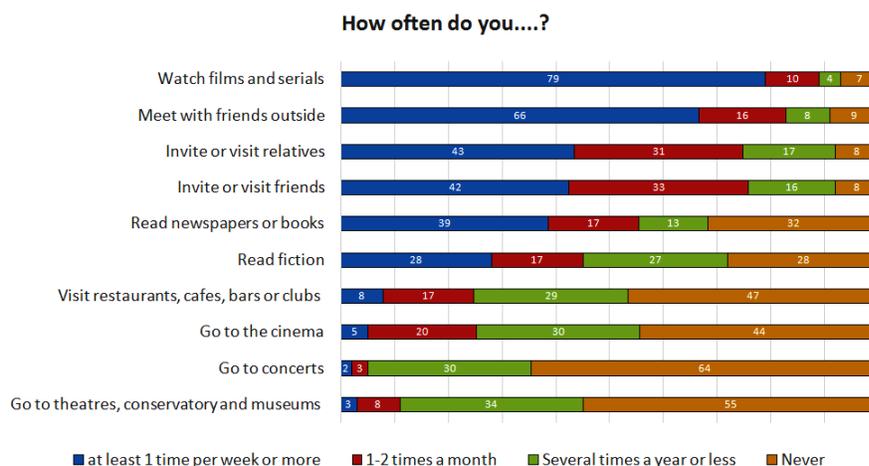


Fig. 6 — Leisure communications in Russia, 2019

Young people are moving especially quickly into the digital media space. The observations of Russian researchers allow us to assert that the practices

traditionally condemned by adults, such as watching videos on YouTube, discussing on TikTok, Facebook and other platforms, including numerous book social

networks, turned out to be the platforms where communication of readers and self-expression of adolescents takes place. Such discussions, as a rule, stimulate reading rather than distract from it, but the quality of this reading is affected by the digital context in the way suggested earlier³⁹. Following the book and reading communities, libraries are also moving into an online environment to engage the reader in reading. The deep essence of the library has not changed in the digital age, nor has reading itself changed. Scribes and librarians alike must remember that the role of libraries in bridging the digital divide in the digital age is critical.

The role of libraries in bridging the digital divide

According to the American Library Association (ALA), the digital revolution and the emergence of gadgets have led to a reading paradox. Children who spent a lot of time on the phones, tablets, computers, etc began to read much more. Realising that digital reading is typical behaviour—not so much reading as scrolling and searching for information, teachers and librarians are trying to implement new reading strategies that promote the in-depth reading of school children and students and bridge the cognitive digital divide.

There are a lot of ideas for attracting readers. These include digital storytelling; the creation of reading circles in the online sphere, wiki pages like school newspapers; founding online magazines or blogs; creation of myths and fairy tales through podcasts, book trailers based on reading books; posting tweets on behalf of historical or literary characters; creating a custom profile for reading literature recommendations etc¹⁴.

The ALA has offered several training modules on the free portal DigitalLearn.org to help people learn digitally at their speed for those who are not proficient in online technology. DigitalLearn.org offers a collection of tutorials in learning modules, most of which are available in both English and Spanish. By mid-2020, the number of English courses taken on the main site, DigitalLearn.org, had increased by 17% compared to 2016, and the number of visits increased by 19%¹⁴.

The role of libraries in imparting digital reading skills, in the popularisation of reading, in the elimination of the social "digital divide" and cognitive "digital divide" in reading is extremely high. In this sense, the experience of the ALA and its recommendations for mastering digital reading technologies can be useful.

Conclusion

Digital reading continues to evolve even as communication between people through electronic texts dynamically changes the communication environment, accelerating and simplifying the consumer's access to information. Digital reading exacerbates the primary digital divide, deepens mental-cognitive break, promotes the development of digital literacy, improves reading habits and skills, and develops communications in the digital environment.

The opinions of scientists and practitioners of the world about the future of traditional and digital reading practices turned out to be very contradictory. The world has entered a transition period in which two reading formats coexist. Traditional paper-based reading for most people and, especially, for mature and elderly people, and new digital forms, characteristic of the young "screen" generation. Presently, it is necessary to use both reading formats in such a way that they support and complement each other. The advantages of screen reading, the negative consequences, and possible development prospects in the context of the total transition of humanity to digital communications are becoming urgent.

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