Trends Shaping Education Spotlight 16
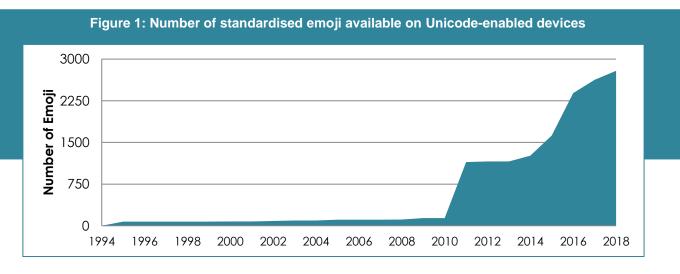
Writing in a Changing World

Written communication has been thousands of years in the making, but in recent decades the way we write, the skills we use and the role writing plays in the world have all changed. This has important implications for education and skills.

Major moments in the history of writing[1]

Some of the earliest examples of writing are imprints and engravings on wood, clay and bones. The inventions of papyrus and paper and the use of brush and ink were also important developments. The most famous breakthrough, the printing press, came into widespread use in Europe in the 15th century, and allowed for mass production of written material. In recent years there have been further shifts, with word processors allowing text to be edited multiple times before printing, and widespread ownership of smartphones facilitating expression using automatic correction and prediction. Our writing systems are evolving too: the vast increase in the number of emoji (Figure 1) and their huge popularity led Oxford Dictionaries to name 😂 as its word of the year (Oxford Dictionaries, 2015).

Figure 1: Number of standardised emoji available on Unicode-enabled devices

Note*: this count is for all combinations possible. For example, the 'thumbs up' emoji has several colour variants, each of which counts as one emoji.

Source: Unicode (2018),"Full Emoji List, v11.0", https://unicode.org/emoji/charts/full-emoji-list.html.

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[1] This Spotlight is inspired by 'Thoth's Pill: an Animated History of Writing'.

Writing for skills and skills for writing

Our education systems equip us with skills to produce, understand, use and reflect on written texts for a variety of purposes (OECD, 2017a). How does our production of written material help our learning, and what skills are required in order to write in today's world?

Writing to learn

Educational activities involving writing lead to more effective learning than activities involving only reading, and different types of writing assignments can have different benefits (Langer and Applebee, 1987). For instance, short-answer questions tend to lead students to focus on items of information within texts rather than necessarily critically engaging with the content. However, the nature of the questions also allowed for broad coverage of the material studied, thus promoting good short-term recall of a wide range of information. More analytical writing led students to bring a deeper focus to the implications and linkages within the source texts.

Cursive and Calligraphy Handwriting Styles

Is cursive handwriting obsolete in the 21st century? Some would argue yes – since 2016, cursive script is no longer part of the national curriculum in Finland. Instead, emphasis is placed on producing digital written material. Students writing by hand can choose to use block letters, but the focus has been shifted to keyboard skills. Minna Harmanen of Finland's National Board of Education said about the change: "[students] don't have time to become fast at cursive writing, so it's not useful for them."

But elsewhere a countertrend seems to be emerging: since 2011, thousands of Chinese schools have been reintroducing calligraphy into the curriculum. This is a response to suggestions that alphabet-based text input systems are undermining students' ability to recall the correct strokes involved in the thousands of characters of their writing system. This phenomenon is known as character amnesia, or 提笔忘字 ('pick up the pen, forget the character'). One teacher said of the move: "the class not only teaches the kids traditional art of Chinese calligraphy but also trains their ability to concentrate and focus. It's good for their growth."

More information: www.theguardian.com/ and http://english.cntv.cn/

Researchers have argued that the act of manipulating information through writing causes it to be better understood and remembered (Langer and Applebee, 1987). For example, "write-to-learn" programmes (short, impromptu or otherwise informal writing tasks that help students think through key concepts or ideas presented can support students' learning (Bangert-Drowns, Hurley and Wilkinson, 2004).

Studies also show that the writing implement matters too: although students take more notes when using a laptop instead of pen and paper, students who handwrite their notes perform better on conceptual questions related to the content covered (Mueller and Oppenheimer, 2014). Reproducing letters freehand on paper activates regions of the brain not activated by tracing or typing the same characters (James and Engelhardt, 2012). This has important implications for education, since the process of writing new letters has been found to be uniquely effective in creating neural activation patterns associated with reading letters (James and Atwood, 2009).

A similar phenomenon seems to occur in students of logographic scripts such as Chinese. Research indicates that learning characters by physically writing them leads to improved recognition when reading (although the research was not able to demonstrate that learning stroke order, considered an intrinsic part of correctly producing each Chinese character, significantly improved reading ability) (Hsiung, Chang, Chen and Sung, 2017). Teaching handwriting may therefore continue to be important in effectively teaching how to read, even in a world where the need to produce handwritten material is increasingly rare.

Digital writing

Technological developments have radically changed the way in which we write and read. The Programme for International Student Assessment (PISA) has found significant variation in digital reading performance that differences in print reading skills cannot explain. These variations may be related to skills that are unique to digital reading and not required of someone reading printed text – skills such as navigating web pages and operating computer hardware (OECD, 2015a).

Evidence from PISA shows that students who make some use of computers (more than never but less than every day) have better digital reading skills than those who make little to no use, but that they also perform better than those with very intensive use (OECD, 2015a). These results do not establish a causal relationship, and other factors also affect children's digital reading skills – for example, how computers are used (communication, information, games or news), and computer use at home.
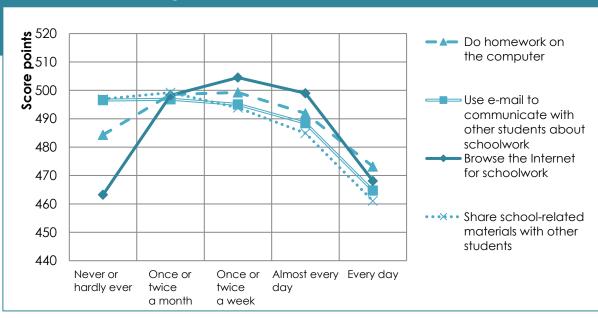
Figure 2: Frequency of computer use at school and digital reading skills; OECD average relationship, after accounting for the socio-economic status of students and schools

Source: OECD (2015b), "How Computers are Related to Students' Performance", https://doi.org/10.1787/9789264239555-9-en.

The written word in the written world

Writing in economies and societies

As economies and the nature of work change, the requirements of writing are changing too. Jobs involving manual labour have long been in decline in most OECD economies, and tasks involving production of written material implicate an increasing percentage of the labour force. This has led some to argue that for the first time the phenomenon of mass writing has exceeded that of mass reading (Brandt, 2014).

As one indication of this transformation, daily use of written materials at work in OECD countries increased by 13% in just over a decade, according to PIAAC, the Survey of Adult Skills (2012) and the International Adult Literacy Survey (1994-1998) (OECD, 2017b).

Meanwhile many new skills are arguably needed in this age of rapid production and dissemination. Learning to express oneself in 280 characters (formerly 140) on Twitter is an extreme example of the brevity demanded in a world of increased competition for attention. Recent research using eye tracking technology also indicates that people develop strategies to scan or skim text for relevant information when faced with excessive quantities of text, such as may be found online (Duggan and Payne, 2011).

The implication for education is the importance of metacognition – the ability of students to reflect on their own thinking. In terms of reading, the skill of metacognition involves students understanding what goes on in their heads when they read, and using that understanding to learn to read more effectively. Studies have shown a significant benefit of teaching metacognitive strategies on students' comprehension of written texts (Mariam, 2016; Reza Ahmadi, Nizam Ismail and Kamarul Kabilan Abdullah, 2013).

The power of the written word

Changes in our ability to produce and distribute written material can have significant consequences. Among the most prominent examples of the political power of changes in the written word are the so-called Twitter revolutions that took place in the Arab world in 2011. The moniker has been attributed to other political uprisings in years since, including the 2013 unrest in Ukraine, although there is debate as to whether messages on social media facilitate or merely document political events (Lynch, 2011).

Meanwhile, recent years have seen various actors use the changing nature of writing to misrepresent written information. Suggestions have been made that voters in the 2016 US presidential election may have been influenced by propaganda messages on social media (Graham-Harrison and Cadwalladr, 2018; Madrigal, 2017; Rosenberg, Confessore and Cadwalladr, 2018; Sullivan, 2017). The rise of online censorship, fake news, and 'echo chambers' on social media all illustrate the challenge that politically engaged citizens must be equipped to face.

> "The idea that fake news on Facebook […] influenced the election in any way, I think, is a pretty crazy idea,"
>
> Mark Zuckerberg (Sullivan, 2017)

Analysis of Twitter suggests that lies spread faster than truthful information, (Vosoughi, Roy and Aral, 2018), since it takes less time to invent a lie than it does to research facts, and the content is often sensationalised. Figure 3 illustrates the increasing efforts of governments around the world to remove Google search content by requesting removal.

Figure 3: Number of government requests to remove Google web search content per reporting period

Note: these data do not indicate how many of the requests were honoured by Google.

Source: Google (2017), "Transparency Report", https://transparencyreport.google.com/.

Writing our identities

Increasing global communication means increasing intercultural interactions, which may result in linguistic convergences and a lesser role for minority languages. Indeed, the number of languages in the world declined by around 20% between 1970 and 2005 according to the Index of Linguistic Diversity (Harmon and Loh, 2010).

Possible causes of this decline include globalisation and the use of English as a lingua franca, particularly online. In the past it was difficult to adapt new technologies such as typewriters and keyboards to non-alphabetic writing systems such as Chinese (Mullaney, 2017) and Japanese. As a result, Romanised systems are used for many languages; some are officially recognised like Hanyu Pinyin for Chinese; others are unofficial or even taboo, such as the Arabic chat alphabet (Danet and Herring, 2007).

On the other hand, a second set of global trends could offer us the opportunity to promote increasing diversity. Numerous online projects and tools are helping to preserve and revitalise languages in their written form, involving a variety of actors such as field linguists, experts in language technologies and the native speakers. For instance, one of the goals of the EU-funded Digital Language Diversity Project is to train speakers of European minority

UNESCO considers 2464 of the world's languages to be vulnerable, endangered, or extinct.

languages to produce and share digital content in their language (The Digital Language Diversity Project, 2015). Another example is the Endangered Language Archive of SOAS University of London, which hosts multimedia collections of endangered languages worldwide.

The enormous amount of data that our computers are capable of handling, rapid improvements in non-alphabetic input (thanks to software keyboards on phones and tablets), and a rise in the number of languages supported by major websites are all indications that linguistic diversity might be helped, rather than hindered, by technology. The average number of languages supported by major websites has more than doubled from 14 in 2006 to over 30 today (Yunker, 2018). The online encyclopaedia Wikipedia is available in almost 300 languages, of which 288 are actively used (Wikipedia, 2018). Figure 4 shows that the dominance of English and other major languages in this online resource is declining relative to other languages. Although the English Wikipedia is still the largest edition and growing, other languages have been growing at a faster rate.
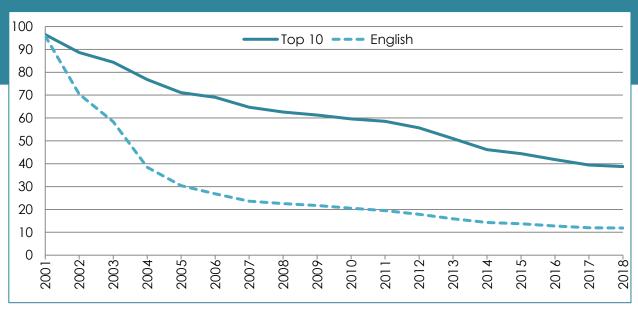
Figure 4: Percentage of total Wikipedia articles with at least one internal link in the English Wikipedia and in the combined top 10 language Wikipedias

Note: the top 10 language Wikipedias included in this calculation are English, Russian, German, Spanish, Japanese, French, Italian, Chinese, Portuguese and Polish.
Source: Wikistats (2018),"Wikimedia Statistics", https://stats.wikimedia.org.
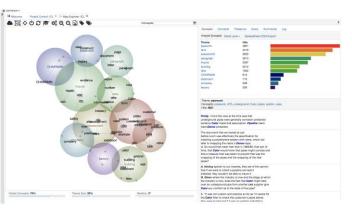
Who writes for whom?

The effects of automated reading

One of the most recent, but perhaps most fundamental changes in writing is that the text we produce is increasingly often analysed by computers before, in combination with, or even instead of being read by humans. Human writers who know that their text will be 'read' by a machine before or instead of another human may take that into account, and change how they write in order to achieve a certain effect. The idea that we would need to write differently for a machine reader is a significant development, with important implications for education and skills – and there are signs that this is already happening.

People writing for computers

Technology is changing our capacity to handle and comprehend written material. In the past, the only way to understand a corpus of written material was to have humans read every text; and the only way to find a specific piece of information within a corpus was to use an index if one had been made and contained the information needed. Now it is possible to use computers to search for words within a text; and search engines enable us to instantly access relevant information among billions of pages.

A number of technologies go further, enabling us to automate traditionally time-intensive tasks like generating summaries of longer texts; synthesising new texts by combining content from different sources; automatic text simplification; discovering and ranking the main topics covered ('topic modelling', software Leximancer pictured); identifying documents that provide novel or more up-to-date information ('novelty detection'); and to an extent translation between languages.

All of these technologies are part of a field known as natural language processing (NLP), and they substantially change what it means to access and use written material, as well as to produce it. Several examples are already in widespread use.

One example is plagiarism detection, where algorithms are used to compare a student's submitted work to an extensive corpus of written material. The software then seeks to match sentences or ideas which are falsely presented as the student's own work. Anti-plagiarism software is widely used – just one service currently counts more than 30 million students at 15,000 institutions in 150 countries (Turnitin, 2018). Another important example is job applications, which may be screened by a robot before a human recruiter. As a further example, firms may use automated sentiment analysis software to 'read' what is being said about them on social media, and give executives an automatically generated report on the firm's online reputation.

Computers writing for people

As computers have become increasingly capable, they have started to take on more of the tasks involved in producing human writing. Predictive input systems use machine learning to analyse tone, context and habits to proactively suggest words before the user needs to type them. Research is limited on the effects of these new input methods on the skills and cognitive processes usually associated with writing (such as spelling) – partly because the technologies are relatively new, and partly because they are so ubiquitous that it is impossible to identify control groups to compare with users of new input systems. What research does exist generally looks at the use of abbreviations associated with SMS messaging, already a dated technology! Studies on children who make greater use of abbreviations have generally found a positive relationship with overall literacy skills (Bushnell, Kemp and Martin, 2011; Coe and Oakhill, 2011; Plester, Wood and Bell, 2008).

Research has also demonstrated the potential of assistive technologies such as dictation with transcription for reducing spelling errors and improving the overall quality of organisation and structure of students' written work (Hetzroni and Shrieber, 2004). Perhaps most famously, the device used by Stephen Hawking was a text-input system.

Trends point toward computers becoming increasingly able to generate written content for human consumption, known as natural language generation (NLG). Early examples of this technology include the Pollen Forecast for Scotland system, which uses a template to generate a simple summary for humans to consult (Turner, Sripada, Reiter and Davy, 2006).

Writing code

A relatively new form of writing is becoming increasingly widespread: coding. The ability to produce and engage with written materials designed to make computers function is increasingly employable and has been described by some as "the new literacy" (Trucano, 2015). Figure 5 illustrates the large increase in the number of applicants on a major job search website who include coding training in their resumes.
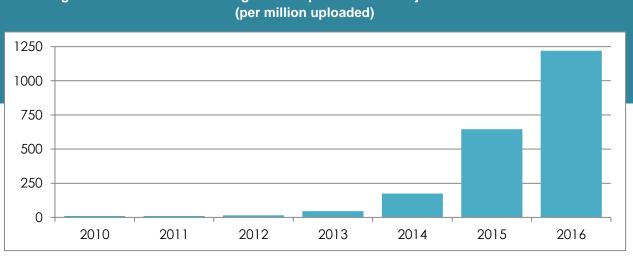
Figure 5: Resumes with 'coding bootcamp' mentioned on job search website Indeed (per million uploaded)

Source: Indeed (2017), "What Do Employers Really Think About Coding Bootcamps?" http://blog.indeed.com/2017/05/02/what-employers-think-about-coding-bootcamp/.

Debate exists as to whether programming languages should be considered as equivalent to foreign human languages in education (Nevadomski Berdan, 2014). Research is extensive on the academic, cognitive and cultural benefits of learning foreign languages; it is unclear to what extent these benefits can also be achieved by studying computer languages.

Initial research using fMRI indicates that understanding code recruits regions of the brain associated with working memory, attention, and language processing – similar to those used in speaking a foreign language (Siegmund et al., 2014). Nonetheless, computer coding evidently does not promote a deeper understanding between human cultures or of their literary and calligraphic traditions in the same way that learning human languages does.

Skills computers demand

The implications of writing for computers for education and skills could be considerable. Upwork, the world's largest freelancing website, produces a Skills Index based on year-over-year growth rates based on freelancer billings, and last year found natural language processing to be the fastest growing skill (Upwork, 2017).

An entire field of expertise within marketing concerns search engine optimisation (SEO), where people aim to generate online written material in such a way that search engines list their content higher in the results returned for related searches. A recent consultation with universities and industry across five countries on digital marketing skills identified SEO as the most important (Heinze, 2014).

As computers assist and even replace humans in generating text, it will become increasingly important to learn to identify and remove the biases and misjudgements in automatically generated content and the algorithms that generated them (O'Neil, 2016). Many of these developments are rapid and volatile – for example, SEO did not exist before the first search engines were invented in the 1990s. This fast pace of change highlights the importance of education systems that are responsive to changing needs in the written world of work.

Estonia: The ProgeTiiger Initiative

In 2012, Estonia launched an initiative to teach schoolchildren aged seven to 19 how to write computer code. ProgeTiiger reflects the strategic goals of the Estonian Lifelong Learning Strategy 2020 to apply modern digital technology to teaching and learning, improving the digital skills of the population, and guaranteeing access to digital infrastructure.

Funded by the government and run by volunteer teachers interested in teaching computer programming skills, the programme aims to promote interest, skills, and involvement of children in coding by promoting access to and collaboration on problem-solving and programming tasks.

The initiative has made a number of training resources and teaching materials available free online, and also provides teachers with classroom learning opportunities. The pool of resources is constantly expanding.

One of the challenges in coding is that much of the material is in English. ProgeTiiger has produced an extensive library of Estonian-language resources in order to broaden access to more students beyond those with strong English skills.

More information: www.progetiiger.ee (in Estonian); www.hitsa.ee/it-education/educational-programmes/progetiger

Towards the Future

Writing is enduringly important, with an indispensable role in our communication and learning. Our societies, cultures, and politics all shape and are shaped by the nature and content of our writing; and much of our linguistic heritage is preserved in written form. Technology is giving us new ways to write and process written material. Computers and humans are collaborating increasingly often in using and producing texts. This has implications for education in terms of what skills people need to adapt to the fast-changing capabilities of writing technology. It is important to be prepared. The written world is changing faster than ever, and with it so is the written word.

WRITING AND LEARNING	THE WRITTEN WORLD	WHO WRITES FOR WHOM
Writing to learn • Memory improvements • Analytical skills	**Economies and socities** • Mass writing • Writing as a political tool	**People writing for computers** • Natural language processing • Coding software
Learning to write • Handwriting and typing • Digital skills	**Cultural identities** • Linguistic diversity	**Computers writing for people** • Predictive and assistive input

Questions for future thinking

1. What skills are lost and gained in the transition from handwriting to word processing with automatic correction and prediction? Should handwriting be preserved?

2. How is the writing process different today thanks to rapid copying, editing and distribution of texts? What could be the implications of further advances?

3. Do students need skills to write computer-friendly texts, or will computers' increasing comprehension of natural language make that redundant?

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