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The "End of Writing" Myth and Hybrid Models of Learning: Balancing Digital and Analogue as a Challenge for the Education System

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Abstract

Recent debates in education often describe digitalization as the "end of writing" or the decline of literacy. This paper challenges that view, arguing instead that digital transformation reshapes literacy into hybrid forms where analogue and digital practices coexist. The study analyzes the interrelations between analogue and digital modes of learning, examining how their balanced integration can enhance cognitive development and educational equity in the post-digital era. Combining critical review with insights from the anthropology of the word and linguistic practices, this study draws on qualitative findings, educational reports, and policy documents to contextualize emerging hybrid learning models. The analysis shows that analogue competencies such as handwriting, deep reading, memorization, and mental calculation remain essential for cognitive grounding and comprehension. At the same time, overreliance on commercial digital infrastructures risks deepening inequalities, weakening public oversight, and encouraging superficial, automation-dependent learning. Two conceptual frameworks are proposed: *new lecto-orality*, which highlights the continuity of oral, written, and digital practices, and the Digital Lowest Common Denominator (DLCD), which promotes accessible, sustainable and pedagogically driven digital tools. The paper advocates for a hybrid educational paradigm that integrates analogue and digital learning through a capacity-first approach, supporting "analogue education for students, media education for teachers". Such an approach strengthens critical thinking and resilience to technological obsolescence.

Keywords: **Hybrid education, literacy, digital transformation, analogue learning, new lecto-orality, Digital Lowest Common Denominator.**

Mit „końca pisania" i hybrydowe modele uczenia się: równowaga między cyfrowym i analogowym jako wyzwanie dla systemu edukacyjnego

Streszczenie

Współczesne debaty o edukacji często przedstawiają cyfryzację jako „koniec pisma": przejaw upadku umiejętności pisania i czytania. Artykuł ten podważa tę narrację, argumentując, że transformacja cyfrowa przekształca piśmienność w formy hybrydowe, w których praktyki analogowe i cyfrowe współistnieją. Artykuł poddaje analizie relacje między analogowymi

a cyfrowymi trybami uczenia się oraz to, w jaki sposób ich zrównoważona integracja może wspierać rozwój poznawczy i równość edukacyjną w epoce postcyfrowej. Artykuł krytyczny przegląd literatury z perspektywą antropologii słowa i praktyk językowych, opierając się na danych jakościowych, raportach edukacyjnych i dokumentach polityki oświatowej w celu kontekstualizacji hybrydowych modeli uczenia się. Wyniki wskazują, że kompetencje analogowe, takie jak pisanie odręczne, pogłębione czytanie, zapamiętywanie i rachunek pamięciowy, pozostają kluczowe dla zakotwiczenia poznawczego i rozumienia, podczas gdy nadmierne poleganie na komercyjnych infrastrukturach cyfrowych może pogłębiać nierówności i osłabiać refleksyjność procesu uczenia się. W artykule zaproponowano dwa pojęcia ramowe: nową lektooralność, opisującą ciągłość praktyk ustnych, pisemnych i cyfrowych, oraz Cyfrowy Najmniejszy Wspólny Mianownik (DLCD), postulujący dostępne i pedagogicznie uzasadnione rozwiązania cyfrowe. Autorzy artykułu opowiadają się za hybrydowym paradygmatem edukacyjnym integrującym uczenie analogowe i cyfrowe w podejściu zorientowanym na rozwój kompetencji, wspierającym zasadę „edukacja analogowa dla uczniów, edukacja medialna dla nauczycieli". Takie podejście wzmacnia myślenie krytyczne i odporność na szybką dezaktualizację rozwiązań i narzędzi technologicznych.

Słowa kluczowe: **Edukacja hybrydowa, piśmienność, transformacja cyfrowa, nauka analogowa, nowa lektooralność, Cyfrowy Najmniejszy Wspólny Mianownik.**

1. INTRODUCTION

Based on critical review of previous studies, this article presents our own diagnosis of the challenges faced by contemporary education and proposes original solutions concerning the interrelations between analogue tools and skills and the digital environment.

At the center of this paper lies the claim that contemporary processes of digitalization do not herald the disappearance of writing, but rather its reconfiguration within increasingly complex analogue-digital ecosystems. The narrative of the "end of writing" obscures the continued relevance of core functions traditionally associated with analogue textual practices, such as conceptual structuring, memory consolidation, and cognitive anchoring, which retain their importance even as communicative environments evolve. What is undergoing transformation are not the foundational cognitive operations of writing, but the material infrastructures, socio-technical arrangements, and interface-driven conditions through which writing is produced, transmitted, and learned.

Against this backdrop, the article advances hybrid education as a conceptual and practical alternative to technologically determinist interpretations of contemporary change. Hybrid education does not oppose analogue and digital practices; rather, it understands them as functionally differentiated yet interdependent components of one learning ecology. This perspective enables a more precise assessment of the roles that specific practices - handwriting, paper-based reading, multimodal digital expression, platform-mediated communication - play in supporting cognitive development and educational attainment. It also facilitates a critical stance toward both alarmist discourses about the decline of literacy and unreflective enthusiasm for digital solutions.

Importantly, the reflections presented here draw primarily on observations, debates, and research emerging within the Polish and broader European Union and global context, treating these environments as representative cases of wider post-digital educational transformations.

The argument unfolds in four analytically interconnected steps designed to guide the reader through the article's theoretical and empirical reasoning.

First, the myth of the end of writing is situated within a broader anthropological and media-historical context. By tracing the recurrence of similar narratives during earlier media transitions, the analysis demonstrates that contemporary anxieties form part of a longer cultural pattern rather than marking a fundamental rupture.

Second, the article offers a critical examination of contemporary digital environments (including platform interfaces, mobile devices, short-form media, and generative artificial intelligence) to show how these technologies reshape, rather than replace, writing practices. This section introduces two conceptual tools central to the analysis: *new lecto-orality*, denoting the multimodal integration of oral, written, visual, and gestural elements describing the condensed expressive forms characteristic of platform-based communication.

Third, the cognitive dimension of analogue practices is examined through a synthesis of existing research on handwriting, reading comprehension, memorization, and mathematical reasoning. This review demonstrates that analogue competencies constitute a set of cognitively durable skills that continue to structure learning processes even in technologically dense environments.

Fourth, the discussion turns to the infrastructural and policy implications of these findings. Here, the article introduces the concept of the Digital Lowest Common Denominator (DLCD) – a principle emphasizing accessibility, durability, device-agnostic design, and pedagogical alignment in the integration of educational technologies. Drawing on examples from the Polish education system, the analysis shows how DLCD can serve as a criterion for distinguishing between meaningful and ineffective forms of digital implementation.

Together, these components form the basis of the concluding proposal for a hybrid model of education grounded in resilient cognitive competencies, multimodal literacy, and sustainable technological infrastructures. The article argues that such an approach provides a more productive framework for understanding and addressing the challenges posed by contemporary media ecosystems than prevailing narratives centred on decline or technological inevitability.

2. METHODOLOGICAL AND THEORETICAL FRAMEWORK

Our research is grounded in the premises of the anthropology of the word and the anthropology of linguistic practices – an original approach developed at the Institute of Polish Culture, University of Warsaw.

As Grzegorz Godlewski (2016) observes, the essence of this approach lies in the assumption that the primary mode of existence of language is constituted by situations of its practical use, determined by diverse and shifting cultural, historical, and social conditions, and differentiated also by the type of medium employed – understood broadly as a comprehensive communicative environment (Godlewski, 2016, p. 50).

Adopting such a perspective entails the recognition that there can be no single, uniform methodology, since each practice unfolds simultaneously in multiple dimensions, and it is impossible to account for all of them in research and description. One must therefore focus on those dimensions that provide the most fruitful access to what is specific to a given practice, and that, in turn, make themselves available to the researcher (Godlewski, 2016, p. 74).

This does not mean, however, that the following article refrains from employing specific methodological approaches. The central concept of the *new lecto-orality* was developed through qualitative research (observation, interviews, participant observation), as discussed in our earlier publications (Stachowicz, 2018, 2024). The role of writing, reading, and other analogue educational practices is examined here on the basis of existing studies and an analysis of secondary data, including reports and online materials. These considerations lead to our concluding remarks, which also serve as a concise proposal outlining the directions in which changes in educational practices and policies should proceed.

The article follows these methodological premises while integrating a set of conceptual tools that help illuminate contemporary transformations in writing, literacy, and education. Several key concepts require clarification:

- The Myth of the End of Writing refers to a recurring cultural narrative suggesting that digital technologies are causing the decline or disappearance of writing. In this text, the term functions not as an empirical claim but as a discursive formation, reflecting anxieties associated with media change rather than actual transformations in cognitive or communicative capacities.
- Hybrid Learning Models denote pedagogical approaches that intentionally combine analogue and digital tools within a unified teaching framework. They treat these modalities as complementary and assign each to the cognitive or organizational functions it supports most effectively.
- Hybrid Education, by contrast, names a broader, systemic orientation in which analogue and digital practices are integrated into curriculum design, assessment structures, and institutional organization. It extends hybrid learning models to the level of educational policy and long-term planning.
- Analogue Competencies designate the cognitive, cultural, and practical skills supported by non-digital activities such as handwriting, paper-based reading, memorization, and spatial note-taking. These competencies, as we think, remain resistant to technological obsolescence because they anchor foundational cognitive processes.
- *New Lecto-orality*, a central concept developed through our qualitative research , describes the continuum of communicative practices that blend oral, written, visual, gestural, AI-generated and platform-mediated forms. It highlights how digital tools reshape writing not by replacing it but by embedding it within multimodal, performative, and interface-driven practices.
- Finally, the Digital Lowest Common Denominator (DLCD) serves in this article as a principle for evaluating educational technologies. DLCD highlights tools and practices that are accessible, durable, device-agnostic, low-maintenance, and pedagogically meaningful. It allows us to distinguish between technologies that genuinely support learning and those that consume resources without improving educational outcomes.

3. THE END OF WRITING MYTH, ITS ROOTS, CONSEQUENCES AND CHALLENGES

In recent years, both in Poland and across the European Union, an intensive debate has been underway concerning the directions of change in educational practices and school curricula in response to the challenges posed by digital technologies. It appears that this debate – and, more broadly, the wider public discourse – is strongly permeated by the conviction that we are witnessing the end of the age of literacy, the decline of writing, and the advent of a "postliteracy" era: the end of analogue modes of producing and receiving texts. This transformation is often invoked as one of the principal reasons for the current crisis in education. Such a view is shared by both techno-enthusiasts and opponents of digital technologies and their implementation in schools.

We refer to this perspective as the *myth of the end of writing (and literacy at large)* for two reasons. First, in accordance with the colloquial meaning of the term *myth*, we regard it as a "false story." Second, we argue that the "end of writing (and literacy at large)" also constitutes a form of narrative – one that structures contemporary social life, provides interpretive frameworks for ongoing transformations, and belongs to the domain of the social imaginary. Moreover, this narrative has been recurrently invoked and (re)actualized for more than a century, since the emergence of visual media technologies.

Contemporary schooling operates amid an accelerated digital transformation, which presents specific challenges that we outline below. Recent diagnoses of media practices among Polish children and adolescents (ages 7–18) indicate widespread, intensive, everyday internet use (Bigaj et.al., 2025). What once was a separate digital life now functions as a core infrastructure for socialization and learning rather than a mere add-on to offline activity. At the same time, school policies and practices often oscillate between technophobia and technoenthusiasm, ranging from complete bans to uncritical acceptance.

A more productive stance recognizes distributional consequences. The *Matthew effect* – the cumulative advantage of those who already possess cultural capital and digital fluency – means that poorly designed educational technology policies can widen existing gaps. Students with strong literacies and supportive home environments leverage new tools to accelerate learning; students with fewer supports may encounter distraction, over-automation, or dependence on templated outputs that inhibit conceptual understanding. The task for public education is not to pick a side in a culture war over technology, but to design conditions that preserve and extend foundational literacies and scaffold meaningful, developmentally appropriate use of digital tools.

Across Europe, the prevailing trend is toward stricter regulation of students' smartphone use in schools, with educational use under teacher supervision generally exempted, suggesting that the goal is thoughtful integration rather than simple rejection (Biga & Trudnowski, 2024).

Against this backdrop, we formulate the central challenge as follows: how can we prepare young people for futures continually reshaped by digital innovation without reproducing cycles of hype and disappointment? Another challenge is the dominance of private equity in digital services for education, indicating a shift of decision-making away from public institutions. Educational institutions and the digital humanities increasingly depend on platform infrastructures for data storage, student information management, and knowledge dissemination.

An example in the Polish and EU context are two widely used systems, which exemplify this trend. VULCAN, owned by the Sanoma Group, integrates administrative and pedagogical modules and is embedded across primary and secondary schools. Sanoma also commissions and disseminates research on teachers and learning, positioning the company simultaneously as service provider and knowledge producer in the educational field. A second case is Librus, a major operator of school information systems. According to its publicly available privacy notices, personal data may be processed by external service providers and transferred to jurisdictions outside the European Economic Area. The documentation also specifies conditions under which data may be shared with third parties.

These arrangements bring into focus core governance issues: purpose limitation, third-party access, international transfers, and accountability under the General Data Protection Regulation (GDPR). Rather than assessing the propriety of individual firms, we treat these examples as illustrative of the importance of interfaces in post-digital schooling. Defaults, dashboards, and data pipelines pre-structure what is visible, recordable, and actionable in classrooms and school administration.

A further challenge is the increasing shift toward *software as a service* (SaaS), where educational platforms operate on subscription models that require ongoing payments for full functionality. This approach removes control from educators and governments, placing it in the hands of private companies. It also forces schools to invest in expensive hardware and software that quickly become obsolete.

This discussion resonates with broader transformations in the political economy of the digital sphere. Following Shoshana Zuboff's (2019) remarks on the current socio-economic system, we understand *surveillance capitalism* as an accumulation regime predicated on large-scale extraction and prediction from behavioral data. In educational contexts, datafication renders student interactions, learning trajectories, and facets of teacher labor as machine-readable traces. These traces can be integrated into value chains that optimize product development, pricing, and platform retention; in some configurations, they may also facilitate secondary uses beyond the immediate pedagogical purpose.For example, the aforementioned Librus offers advertising space as part of its services. The concern is not merely privacy, but control over the conditions of learning when classroom life is mediated by commercial infrastructures.

This leads to what we call the *Power of Interfaces* (Stachowicz, 2024): a situation in which digital humanities and education are no longer shaped primarily by teachers, scholars, or policymakers, but by the design and control of digital platforms. Interfaces dictate user interactions, available choices, and how knowledge is structured. When controlled by corporations rather than public institutions, market priorities take precedence over pedagogical values.

The ideological backdrop has also been theorized by Barbrook and Cameron (1996) as the *Californian ideology*, which champions unchecked technological growth while overlooking autonomy and the public interest. If digital education is steered primarily by commercial agents and lacks public-interest safeguards, EU member states risk ceding steering capacity over core educational infrastructures and data governance. Ensuring strategic autonomy therefore requires procurement and data-governance frameworks that align platform provision with public mandates rather than market logics alone. If mobile devices have been largely domesticated within schooling, generative artificial intelligence (AI) has unsettled the field in new ways. Two divides are salient:

- **Content-quality divide:** between easily accessible, generic AI outputs and curated, high-quality materials often locked behind paywalls or institutional subscriptions.
- **Agency divide (the Matthew effect, again):** between students who use AI as a scaffold (to draft, simulate, compare, and then revise) and those who use it as a substitute (to offload cognition and submit minimally edited outputs).

As stated above, while generative AI tools in education can raise productivity, they also encourage the replacement of one's own problem solving with model outputs, risking an erosion of cognitive effort and a new digital divide between students with high and low digital competencies. The recommended response in European policy and pedagogy, according to our expertise, should be to reinforce analogue competencies and critical thinking skills, ensuring that students remain active agents in the educational process rather than passive auditors of machine answers.

4. THE LECTO-ORAL CONTINUUM IN THE DIGITAL REALM: THE NEW LECTO-ORALITY

The way we communicate is constantly evolving, shaped by new technologies and shifting cultural practices. However, despite these transformations, there remains strong continuity between past and present communicative forms.

In the history of human communication, few concepts capture the intersection of speech and writing as clearly as *lecto--orality*, a term introduced by Jack Goody, a prominent British anthropologist and literacy theorist. *Lecto-orality* refers to the blending of oral and written traditions, acknowledging that even in literate societies, spoken language continues to shape how we write, read, and interpret texts. The persistence of storytelling, rhetorical techniques, and performative aspects of speech within written culture highlights how literacy never fully replaced orality – it merely transformed it.

In his book *Myth, Ritual and the Oral* (2010), Goody reminds us: "For it must be remembered that the arrival of a new means of communication does not replace the earlier (except in certain limited spheres); it adds to it and alters it". (Goody, 2010, p. 155). This insight, which resonates with Marshall McLuhan's media theory, underscores a crucial point: new technologies do not erase prior communicative modes but rather transform and integrate them into new configurations.

The digital era has introduced a new dimension to this relationship, leading us to coin the term *new lecto-orality* (Stachowicz, 2018). In this emerging paradigm, digital communication revives oral characteristics through technology. Speaking, writing, and reading – once revolutionary themselves – remain valuable and irreplaceable even in an era dominated by digital media.

Historically, literacy has evolved through technological shifts – from manuscripts to print, and from print to digital. Today, digital platforms enable a hybrid mode of engagement, in which reading, writing, speaking, visual interpretation, and interaction with AI tools converge. New forms of expression draw upon long-standing practices while adapting to the digital environment. The term *new lecto-orality* thus describes today's media landscape, characterized by blurred boundaries between spoken and written language and by the incorporation of AI-generated text into hybrid spaces of communication.

Among contemporary digital platforms, TikTok provides one of the most striking illustrations of the transformation of literacy practices. Its short-form videos, which integrate speech, writing, and visual design, exemplify the dynamics of lecto-oral communication. On TikTok, users read, listen, watch, and speak – often simultaneously – engaging in hybrid modes of expression that merge oral and written traditions.

The rise of such platforms raises a critical question: does the dominance of short-form video content signal the decline of writing and reading, or does it instead mark the emergence of a new linguistic paradigm?

Stachowicz's (2024) paper *Nie przeszkadzaj mi, bo robię edity: Nowa lektooralność i nowa lapidarność na platformie TikTok w perspektywie antropologii praktyk językowych (Stop Bothering Me, I'm Editing Here! A New lecto-orality and Concise Media Forms on TikTok in the Anthropology of Language Practices)* offers insight into this phenomenon. Stachowicz argues that TikTok users develop novel linguistic and semiotic practices that combine speech, written captions, and visual elements within concise, algorithmically optimized formats. Rather than replacing writing, TikTok redefines it – shifting it from a central communicative mode to a complementary component within a multimodal ecology. Writing

appears as captions, hashtags, subtitles, annotations, or automated speech-to-text transcripts, all of which serve to enhance accessibility, visibility, and engagement.

As one participant in a 2023 survey conducted by Stachowicz (2024) observed: "It's new forms of reception – listening instead of reading, but not just listening alone; listening while reading." (p. 24). This remark underscores a crucial aspect of the *new lecto-orality*: the simultaneous interplay of auditory and textual reception. The user's engagement is no longer confined to a single sensory mode but distributed across multiple semiotic channels.

From this perspective, platforms such as TikTok do not herald the "end of literacy" or the "end of writing". Instead, they exemplify literacy's ongoing adaptation to a more interactive, visually driven, and multimodal environment. The principle of *digital conciseness* – the capacity to communicate meaningfully within highly compressed formats – depends fundamentally on traditional literacy skills (Stachowicz, 2024, p.20). Understanding and producing such content requires the ability to read, write, and interpret signs critically, even when those signs appear only fleetingly on a screen.

Ultimately, digital conciseness does not eliminate writing, it reshapes it. TikTok and similar media demonstrate how writing, speech, and visual storytelling converge to form a new communicative continuum. Recognizing this shift is essential not only for the study of digital culture but also for education: cultivating digital literacy today entails strengthening, rather than abandoning, the foundational competencies of reading and writing.

It is worth emphasizing that the importance of continuity in communicative practices is not solely our own idea. Laura Sterponi, Professor of Language and Literacy at the University of California, Berkeley, together with her colleagues, has highlighted the same principle in studies of literacy practices in medicine – particularly in the communicative dynamics between patients and doctors. According to their research, understanding this continuity is crucial

This perspective directly aligns with our concept of *new lecto-orality*, which emphasizes the fluid interplay between oral, written, and digital forms of communication. The rise of new media does not signify the decline of traditional literacy but rather its transformation – an evolution in how we engage with text, speech, and multimodal expression.

As Sterponi et al. (2017) suggest, we must move beyond the binary opposition between analogue and digital technologies and instead recognize how they coexist, influence, and enrich one another. Their assertion that "literacy is rooted in the very dimension it transcends" encapsulates this insight. Literacy does not exist in isolation; it is always shaped by its historical, technological, and cultural contexts.

By understanding literacy as a process of continuity rather than rupture, we can build a more comprehensive and adaptive framework – one that enables learners not only to master digital tools but also to cultivate the critical, reflective, and multimodal competencies essential for navigating the complex communicative environments of the twenty-first century.

5. ANALOGUE COMPETENCIES IN A DIGITALLY DENSE WORLD: AN OVERVIEW

While much attention has been devoted to identifying practices that foster cognitive growth, it is equally important to consider what may hinder it. Public discourse frequently attributes declines in student well-being and cognitive outcomes to screens and social media. Prominent experts such as Jonathan Haidt have contributed greatly to this framing, warning in alarmist tones against the "rewiring" of children's minds by social media algorithms (2024). Yet, the empirical picture is more nuanced: large-scale reviews and preregistered analyses generally report small and heterogeneous associations between overall screen time and adolescent well-being. These findings caution against causal overreach and recommend focusing on how and why technologies are used rather than how long they are used (Orben, 2020; Odgers & Jensen, 2020; Przybylski & Weinstein, 2017).

As discussed earlier, educational responses to smartphone use vary across countries. In Poland, approximately 50% of schools have introduced mobile phone use restrictions on school grounds (Szumiło, 2025). However, many of these institutions permit their use for educational purposes – a sign that policymakers may be moving beyond simplistic narratives that cast technology as the root of all problems. This shift reflects a growing recognition that the challenge lies not in the presence of digital tools themselves, but in how they are integrated into pedagogical contexts. Rather than serving merely as damage control, the educational use of smartphones should emerge from a genuine belief in their cognitive and communicative potential. Policy determines who may use what and when; pedagogy must answer what knowledge endures and why. In our opinion, this approach can be summarized as investing in competencies beyond technological obsolescence.

This discussion brings us back to the broader question of what kinds of skills remain valuable in an era of rapid technological turnover. We can recall for example the case of Segway – a once-celebrated innovation that failed to transform mobility in the way its creators envisioned. More recent cases, such as the Metaverse or virtual reality (VR), have followed similar trajectories: both promised to revolutionize the way we interact, work, and socialize. Yet, their practical application has proven far more complex, raising numerous challenges and ethical dilemmas along the way.

In the face of ever-evolving technologies – entangled in a complex web of market dependencies and shaped by narratives that serve as both political battlegrounds and instruments of soft power – it seems reasonable to turn our attention back to their very foundation: text. As Kenneth Goldsmith observes, every digital material is, at its core, textual (2011, p. 14–33). Kittler further emphasizes that even software has a material dimension, ultimately reducible to shifts in electrical circuit

voltages (1992). The iconic photograph of Margaret Hamilton standing beside the Apollo mission's printed code serves as a reminder that the most groundbreaking technological achievements have always been built on text, logic, and problem-solving skills.

Hype cycles around the "next big things" (e.g., VR, the metaverse, generative AI), underscoring a strategic imperative: invest in foundational competencies that transcend tools and epochs, such as textual fluency, argumentation, and problem--solving.

Handwriting, memorization, reading on paper, and other basic skills provide a useful point of departure for this analysis. In an era dominated by digital tools, handwriting remains a crucial cognitive and educational skill; converging evidence indicates cognitive benefits of handwriting for encoding and learning. Experimental and neurophysiological studies report broader cortical engagement and advantages for conceptual processing when writing by hand relative to typing (Backes & Cowan, 2019).

Numerous studies across disciplines have demonstrated that handwriting supports deeper learning and memory retention. For instance, Wiley and Rapp (2021) found that handwriting training during letter learning enhances both reading and spelling skills, emphasizing its role in literacy development. Similarly, Marano et al. (2025) suggest that handwriting provides optimal conditions for encoding information, making it a superior tool for deep learning compared to digital note-taking.

Beyond literacy, handwriting is vital for brain development, creativity, and writing competence, particularly among children and students with learning difficulties (Lyu, 2023; Mangen, 2014; Van der Weel & Van der Meer, 2024). Scholars argue that handwriting should not be abandoned in education but taught alongside digital writing skills to ensure a balanced approach to literacy development (Lyu, 2023). Moreover, writing proficiency is often a prerequisite for academic success, with Sturk (2023) describing it as an "entrance ticket" to higher education. The ability to structure arguments and express complex ideas in written form remains a fundamental expectation in academic and professional settings. Finally, Sterponi et. al. (2017) advocates for a balanced integration of traditional and digital writing methods in school curricula, recognizing that each mode offers distinct cognitive advantages.

Rather than replacing handwriting with digital alternatives, educators should cultivate a hybrid approach that leverages the strengths of both. In line with this evidence, we may interpret Sweden's recent turn toward paper-based reading as a forward--looking recalibration aimed at improving reading literacy – advocating evidence-based, purpose-bound integration of digital tools while emphasizing the development of foundational skills that precede the use of technological devices (Diaz et al., 2024).

The debate over digital versus paper-based reading extends beyond preference; it carries significant cognitive, psychological, and educational implications. Meta-analyses show a small but robust advantage of print over screens for expository or assessment-like reading, alongside better calibration of comprehension (Delgado et al., 2018; Goodwin et al., 2019; Clinton, 2019). Another advantage of paper reading is its lower potential for distraction. Digital reading often involves switching between apps, notifications, and hyperlinks, which fragments attention (Subrahmanyam et al., 2013). In contrast, paper reading minimizes distractions, allowing for deeper focus and comprehension.

Clinton (2019) emphasizes that paper-based reading enhances metacognitive awareness – the ability to monitor and regulate one's understanding. Readers of print materials are more likely to recognize when they need to reread or adjust their strategies, which is crucial for effective learning. A key concern in the digital age is eye strain and fatigue, which Kareva (2024) highlights as a growing issue. Screens emit blue light that can contribute to headaches, difficulty concentrating, and disrupted sleep patterns. Paper, by contrast, provides a more comfortable reading experience that is easier on the eyes. For younger readers, Ronconi et al. (2022) notes that reading on paper improves performance calibration. When it comes to complex texts, Van der Weel and Mangen (2022) find that print reading supports deeper comprehension. Building on this, Froud et al. (2024) argues that reading in print leads to deeper semantic encoding – meaning that readers process and remember information more effectively compared to digital reading. This has long-term implications for learning and knowledge retention. Finally, Hakemulder and Mangen (2024) warn that excessive digital reading can promote shallow reading habits, where readers skim texts without engaging deeply. Taken together, these studies make a strong case for preserving and promoting paper-based reading, particularly in educational settings.

The same applies to memorization, mental calculation, and mathematical learning. In an era of ubiquitous digital devices, it is tempting to assume that calculators and computers eliminate the need for handwriting, memorization, and mental arithmetic. However, research consistently shows that these analog skills remain essential for deep mathematical understanding. Foundational knowledge and automaticity free working memory for higher-order reasoning (Willingham, 2006) Memorization provides the base necessary for advanced math learning. Students who internalize basic arithmetic facts, such as multiplication tables, can progress more quickly to higher-level concepts without being slowed by simple calculations.

A strong memory base frees cognitive resources, allowing students to focus on problem-solving rather than recalling basic facts. The ability to mentally manipulate numbers fosters logical reasoning, numerical intuition, and adaptability in problem-solving. Studies have shown that students who practice mental math develop stronger analytical thinking skills, which are applicable beyond mathematics. In mathematics, retrieval fluency and mental calculation support flexible strategy use and reduce cognitive load; conversely, math anxiety taxes working memory (Ashcraft & Krause, 2007).

Handwriting plays a crucial role in math learning. When students write out equations, formulas, and geometric proofs by hand, they actively engage with the material, improving their ability to visualize and understand mathematical relationships.

Unlike typing or calculator-based problem-solving, handwriting encourages slower, more deliberate processing, reinforcing comprehension.

Together, handwriting, memorization, and mental calculation create a powerful synergy, contributing to better mathematical development and stronger problem-solving abilities. By balancing traditional learning methods with modern tools, education can equip students with both the foundational skills and the cognitive agility needed for success in mathematics and beyond. Rather than treating smartphones as scapegoats, schools should design hybrid ecologies: deliberate, teacher-orchestrated use of digital tools where they add value, anchored in analog practices – handwriting, paper-based deep reading, retrieval practice, and mental arithmetic – that cultivate durable cognitive capacities.

Viewed through the lens of the anthropology of the word (Godlewski, 2015), the enduring relevance of handwriting, paper--based reading, and memorization reveals the deep continuity of human communicative practices. These embodied forms of literacy remind us that learning is not only cognitive but also material, sensory, and relational. Within the framework of *new lecto-orality,* analog and digital modalities coexist in a dynamic continuum rather than in opposition. By thoughtfully integrating these practices, education can preserve the reflective and interpretive dimensions of literacy while preparing learners for the multimodal environments of the twenty-first century.

From an anthropological perspective, this continuity underscores how communication technologies, regardless of their material form, mediate relationships between bodies, texts, and knowledge systems. Writing – whether on paper, screen, or other substrates – constitutes a social practice embedded in cultural values and epistemological frameworks. The persistence of handwriting, note-taking, and memorization across generations illustrates not resistance to innovation but the adaptability of human semiotic behavior. These practices embody a form of "cognitive craftsmanship," where meaning emerges through the tactile interaction between mind, hand, and medium.

6. DIGITAL HUMANITIES AND THE DIGITAL LOWEST COMMON DENOMINATOR

Digital Humanities (DH) denotes an interdisciplinary field that mobilizes computational methods and digital infrastructures to study, curate, and present objects of humanistic inquiry – literature, history, philosophy, linguistics, the arts, and cultural heritage. Initially, the Digital Humanities were primarily focused on the digitization of cultural texts, making historical and literary works accessible through digital archives. However, the field has since expanded to include critical reflection on the social dimensions of technology and the ways in which new technologies and media reshape institutions and social processes (Burdick et al., 2016; Maryl, 2017).

Today, the Digital Humanities not only involve textual analysis and computational research but also examine broader questions such as: How do digital platforms influence public discourse and cultural memory? What are the ethical implications of artificial intelligence in knowledge production? How do digital tools shape academic institutions, publishing, and access to education? In educational contexts, DH spans practices ranging from basic corpus exploration to data storytelling, the creation of interactive maps, or the use of AI models for analyzing and processing digitized artworks. These activities integrate technical practice with interpretive methods rather than replacing one with the other.

Translating this field-level definition into curricular terms clarifies why DH matters for schools: it supplies the interpretive capacities that STEAM frameworks increasingly seek to cultivate. After decades of STEM prioritization, policy and scholarship now advocate for STEAM – the inclusion of arts and humanities – to foster creativity, transfer, and integrative problem-solving. DH contributes distinctively to this effort by cultivating interpretive and reception literacies (e.g., historically situated reading, audience formation, cultural analysis) that underpin the creative ecosystem – not only cultural production but also the ability to understand, evaluate, and sustain it (Sanz-Camarero et al., 2023). This complements "creative class" arguments linking cultural and humanistic capacities to innovation while avoiding simplistic economism (Florida, 2012).

However, creativity-based arguments alone do not address inequality. Without attention to cultural capital, schools may amplify rather than reduce existing advantages. Classic sociology of education shows that schools often reproduce privilege through evaluative norms and cultural repertoires that favor already advantaged students (Bourdieu & Passeron, 1977). In practical terms, many "humanities" experiences – close reading, debating, or familiarity with museums – reflect middle-class cultural capital. DH can help escape this trap of reproduction and distinction if it is treated as an inclusive humanistic practice that develops students' everyday media skills (searching, selecting, remixing, visualizing) while teaching scientific standards of evidence and interpretation. The goal is not to "technologize" the humanities but to broaden access to cultural works, weakening the mechanisms of reproduction described in the literature.

The viability of this inclusive potential depends on what teachers and students can reliably do with the devices they already use. As demonstrated, among others, by the Copernicus Science Centre report *Mobile Devices in Learning and Teaching*, Polish students use mobile phones ubiquitously, and teachers already orchestrate device-supported activities (communication, collaborative writing, gamified quizzes) alongside persistent technical frictions (e.g., connectivity, device heterogeneity) (Potęga vel Żabik & Sadowska, 2024).

These challenges remain relevant amid the widespread adoption of AI tools in education. Polish discourse on generative AI emphasizes both the opportunities these tools create in schools (personalization, workflow support, democratization of access to knowledge) and the need for guidance regarding privacy, ethics, and assessment integrity (Wilamowska, 2024) This reinforces the case for DH units that teach source critique, prompt transparency, and model literacy, rather than outsourcing cognition to chatbots.

For curricular alignment, DH activities should map to digital competence frameworks used in Poland and the European Union (e.g., DigComp), encompassing information and data literacy, communication and collaboration, digital content creation, safety, and problem solving – each with defined proficiency levels and descriptors. Positioning DH within DigComp 2.2 clarifies progression, assessment, and teacher development pathways (Vuorikari et al., 2022).

Integrating the Digital Humanities into school education often faces practical and technological barriers. Many well-intentioned initiatives fail because they rely on advanced, expensive, or quickly outdated tools that are impractical for long-term educational use. A clear example is the introduction of 3D printers in Polish schools. While they represent an innovative way to engage students in hands-on learning, their impact has been limited by a lack of trained teachers and insufficient curricular integration.

Polish evidence shows that teacher time, reliability, and cross-platform operability are persistent constraints; hence, the priority should be low-barrier, browser-based workflows and iterative teacher support rather than one-off equipment purchases (Potęga vel Żabik & Sadowska, 2024). These findings support the case for the purpose-bound integration of digital activities. To re-center equity and effectiveness, we propose a Digital Lowest Common Denominator (DLCD) approach.

DLCD favors widely accessible tools with minimal hardware demands to maximize the reach and sustainability of curricular innovations. It prioritizes device-agnostic, standards-based tools (web apps, open formats, cloud services with offline fallbacks) that minimize total cost of ownership (TCO) and reduce dependence on specialized equipment. Beyond cost-effectiveness, this approach fosters long-term sustainability in digital education. It prevents schools from constantly chasing technological trends, enabling them to focus on developing digital literacy skills that remain relevant over time.

Diagnostics of the Polish education system illustrate why this shift is needed. School leaders tend to over-specify *what to buy* while under-diagnosing staff competencies: only 18% of principals report being able to identify the digital skills each teacher needs to develop, whereas 43% can readily list desired equipment – an imbalance that tilts decisions toward procurement rather than practice (Polityka Cyfrowej Transformacji Edukacji, 2024). At the same time, more than half of school computers are over five years old (51.2% in 2023; 14.1% over ten), and connectivity remains a bottleneck (92% of schools below 500 Mb/s; only 3% above 1 Gb/s). These constraints limit the educational return on "high-tech" purchases.

These structural frictions coexist with near-ubiquitous student access to mobile devices and teachers' existing device-supported practices. Research by the Copernicus Science Centre documents such everyday classroom uses alongside persistent infrastructure disparities (Potęga vel Żabik & Sadowska, 2024) . Other studies provided by NGOs indicate that the smartphone is now students' primary learning interface, implying that robust campus-wide Wi-Fi, security, and platform-neutral workflows – not bespoke devices – should form the backbone of digital modernization in schools (Drzewiecki et al., 2018).

If smartphones are the default interface, clear rules for their use are a basic prerequisite. In Poland, such rules are defined primarily in school statutes rather than by national directive. Most schools formalize phone-use policies (89.42%), about half (51.59%) apply general on-premises bans (typically with instructional exceptions), and only 15.08% use phone "deposits." Notably, 92.86% of schools report conducting some form of digital-education activity, indicating that everyday device use is better served by guided integration than by prohibition (Szumiło, 2025).

Viewed through the DLCD lens, a useful stress test of policy choices is the large, hardware-led initiative Laboratoria Przyszłości (*Laboratories of the Future*). The national program (2021–2023) equipped primary schools with STEAM hardware (e.g., 3D printers, microcontrollers, A/V kits) at a budget of roughly 1 billion PLN (Polityka Cyfrowej Transformacji Edukacji, 2024). However, the Supreme Audit Office (NIK) concluded in 2024 that the program was prepared unreliably and implemented with irregularities. Crucially, the government did not monitor or evaluate outcomes, leaving the contribution to student skills and teacher competencies unknown.

Independent reporting highlights additional issues, including ad hoc equipment requests, safety and compliance lapses, and uneven training (Najwyższa Izba Kontroli, 2019) Read together with system diagnostics – obsolete devices, connectivity gaps, and uneven infrastructure – the audit underscores a broader lesson: hardware-led modernization without needs analysis, teacher development, lifecycle planning, and usage analytics will underperform, regardless of how innovative the devices may be.

This example, among many, motivates a shift from acquiring devices to designing sustainable, device-agnostic ecologies. In other words, the question is less *what to buy* than *what persists*. The DLCD framework operationalizes that shift by prioritizing platforms and practices that:

- work across the devices students already have access to,
- rely on open standards and widely supported file types, and
- can be sustained within typical school budgets and IT capacities.

From an equity and reach standpoint, bring-your-own-device (BYOD) realities and near-universal smartphone access argue for browser-based activities that degrade gracefully on low-spec devices, ensuring inclusion without costly one-to-one hardware programs (Drzewiecki et al., 2018) . At the same time, a resilience logic applies: where more than half of devices are over five years old and bandwidth is constrained, lightweight, standards-compliant tools better preserve functionality over time and reduce technical overhead.

Pedagogical alignment should guide technology selection. Teacher upskilling and digital-competence assessment – not procurement lists – must drive decisions, in line with national and European frameworks (Polityka Cyfrowej Transformacji Edukacji, 2024).

At both system and school levels, implementation should begin with an exploration of possibilities rather than procurement. Major purchases ought to be preceded by needs assessments and staff-development plans to correct the documented equipment-first bias. Within this capacity-first posture, technology choices should privilege web-first, standards-based tools with offline modes and open formats, avoiding proprietary lock-in and recurring license churn.

This preference is not merely technical. The *Digital Transformation of Education Policy* report notes strong supplier influence on school purchasing via marketing, webinars, and bundled offers, with some schools later regretting their vendor choices (Polityka Cyfrowej Transformacji Edukacji, 2024). Avoiding lock-in should therefore be a governance requirement, not a matter of convenience. Because equitable use of personal devices depends on shared infrastructure, investments should prioritize campus-wide Wi-Fi, security, and reliable bandwidth (Cyfrowa szkoła 4.0, 2024)

Usage and outcomes should be monitored with simple analytics tracking who uses which tools, how often, and for which learning tasks, followed by periodic public reviews – precisely what the NIK audit found missing in *Laboratoria Przyszłości*. Procurement must also follow lifecycle and TCO discipline, budgeting for maintenance, consumables, training, and responsible decommissioning, and favoring tools with long support windows and multi-device compatibility.

In the context of school education, a DLCD approach translates into high-value, low-friction practices that run on devices students already use and draw on open cultural resources. Instruction should leverage national and European repositories of digitized texts, artworks, and maps for data storytelling, annotation, and comparative analysis. This cultivates reception literacies and source critique while aligning with the realities of everyday mobile use and heterogeneous classroom devices.

By introducing students to open-access digital archives, collections, and databases, educators empower them not only to explore and interpret cultural materials but also to adapt, remix, and creatively repurpose them. This approach fosters the development of students as active prosumers of cultural content – individuals who engage critically and creatively with heritage and media rather than passively consuming them.

In parallel, teachers should implement reproducible, browser-based workflows (e.g., lightweight text analysis in web notebooks, interactive mapping, or audio storytelling in web editors) and evaluate them against learning aims and competence descriptors, not mere device utilization. This aligns with recommendations to organize open resources, ensure platform continuity, and adhere to accessibility standards (e.g., WCAG) so that activities remain inclusive across learner needs.

The responsible use of generative AI should be treated both as a subject of inquiry and as a support tool. It requires transparency, citation and verification of results, and a clear distinction between cognitive support and cognitive substitution. Finally, a web-first, standards-based toolset reduces dependence on niche equipment and better tolerates bandwidth constraints and aging devices.

By embracing the Digital Lowest Common Denominator, education systems can ensure that the Digital Humanities become an inclusive, accessible, and sustainable dimension of modern schooling.

7. CONCLUSION: TOWARDS A HYBRID MODEL OF EDUCATION

As education continues to evolve in response to technological advancement, the challenge lies not in choosing between analogue and digital learning, but in establishing an effective balance between the two. In the digital era, analogue modes of education remain indispensable to cognitive development and intellectual engagement. As Sterponi et al. (2017) argues: "Understanding the affordances of paper-based literacy provides insights for refining digital tools as well as for motivating the design of possible hybrid forms and digital-analogue intersections." (p.360) This perspective emphasizes that analogue methods are not obsolete but continue to offer distinctive cognitive benefits, including deeper comprehension, critical thinking, and sustained focus. Consequently, digitalization should be viewed not as a replacement for traditional education but as an enhancement – where digital tools complement rather than displace the proven advantages of handwriting, memorization, and deep reading.

7.1 The Enduring Cognitive Value of Analogue Practices

Paper-based literacy continues to play a crucial role in shaping effective educational practices. Traditional methods such as handwriting and working on paper foster cognitive development, enhance memory retention, and strengthen problem--solving abilities. These forms of learning engage tactile and spatial dimensions of cognition that are often diminished in digital contexts. Rather than presenting analogue and digital approaches as opposing paradigms, contemporary education should aim

to integrate them meaningfully. Such integration recognizes that while digital tools enable access, speed, and collaboration, analogue methods support reflection, focus, and depth of understanding – qualities essential for sustained intellectual growth.

7.2 Skills Beyond Technological Obsolescence

In an era of rapid technological change, the most valuable skills are those that do not expire. While digital tools evolve and become obsolete within short cycles, foundational abilities such as handwriting, deep reading, and critical thinking remain enduring and indispensable. A balanced educational model, in which analogue and digital methods operate in mutual support, is therefore central to fostering long-term learning and cognitive adaptability. The cultivation of these skills equips students not only to use technology effectively but also to question, interpret, and create knowledge independently within a digitally mediated world.

7.3 Preparing for the Future, Not Merely the Next Update

Education systems must therefore prepare for the future, not merely the next technological update. This involves investing in skills that transcend technological obsolescence and equipping students with cognitive capacities that endure beyond changes in hardware or software. Handwriting and paper-based reading strengthen comprehension and memory, providing a foundation for deep, critical engagement with knowledge. By reinforcing analogue learning methods, educators can cultivate independent reasoning and reflective thought – competencies that remain essential regardless of technological context.

7.4 Sustainable Integration of Digital Tools: DLCD

At the same time, schools must adopt a pragmatic and sustainable approach to technology. Rather than pursuing the latest digital devices, institutions should prioritize accessible, adaptable, and pedagogically sound digital tools using the rule of the Digital Lowest Common Denominator. Technology should enhance learning rather than dictate it, ensuring equitable access across diverse socioeconomic settings. Web-based resources and open platforms offer practical, inclusive alternatives to expensive, rapidly outdated hardware, supporting both pedagogical innovation and educational equity.

7.5 A Balanced Educational Principle: "Analogue Education for Students, Media Education for Teachers"

A renewed balance between analogue and digital learning can be expressed through the principle: analogue education for students, media education for teachers. This formulation encapsulates the complementary roles of learners and educators in the digital era. Students should first master fundamental, non-digital skills before integrating technological tools into their learning processes. Teachers, in turn, must engage in continuous media education, enabling them to evaluate digital tools critically and guide students toward their meaningful use. Such a framework mitigates superficial engagement and overreliance on algorithmic or AI-generated content, while fostering creativity, adaptability, and intellectual independence.

7.6 Teachers as Critical Guides in the Digital Environment

In this context, teachers must be understood not merely as users of technology but as critical guides within the digital environment. Their pedagogical role extends beyond the implementation of digital tools to include their critical assessment and contextual adaptation. This demands ongoing professional development focused on digital literacy, pedagogical reflection, and the capacity to integrate technology in ways that deepen understanding rather than accelerate distraction. Increasingly, this hybrid approach is gaining institutional recognition, reflecting a broader awareness that effective education in the digital age requires both technological competence and cognitive depth.

7.7 A Vision for the Future of Education beyond the Myth of the End of Writing

Ultimately, the future of education depends not on the dichotomy between analogue and digital learning but on their thoughtful integration. This integration requires rejecting what may be termed the myth of the end of writing – the belief that digital technologies render handwriting, textual production, and traditional literacy practices obsolete. Such narratives often accompany each technological revolution, from the advent of print to the rise of the computer, predicting the disappearance of earlier communicative forms. Yet history demonstrates that new media rarely eliminate previous ones; rather, they transform and recontextualize them.

By cultivating deep literacy, critical thinking, and adaptable technological competence, education can prepare students for a world in which technology functions as a tool for meaningful learning and intellectual growth rather than as a substitute. A hybrid educational model, grounded in cognitive tradition yet responsive to technological innovation, offers the most sustainable path toward a future-ready and holistic system of education.

REFERENCES

Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance, and math anxiety. *Psychonomic Bulletin & Review, 14*(2), 243–248. https://doi.org/10.3758/BF03194059

Backes B., & Cowan J. (2019). Is the pen mightier than the keyboard? The effect of online testing on measured student achievement. *Economics of Education Review, 68*, 89–103. https://doi.org/10.1016/j.econedurev.2018.12.007

Barbrook, R., & Cameron, A. (1996). The Californian ideology. *Science as Culture, 6*(1), 44–72. https://doi.org/10.1080/09505439609526455

Biga, B., & Trudnowski, J. (2024). *Zatrzymać smartwicę. Badania, regulacje, rekomendacje dotyczące smartfonów w szkołach*. Centrum Analiz Klubu Jagiellońskiego.

Bigaj M., Ciesiołkiewicz K., Mikulski, K., Miotk, A., Przewłocka J., Rosa, M., & Załęska, A. (2025). *Internet dzieci. Raport z monitoringu obecności dzieci i młodzieży w internecie. Instytut Cyfrowego Obywatelstwa*. Państwowa Komisja do spraw przeciwdziałania wykorzystaniu seksualnemu małoletnich poniżej lat 15.

Bourdieu, P., & Passeron, J.-C. (1977). *Reproduction in education, society and culture*. Sage.

Burdick, A., Drucker, J., Lunenfeld, P., Presner, T., & Schnapp, J. (2016). *Digital_Humanities*. MIT Press.

Clinton, V. (2019). Reading from paper compared to screens: A systematic review and meta-analysis. *Journal of Research in Reading, 42*(2), 288–325. https://doi.org/10.1111/1467-9817.12269

Cyfrowa szkoła 4.0. Raport Związku Cyfrowa Polska. (2024). https://cyfrowapolska.org/wp-content/uploads/2024/03/Raport_Cyfrowa_Szkola_4.pdf

Delgado, P., Vargas, C., Ackerman, R., & Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension. *Educational Research Review, 25*, 23–38. https://doi.org/10.1016/j.edurev.2018.09.003

Díaz, B., Nussbaum, M., Greiff, S., & Santana, M. (2024). The role of technology in reading literacy: Is Sweden going back or moving forward by returning to paper-based reading? *Computers & Education, 213*, 105014. https://doi.org/10.1016/j.compedu.2024.105014

Drzewiecki, M., Głomb, K., Maziarz, M., Michalska, B., Michniuk, A., Mieczkowski, P., Morańska, D., Srokowski, Ł., Tokarz, T., Turski, R., Szpot, E., & Zwierzyńska, B. (2018). *Smartfon jako osobiste narzędzie edukacyjne ucznia. Studium. Analiza i rekomendacje ekspertów Sieci Edukacji Cyfrowej KOMET@*. https://digitalpoland.org/assets/publications/smartfon-jako-osobiste-narzedzie-edukacyjne-ucznia/smartfon-jako-osobiste-narzedzie-edukacyjne-ucznia-raport.pdf

Florida, R. (2012). *The rise of the creative class – revisited*. Basic Books.

Froud, K., Levinson, L., Maddox, C., & Smith, P. (2024). Middle-schoolers' reading and lexical-semantic processing depth in response to digital and print media: An N400 study. *PloS one, 19*(5), e0290807. https://doi.org/10.1371/journal.pone.0290807

Godlewski, G. (2015). Anthropology of the word: The stepsister of linguistic anthropology. *Anthropological Journal of European Cultures, 24*(1), 7–23. https://doi.org/10.3167/ajec.2015.240102

Godlewski, G. (2016). Antropologia praktyk językowych: wprowadzenie. In M. Rakoczy, G. Godlewski & A. Karpowicz (Eds.). *Antropologia praktyk językowych* (pp. 7–80). Wydawnictwa Uniwersytetu Warszawskiego. https://doi.org/10.31338/uw.9788323521822

Goldsmith, K. (2011). *Uncreative writing: Managing language in the digital age*. Columbia University Press.

Goodwin, A. P., Cho, S.-J., Reynolds, D., Brady, K., & Salas, J. (2019). Digital versus paper. Reading processes and links to comprehension for middle school students. *American Educational Research Journal, 57*(4), 1837–1867. https://doi.org/10.3102/0002831219890300

Goody, J. (2010). *Myth, ritual and the oral*. Cambridge University Press. https://doi.org/10.1017/CBO9780511778896

Hakemulder, F., & Mangen, A. (2024). Literary reading on paper and screens: Associations between reading habits and preferences and experiencing meaningfulness. *Reading Research Quarterly, 59*, 57–78. https://doi.org/10.1002/rrq.527

Haidt, J. (2024). *The anxious generation: How the great rewiring of childhood is causing an epidemic of mental illness*. Penguin Press.

Kareva, L. (2024). The influence of the reading medium on learning efficacy. *International Journal of Social Science and Education Research Studies, 4*(1), 65–69.

Kittler, F. (1992). *Discourse Networks 1800/1900*. Stanford University Press.

Lyu, Y. (2023). The cognitive and educational importance of handwriting in the digital age. *Frontiers in Psychology, 14*, 110234. https://doi.org/10.3389/fpsyg.2023.0110234

Mangen, A. (2014). The hand and the digital: Reflections on the psychophysiology of writing. *Literacy Studies, 9*(2), 117–129. https://doi.org/10.1007/s11145-013-9474-0

Marano, G., Kotzalidis, G., Lisci, F., Anesini, M.B., Rossi, S., Barbonetti, S., Cangini, A., Ronsisvalle, A., Artuso, L., Falsini, C., Caso, R., Mandracchia, G., Brisi, C., Traversi, G., Mazza, O., Pola, R., Sani, G., Mercuri, E., Gaetani, E., & Mazza, M. (2025). The Neuroscience Behind Writing: Handwriting vs. Typing—Who Wins the Battle? *Life, 15*(3),345. https://doi.org/10.3390/life15030345

Maryl, M. (2017). Kim są polscy humaniści cyfrowi? *Teksty Drugie* (1), 286–300.

Najwyższa Izba Kontroli (2019). *Informacja o wynikach kontroli. Realizacja programu „Laboratoria przyszłości"*. https://www.nik.gov.pl/plik/id,29648,vp,32504.pdf

Odgers, C. L., & Jensen, M. R. (2020). Annual research review: Adolescent mental health in the digital age: facts, fears, and future directions. *Journal of Child Psychology and Psychiatry, 61*(3), 336–348. https://doi.org/10.1111/jcpp.13190

Orben, A. (2020). Teenagers, screens and social media: A narrative review of reviews and key studies. *Social Psychiatry and Psychiatric Epidemiology, 55*(4), 407–414. https://doi.org/10.1007/s00127-019-01825-4

Polityka Cyfrowej Transformacji Edukacji. Diagnoza. (2024). https://www.gov.pl/attachment/02cc2285-f376-4222-b-185-2923278aadf1

Potęga vel Żabik, K., & Sadowska, S. (2024). *Urządzenia mobilne w uczeniu się i nauczaniu. Raport z badań ilościowo-jakościowych*. Centrum Nauki Kopernik.

Przybylski, A. K., & Weinstein, N. (2017). A large-scale test of the Goldilocks hypothesis: Quantifying the relations between digital-screen use and the mental well-being of adolescents. *Psychological Science, 28*(2), 204–215. https://doi.org/10.1177/0956797616678438

Ronconi, A., Veronesi, V., Mason, L., Manzione, L., Florit, E., Anmarkrud, Ø., & Bråten, I. (2022). Effects of reading medium on the processing, comprehension, and calibration of adolescent readers. *Computers & Education, 185*. https://doi.org/10.1016/j.compedu.2022.104520.

Sanz-Camarero, R. Ortiz-Revilla J., & Greca, I.M. (2023). The impact of integrated STEAM education on arts education: A systematic review. *Education Sciences, 13*(11), 1139. https://doi.org/10.3390/educsci13111139

Stachowicz, J. (2018). Digitally assisted conversation – Google and changes in literacy practices. *Open Cultural Studies, 2*(1), 805–813. https://doi.org/10.1515/culture-2018-0074

Stachowicz, J. (2024). „Nie przeszkadzaj mi, bo robię edity": Nowa lektooralność i nowa lapidarność na platformie TikTok w perspektywie antropologii praktyk językowych. *Kultura Współczesna*, *2*(127), 16–31. https://doi.org/10.26112/kw.2024.127.02

Stachowicz, J. (2024). Władza interfejsów? Kalifornizacja akademickiego pisania. In M. Rakoczy & A. Sobolewska (Eds.), Praktyki piśmienne / Warsztaty humanistyczne. *Almanach antropologiczny. Communicare, t. 9,* 117–127. Wydawnictwa Uniwersytetu Warszawskiego. https://doi.org/10.31338/uw.9788323565758

Sterponi, L. Zucchermaglio, C., Alby, F., & Fatigante, M. (2017). Endangered literacies? Affordances of paper-based literacy in medical practice and its persistence in the transition to digital technology. *Written Communication, 34*(4), 359–386. https://doi.org/10.1177/074108831772330

Sturk, E. (2023). The teaching of writing across the curriculum in school years 4–6 in Sweden. *Written Communication, 40*(3), 892–942. https://doi.org/10.1177/07410883231169505

Subrahmanyam, K., Michikyan, M., Clemmons, C., Carrillo, R., Uhls, Y., & Greenfield, P. (2013). Learning from paper, learning from screens: Impact of screen reading and multitasking conditions on reading and writing among college students. *International Journal of Cyber Behavior, Psychology and Learning, 3*(4), 1–27. https://doi.org/10.1016/j.econedurev.2018.12.007

Szumiło, W. (2025). *Edukacja cyfrowa*. Fundacja Grow Space.

Wilamowska, K. (2024). Jak ChatGPT zmieni polską szkołę. *Domena*, 2/2024. https://pti.org.pl/wp-content/uploads/2024/06/8_Jak-ChatGPT-zmienia-polska-szkole.pdf

Wiley, R. W., & Rapp, B. (2021). The effects of handwriting experience on literacy learning. *Psychological Science, 32*(7), 1086–1103. https://doi.org/10.1177/095679762199311

Willingham, D.T. (2006). How knowledge helps. *American Educator, 30*(1). https://www.aft.org/ae/spring2006/willingham

Van der Weel, A., & Mangen, A. (2022). Textual reading in digitised classrooms: Reflections on reading beyond the internet. *International Journal of Educational Research, 115*, 102036. https://doi.org/10.1016/j.ijer.2022.102036

Van der Weel, F. R., & Van der Meer, A. L. H. (2024). Handwriting but not typewriting leads to widespread brain connectivity: A high-density eeg study with implications for the classroom. *Frontiers in Psychology, 14*, 1219945. https://doi.org/10.3389/fpsyg.2023.1219945

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The digital competence framework for citizens. Publications office of the European Union*. https://data.europa.eu/doi/10.2760/115376

Zuboff, S., & Schwandt, K. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*. Profile Books.