

Article

Communicating for Sustainability in the Digital Age: Toward a New Paradigm of Literacy

Brian L. Ott 

Department of Communication, Media, Journalism and Film, Missouri State University,
Springfield, MO 65897, USA; brianott@missouristate.edu

Abstract: Efforts to create a sustainable future require careful and complex thinking, interdisciplinary and cross-organizational collaboration, and effective and ethical communication. However, the structural biases of digital communication technologies foster modes of thought and expression that undermine or impede these necessities. While one possible solution to this problem is digital literacy, the two prevailing paradigms of digital literacy both reproduce the myth of technological neutrality. This myth further inhibits sustainability by wrongly suggesting that digital technologies are appropriate to all communication goals and tasks. As a corrective to these models, I propose a new paradigm of digital literacy, one rooted in media ecology. The adoption of this model, I maintain, allows us to consciously co-create our social world rather than merely inhabit it.

Keywords: communication sustainability; digital literacy; digital mindset; myth of technological neutrality; media ecology; structural bias; habits of mind

1. Introduction

Our world is beset by challenges. Despite considerable scientific achievements and technological advancements, humanity continues to wrestle with issues of sustainability such as social equity, public health, renewable energy, resource conservation, and human-induced climate change among others. Given the complexity of these issues, efforts to successfully address them require experts and specialists across various fields to work together to develop, promote, and implement innovative solutions.

Though often overlooked, effective and ethical communication is a crucial dimension of sustainability efforts [1–5]. This is especially true in the digital age when even the best ideas and solutions are easily overlooked or misunderstood amidst the 120 zettabytes of existing information. Nor are the benefits of communication limited to promoting awareness and understanding. Communication is vital to fostering collaboration, facilitating education, encouraging behavioral change, securing funding, and generating political support for sustainability.

In short, the challenges of our age demand sophisticated thinking, cooperative action, and clear, coherent, and constructive communication. Indeed, that recognition is partially the impetus for this journal. However, even as the challenges we face have grown in complexity, our prevailing communication technologies have fostered modes of thought and expression that are ill equipped to address them. In fact, my central contention in this essay is that digital communication technologies encourage modes of thought and expression that are simplistic, polarizing, emotional, and self-interested.

This is, I maintain, a sustainability concern. As I demonstrate throughout this essay, digital technologies work to atomize us, to undermine rational, deliberative thought, to encourage impulsivity, and to silence voices and views interested in bringing people together to solve problems. In so doing, digital communication technologies undermine our shared humanity and, ultimately, the future health of our planet.

But even if one does not regard the structural biases of digital technologies as a sustainability concern, the matter threatens traditional sustainability efforts to the extent that it is



Citation: Ott, B.L. Communicating for Sustainability in the Digital Age: Toward a New Paradigm of Literacy. *Challenges* **2024**, *15*, 29. <https://doi.org/10.3390/challe15020029>

Academic Editor: Susan Prescott

Received: 28 April 2024

Revised: 20 May 2024

Accepted: 30 May 2024

Published: 3 June 2024



Copyright: © 2024 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

logically prior to them. Since the challenges identified above demand careful and complex thinking, cross-organizational collaboration, and clear and cooperative communication, and digital technologies limit and erode those modes of thought and expression, we cannot reliably solve those problems without first solving the “communication technology” problem.

My central aim in this essay, in addition to highlighting how digital communication technologies create limiting and often dangerous modes of thought and expression that impede sustainability efforts, is to propose a solution to our communication technology problem. That solution is rooted in the idea of digital literacy. While digital literacy is not a novel solution, I advance an alternative approach to the prevailing models of digital literacy.

Toward this end, the essay proceeds in four stages. First, I map the current intellectual terrain of digital literacy, describing the two dominant paradigms and demonstrating how they participate in the myth of technological neutrality. Second, I sketch the contours of a conscious model as an alternative way to conceptualize literacy by explaining media ecology and charting anti-environments. Third, I identify the seven key structural biases of digital technologies and the attendant habits of mind they cultivate. Fourth, I reflect on the challenges and consequences of the new paradigm and demonstrate how it is better equipped to help us navigate and negotiate the challenges of our digital world.

2. The Prevailing Paradigms: Competency and Critical Thinking

Digital literacy is an interdisciplinary field of study that aims to enhance our use of digital communication technologies. Like many areas of academic study, it is multifaceted and employs a wide variety of perspectives and methodologies [6–16]. Digital literacy is important to sustainability because our experience of the social world today is mediated almost entirely by digital technologies [17,18]. Even when we are not online, a digital mindset conditions how we think, feel, and act [19,20].

This fact fuels a complex array of interrelated social problems that, at minimum, include the proliferation of misinformation [21], fake news [22], conspiracy theories [23], affective polarization [24], political tribalism [25], cultural fragmentation [26], authoritarianism [27], social alienation [28], cyberbullying [29], interpersonal incompetence [30], malignant narcissism [31], and varying psychological problems ranging from loneliness and depression to anxiety and compulsiveness [32,33]. All these concerns potentially impede efforts to solve larger social problems.

Deepening our commitment to the project of digital literacy is the best way to combat these problems. This is only possible, I argue, if we first correct the faulty assumption that animates much of this work. That assumption, which can succinctly be stated as the belief that digital technologies are neutral or inert, seriously hampers the efficacy of digital literacy efforts and programs because it forecloses consideration of the most salient issue, which is the underlying structural biases of digital technologies.

Technologies are never neutral [34]. Rather, they possess inherent biases that make them well suited to some tasks and poorly suited to others. One would not use a sponge to pound a nail or a hammer to clean a window. So, it is foolish to assume that digital technologies (devices, platforms, and media) can profitably achieve any communication goal. We make this misguided assumption, at least in part, because the two prevailing models of digital literacy are both concerned with using digital technologies—one more effectively and the other more reflectively—but not with how digital technologies use us and, thus, whether they are beneficial and appropriate in some contexts. In this section, I clarify the two prevailing paradigms of digital literacy and highlight how they reflect and reproduce the misguided and dangerous assumption of technological neutrality.

The first paradigm, which I call the *competency model*, treats digital literacy as a set of procedural skills or technical proficiencies related to digital communication technologies (devices, platforms, and media) [8–10]. It grew out of a corporate desire to maximize the use of new information technologies to enhance and achieve organizational goals, especially in the areas of marketing and public relations. This model focuses on the development of various “competences” like the ability to use computers (computer literacy), to search,

locate, and retrieve information (library literacy), and to effectively design, create, edit, manipulate, post, circulate, and generate maximum engagement with digital content across social media platforms (production literacy). In the competency model, digital literacy provides “a strong requirement for the sustainability of businesses, the livelihood of workers, and the growth of economies” [8] (p. 2).

The second paradigm, which I refer to as the *critical model*, treats digital literacy as a hermeneutic practice [12,13]. It grew out of a broader concern among educators about media literacy that emerged in the 1960s. It focuses on the ability to assess and evaluate different aspects of digital content and includes various subcategories like photo-visual literacy, news literacy, socio-emotional literacy [16], and more recently, data literacy [35]. The central concerns of the critical model are to foster the practice of critical thinking and to promote the development of digital citizenship [14,36,37]. More specifically, the critical model seeks to reveal the underlying attitudes, values, and beliefs of digital messages, which is to say the ideological biases of digital content.

danah boyd has criticized the critical model of literacy for its obvious partisanship [38,39]. While boyd’s concerns about the political bias of this model are worth taking seriously, my primary issue has to do with the model’s failure to account for epistemological bias. The critical model of literacy is typically not concerned with the habits of mind or modes of consciousness unique to digital communication technologies, and, thus, is not well suited for making determinations about whether digital media are beneficial and appropriate in certain contexts and situations.

There is, however, a growing recognition among some scholars that the critical model needs to be rethought for the digital age. Cathy Burnett and Guy Merchant, for instance, have variously argued that critical literacy needs to attend more carefully to the unique character of digital messages [40–42]. This is a step in the right direction, though their approach overwhelmingly remains focused on messages (or “texts”) and their meanings and ideologies rather than on technologies and their structural biases. So, while Burnett and Merchant are interested in how digital messages circulate in larger social networks and elicit and mobilize affective investments, they lack a well-developed vocabulary and perspective for understanding how both of these factors are related to technological bias as opposed to message or ideological bias.

In sum, while the competency and critical models of digital literacy have very different aims, they both participate in the myth of technological neutrality. That myth is a particularly challenging one to combat today because our current social environment is so thoroughly dominated by digital communication technologies that the environment itself—like any environment at the moment we inhabit it—is all but “invisible” [43] (p. 68). That invisibility is precisely why an alternative model of literacy must actively establish anti-environments. Without showing how different technologies produce different environments, it is nearly impossible to “map” how digital technologies condition the way we make sense of ourselves and our social world [17], which reproduces the myth of technological neutrality.

The competency model reproduces the assumption of technological neutrality by insisting on our use of and proficiency with digital technologies, which it treats as being as equally appropriate and well suited as nondigital technologies for all communication goals and tasks. The speed with which institutions “transitioned” education—at all levels—to remote learning during the COVID-19 pandemic reflects a broad cultural ignorance about the importance and influence of different mediums. We now, of course, have considerable evidence that students—again, at all levels—were harmed by the transition to remote learning [44]. Despite the dramatic limitations of online learning, educational institutions continue to aggressively develop and promote remote learning as though it is as effective as seated, face-to-face learning. It is not.

The critical model also reproduces the mistaken assumption of technological neutrality, though it does so in a different manner. Rather than incorrectly suggesting that digital and nondigital technologies are interchangeable, it suggests that any bias in digital media is

derived either from content or use. This model of digital literacy would have users reflect on how the source or receiver of a message biases content, but it ignores how the technology itself is inherently biased. In doing so, this perspective fails to take seriously the insights of new materialism, which insists both on the liveliness of matter and the idea that “it is *the medium that makes rhetoric* [media messages] *material*” [45] (p. 41).

3. An Alternative Paradigm: Consciousness

To correct the flawed assumption of technological neutrality, it is crucial that we rethink the concept of digital literacy. Thus, in this section, I sketch the contours of an alternative paradigm that I have dubbed the consciousness model. To better understand this model, I first introduce and explain the perspective of media ecology, which serves as the basis for developing a conscious model of literacy, and second, situate our digital environment in an appropriate historical context. The effort to historicize technologies is key to a consciousness model of digital literacy because it fosters “perspective by incongruity”, transforming a way of not seeing into a way of seeing [46] (pp. 308–310).

3.1. On the Field of Media Ecology

The last century . . . has witnessed a radical transformation in the entire human environment, largely as a result of the impact of . . . technology. All these changes have, in turn, produced alterations in the human personality. [47] (p. 3)

Media ecology is an interdisciplinary field of study that examines how technologies of communication create distinctive social environments that, in turn, alter the character of our communication, shape the contours of our culture, and condition our modes of consciousness [48–50]. At a minimum, it draws insights from the disciplines of communication, psychology, sociology, anthropology, history, urban planning, and political science. A few of its most well-known practitioners include Harold Innis, Marshall McLuhan, and Walter Ong, though its roots can be traced back to the ancient Greeks. As a field of study, media ecology is rooted in medium theory, which adopts four axioms [51].

Axiom 1 holds that every medium has relatively distinct and fixed structural features. In explaining this axiom, it is important to note that media ecologists often use the terms media and technology interchangeably. Not only do they regard every medium as a technology, but to the extent that every medium is expressive of a core idea or set of ideas, they also regard every medium to be a communication technology. To understand the central idea or set of ideas that a technology conveys, one needs, first, to examine its basic structural features and underlying form. A carpenter’s hammer, for instance, has a long handle and a weighted head, two structural features that allow it to concentrate and direct considerable force into a small area.

Axiom 2 states that the structural features of media are never neutral. In other words, all technology is biased. As Neil Postman writes in *Technopoly*, “Embedded in every technology there is a powerful idea, sometimes two or three powerful ideas” [52] (p. 14). Continuing with the example of a hammer, we might say that is biased in favor of exercising concentrated force. However, the so-called “powerful idea” of a hammer is that you can construct things using concentrated force. You can “build” new things by nailing them together. While a hammer can be used to smash as well as to build things, smashing is not its core idea. Indeed, we have separate technologies, like clubs and wrecking balls, which are specifically designed for smashing rather than building.

Axiom 3 asserts that technology’s biases create the social environment we inhabit. The important point to understand regarding axiom 3 is that technologies are not merely additive, they are transformative or “ecological” [52] (p. 18). When a new technology is introduced into an environment, the result is not simply the “old” environment plus the “new” technology. The new technology creates a new environment, though how much that environment differs from the previous one is obviously related to the technology. When hammers and other technologies of construction were introduced into our social

environment, that environment became one of building and construction. Clubs, which existed long before hammers, did not lead to an explosion of construction.

Axiom 4 states that our social environment structures our communication, culture, and consciousness. As our environment changes, so too does everything else because everything else is, at least partially, a consequence of our environment. That having been said, while the structural biases of a technology are relatively fixed, the introduction of the same technology into different existing environments will not always produce identical results. Attitudes about a specific technology and, by extension, the rules and regulations governing its use can powerfully influence the changes that technology elicits. Guns, for instance, have changed every society in which they were introduced, but only in the United States did they create a culture of gun violence [53].

A consciousness model of literacy draws on the four axioms of medium theory to better understand the environment that prevailing technologies create. Importantly, in this alternative paradigm, competency and critical models of literacy are still valued. However, the matter of how to use digital media—both effectively and reflectively—is secondary to a focus on technological bias. Recognizing that not all technologies are equally suited to all communication tasks, the conscious model foregrounds the appropriateness of digital technologies in the teaching of competency. Similarly, the revised paradigm continues to value critical thinking, but situates the concern with ideology (attitudes, values, and beliefs) in the broader context of epistemology (habits of mind).

3.2. On the Importance of Anti-Environments

[A]lmost by definition any radical transformations brought about by the media are impossible to fully grasp at the time they are taking place. This is because how we understand the world is structured by and accessible through our media. . . . All we can do therefore is to map the changes we see. [17] (pp. 9–10)

Mapping the contours and consequences of a social environment is especially challenging when one occupies the environment they wish to map. As Marshall McLuhan explains in *War and Peace in the Global Village*, “One thing about which fish know exactly nothing is water, since they have no anti-environment which would enable them to perceive the element they live in” [54] (p. 135). As such, any attempt to map our digital environment would do well to begin by establishing anti-environments that can serve as counter points. McLuhan issues a similar call in *Counterblast*, noting “the need for a counter-environment as a means of perceiving the dominant one” [55] (p. 5).

Media ecologists who study environments typically divide the history of society into three major stages based on the communication technologies that dominated at a given time: the oral era, the literate era, and the electronic era [56]. The oral era encompasses the stages of both signal and symbolic communication [56]; the literate era covers both chirographic (writing) and typographic (printing) cultures [57]; and the electronic era comprises analog and digital cultures. In the remainder of this section, I briefly sketch the broad features of each of the three major communication eras.

The oral era, which is often referred to as primary orality, describes an environment dominated by the spoken word. It is difficult to date this era because we do not know with certainty when human beings developed spoken language, as there was no way to record this innovation. Based on fossil records, *Homo sapiens* are believed to have emerged in Africa around 315,000 years ago [58], but they did not develop language until much later. Estimates typically put the development of the spoken word somewhere between 200,000 and 50,000 years ago [59]. Prior to the development of language, early humans would have communicated “predominantly by nonlinguistic [vocalizations,] gestures and body movements” [56] (p. 8).

The development of speech or oral language reflected a “shift from *signal* to *symbolic* communication [and] constituted a fundamental change” [56] (p. 9). As Ernst Cassirer explains, whereas signals are “operators”, part of the physical or material world, symbols are “designators”, part of the world of representation [60] (p. 32). The shift from signal

to symbolic communication is closely tied to hominid evolution and to the development of social behavior governed by convention rather than pure instinct [61,62]. After speech developed, it was the primary mode of human communication for tens of thousands of years, though obviously humans also communicated through various forms of art before the development of writing [63].

During primary orality, the spoken word was an event [57] (p. 32). One was either present when it occurred or not. Speech involved direct, face-to-face human interaction between two or more people who were physically present in the same space. While the spoken word privileges the sense of hearing, it is a fully embodied, multidirectional, multisensory experience involving sight, smell, taste, and touch. Edmund Carpenter and Marshall McLuhan have described this dynamic interplay of sense perceptions as “acoustic space” [64]. During primary orality, humans would have been attuned to their surroundings when they spoke, and indeed, their immediate surroundings would have provided much of the content for discussion.

Because the spoken word occurred among people occupying a shared space, it fostered a strong sense of community and belonging [57] (p. 73). It was a highly collaborative affair in which knowledge had to be continuously repeated to survive. Without any way to record what was known (such as the best time and place to plant certain crops), people in primary orality knew only what they could remember, and they remembered what was shared orally. Given that the spoken word was the principal way to both convey and preserve knowledge, conversations typically involved concrete and consequential matters that were directly relevant to people’s lives [57] (p. 49).

The social environment created by orality endured until the invention of writing, which slowly gave rise to the literate era. By fixing words in visual space, writing and later printing transformed the word from an event involving evanescent sound into an object involving visible text [43,57]. The printed word no longer necessitated direct and immediate interaction between sender and receiver. Information could be recorded and retrieved at a later time in a distant place. By privileging sight over hearing, writing also altered the experience of space, replacing the multidirectional character of sound with the highly directed nature of looking [43].

While the technology of writing developed among the Sumerians in the form of cuneiform in Mesopotamia c. 3500 BCE [65], the first phonetic alphabet was not invented until around 1500 BCE by the Canaanites, a Semitic-speaking people who inhabited the eastern Mediterranean region [66]. In practice, writing was largely limited to a specialized class of individuals known as scribes. Scribes played a crucial role in the administrative functions of society, recording transactions, managing inventories, and documenting legal proceedings. They also copied and preserved religious texts, literature, and scientific knowledge.

Scribal culture existed for several thousand years, during which time writing had profound effects on human society, especially in the spheres of law, commerce, and religion. Among other influences, writing enabled the transmission of knowledge across generations and facilitated the development of complex civilizations by allowing persons to build on the knowledge of the past. Despite these influences, scribal culture was tedious, inefficient, and prone to human error.

These challenges persisted until the development of movable type printing, which was invented by Bi Sheng in China c. 1040 AD during the Song Dynasty (960–1279 AD) and later refined and promoted by Johannes Gutenberg in Germany c. 1440 AD [56] (p. 16). Mass printing was a revolutionary technological innovation [67]. It standardized the presentation of information, further distanced the writer and the reader, and made information available to a much wider audience. In doing so, printing facilitated both “mass education and mass literacy” [56] (p. 125).

Printing had other profound effects on the social environment. By promoting abstraction, classification, and analysis, mass printing fueled the scientific revolution. By allowing for the humanistic revival of classical influences, it contributed significantly to the Renaissance. By freeing the interpretation of religious doctrine from clergy, it drove

the religious Reformation. Moreover, since reading is something that typically happens in isolation, it promoted a culture of individualism over collectivism [56].

While writing and printing dramatically altered our social environment, some scholars believe the electronic revolution was even more consequential. According to Lev Manovich, “The [electronic] revolution is arguable more profound than previous ones. . . . Indeed, the introduction of the printing press affected only one stage of cultural communication—the distribution of media. . . . In contrast, the computer media revolution affects all stages of communication, including acquisition, manipulation, storage, and distribution; it also affects all types of media—texts, still images, moving images, sound, and spatial constructions” [68] (p. 19).

The electronic era, which is sometimes referred to as secondary orality, comprises two stages: the broadcast or telecommunications age (1837–1942), which entailed analog media, and the interactive or computer age (1942–present), which entails digital media. The broadcast age and the analog culture it created began with two technological innovations. The first was the daguerreotype or photographic process, which ultimately would displace the centrality of the word in favor of the image [69]. While images existed long before photography in the form of drawings and paintings, they could not be easily shared. The camera allowed for mechanical production and slowly gave rise to the visual culture we have today.

The rise of the image and the corresponding fall of the word is important for several reasons. First, unlike the written word, which is processed sequentially, images are processed simultaneously. In contrast to a paragraph, which is only meaningful when the words are read in a prescribed order, our minds make sense of images all at once. Second, and somewhat counterintuitively, whereas the written word privileges the sense of sight, images appeal significantly to the sense of touch. As Laura Marks explains, images emphasize haptic visuality, turning the eyes themselves into “organs of touch” [70] (p. 2). The importance of haptics or touching images is further enhanced in the digital world where we increasingly interact with and manipulate images by literally touching the screens on which they appear [71].

The second key innovation of the broadcast age was the invention of the telegraph in 1837. This was a significant technological innovation because it conquered physical space by freeing the transmission of messages from modes of transportation. In doing so, Neil Postman argues, “telegraphy gave . . . legitimacy to the idea of context-free information . . . introducing on a large scale irrelevance, impotence, and incoherence [into our discourse]” [72] (p. 65). The invention of the telegraph was itself made possible by the discovery of the basic principles of electricity generation, and thanks to electricity, subsequently innovations like the facsimile machine and television allowed for the easy and wide transmission of images.

While the broadcast age fundamentally altered the human experience of time and space by allowing for the near-instantaneous transmission of images over vast distances, it was another innovation, the invention of digital computing in 1942, that would radically transform all aspects of the creation, storage, distribution, circulation, and reception of information and usher in the digital age. Computers, which work by converting information into binary code, replaced the continuous signal of analog media with the distinct bits that comprise digital media [73,74].

The conversion of information and data into bits, which is known as digitalization, is significant because, as Nicholas Negroponte explains, “bits commingle effortlessly” [75] (p. 18). The bits that comprise a digital book, picture, and audio or video file are all the same, which makes them easy to integrate. However, bits are unique not just because they foster convergence; they are also unique because they are easy and inexpensive to both replicate and manipulate. It requires almost no time, effort, or cost—other than an infinitesimal amount of energy—to duplicate a large video file, for instance. Moreover, it is easier to make changes to the content of that file because one needs to change only the relevant bits rather than recreating the whole thing.

Bits are important for another reason, which is that they fundamentally alter the nature of the relationship between producers and consumers. With analog media, messages still traveled largely unidirectionally, and when the message arrived at the receiver there was nothing to do but passively consume it. The consumer could neither respond to the message nor remake it. Bits changed that; they made the transmission of information multi-directional and they made the message itself dynamic and responsive. Finally, bits decentered our modes of production, allowing anyone with a networked computer to potentially become a mass producer of information.

Throughout this section, I have highlighted some of the major technological innovations that have occurred across the history of human civilization, as well as drawn attention to the ways those innovations created unique social environments with distinctive patterns of communication, culture, and consciousness. Table 1 summarizes several of the key differences between oral, literate, and electronic societies. This survey—in reconstructing several anti-environments—is intended only as the first step toward digital literacy. In the next section, I offer a more extended analysis of our digital environment by highlighting the chief structural features of digital media and the corresponding habits of mind they cultivate in Western culture.

Table 1. Comparison of social environments based on prevailing communication technologies.

Oral Era	Literate Era	Electronic Era
Tribal	National	Global
Speech	Writing and print	Analog and digital
Words are events	Words are objects	Images displace words
Concerns the preservation of knowledge	Concerns the advancement of knowledge	Concerns access to and retrieval of information
Privileges hearing	Privileges sight	Privileges touch
Favors acoustic space	Favors visual space	Favors virtual space
Promotes collectivism	Promotes individualism	Promotes fluid alliances
Aggregative and experiential reasoning	Linear and causal reasoning	Associative and affective reasoning

4. Our Digital Environment

[D]igital media . . . are in the process of transforming not just our world, but our very selves, how we understand who we are. They are changing everything. [17] (p. 9)

The consciousness model of literacy is rooted in the idea that the prevailing technologies of communication at any given historical moment create the social environment that we inhabit, an environment that, in turn, conditions human consciousness by fostering unique habits of mind or what Jack Goody has called “modes of thought” [76] (p. 19). This paradigm of literacy provides a correction to the competency and critical models. After all, how can individuals be expected to use technologies effectively if they do not first understand the inherent biases of a technology, as well as the suitability of that technology for performing a specific communication task? Similarly, how can individuals critically assess the ideologies of the messages created on and circulated by a particular technology if they do not first understand the underlying epistemology of that technology?

The answer to both questions is that they cannot. Consequently, it is imperative that any literacy project begins with a deep understanding of the structural biases of a communication technology and the modes of consciousness it cultivates. That is the central goal of this section, to identify and explain the seven key structural biases of digital media along with their corresponding habits of mind.

The ability to engage in this undertaking relies in no small part on having established the cultures of orality, writing and print, and analog media as anti-environments in the previous section. The ways those environments differ from a digital environment serve as a constant reminder that nothing about our digital environment is “natural” or given. It is a product of the structural biases of digital technologies. While I will do my best to paint a

picture of digital media's key structural biases, the broad scope of what constitutes digital media necessarily entails thick brush strokes.

4.1. The Structural Biases of Digital Media

Digital media describes a wide array of devices, platforms, and technologies that are unified by their basis in digital computing. So, while individual social media platforms like TikTok, Instagram, Facebook, X, and others certainly possess distinctive biases, they nonetheless also exhibit a series of common biases related to digital computing. These biases are particularly influential (and difficult to resist) precisely because they are replicated across all digital platforms. In this section, I identify and explain seven key structural biases of digital media: digitality, publicity, connectivity, instantaneity, indeterminacy, interactivity, and immersivity.

Digitality is the most fundamental and largely invisible structural bias of digital media [18,77]. Unlike analog media, which involve a continuous uninterrupted signal, digital media operate according to binary code, which is represented as either 0 or 1 [73–75]. These numbers are more than mere symbols, however; they are opposing “states” like “open or closed” or “on or off” [78] (p. 32). In binary code, any kind of information can be reduced to these discrete units. A helpful metaphor for understanding the difference between analog and digital media is that of a ramp versus a staircase. Ramps are analog because movement along them is continuous and uninterrupted; stairs, by contrast, divide space into several distinct levels [73]. This is why it is easier to push a baby carriage up a ramp than up a set of stairs. Digitality breaks down information into discrete bits. Those bits are defined by the dichotomous states of 0 and 1. The discrete and opposing states of bits are the basis of all digital technologies.

Publicity describes the structural bias of digital media toward the public sharing of information [27]. Unlike a purely analog world where a person might undertake an action or engage in communication that is private, all actions and communication in a digital environment are tracked or recorded by computing technology and are potentially retrievable by a third party. There are no truly private digital behaviors, as computers track and “log” everything we do. Digital media generally, and social media platforms in particular, invite the public sharing of information, and, in fact, no one willingly posts information on such platforms that they do not hope will be seen widely. Publicity or being seen is the point of social media. Digital media uniformly encourage us to share virtually everything or, perhaps more actually, to share everything virtually. Consequently, interpersonal communication, which used to be mostly private, has become increasingly public [27].

Connectivity refers to the fact that digital communication technologies are networked [18,77]; they endlessly transmit and receive data from other digital devices over wired and wireless networks. Consequently, information flows differently in a virtual network than in a material space. In an analog environment like a physical library, all information has a designated place, which is rigidly organized according to the Dewey Decimal system. A book on physics will not be found next to a book on psychology. In short, the relation among various pieces of information is highly structured. In a digital or databased environment, everything is miscellaneous [79], meaning that information is not arranged hierarchically. Since it has no fixed place, anything can appear next to and, hence, be connected to anything else via hyperlinking. This significantly expands the relations among things, replacing hierarchies with decentered networks.

Instantaneity captures the way digital media promote acceleration [80]. It arises as a consequence of two closely related features: computing efficiency and the elimination of “information float”, the time a message is in transit [81] (pp. 22–23). The history of digital technologies is really the history of the microprocessor, which performs the mathematical calculations that allow computers to work. Microprocessors are engineered to perform as many calculations as quickly as possible. Not surprisingly, communication technologies built upon microprocessors are similarly designed to transmit information as quickly

as possible. The development of electronic media freed communication from modes of transportation, annihilating space and making communication virtually instantaneous [82] (p. 39). Today, as Mark Taylor explains, “Everything moves faster and faster until speed becomes the end in itself” [83] (p. 3).

Indeterminacy signals the perpetually unfinished and, thus, unstable character of digital media [77]. Unlike analog media, whose content is relatively fixed and unchanging, digital content is easily altered, updated, and manipulated. Nor is it merely the content of digital media that is fluid and customizable. So, too, is the way users potentially navigate and consume the content. Whereas the pages of a printed book are permanently arranged in the same order and invite sequential processing, hyperlinks encourage users to consume content in highly personalized—often inconsistent and incomplete—ways. Since hyperlinks are themselves constantly changing, so too are the pathways or connections that link bits of data and information. So, in a digital environment, both content itself and the way we move between specific pieces of content are fluid.

Interactivity reflects the structural bias of digital media to enlist the participation of users [18,77]. Analog media like printed books exist in a relatively finished form that, aside from inviting interpretation, do not ask the user to engage in actions that directly respond to or alter the message itself. Analog media are designed to be consumed, creating a relatively common and shared experience across consumers. Digital media, by contrast, urge users to make a series of choices and to engage in actions that both respond to and potentially alter the form and content of the information with which they are engaging. Video games and social media afford particularly clear examples of the ways digital media encourage users to actively participate in co-creating experiences. Unlike analog media, which stimulate relatively passive consumption, digital media demand active coproduction.

Immersivity designates the bias toward the all-encompassing and simulated world of images [77]. If primary orality, chirographic culture, and typographic culture all favored the word, albeit different conceptions of the word, digital media favor the image and specifically the hyperreality of images. In a digital environment, images no longer refer to a basic external reality. Rather, as Jean Baudrillard explains, the image has become its own pure simulacrum, “the generation by models of a real without origin or reality” [84] (p. 1). Even something as basic as the notion of “love” is today based upon the endless circulation of mediated images of love that have no basis in external reality. Digital media traffic in images and those images create immersive simulations, which form the basis of our reality.

4.2. Corresponding Habits of Mind

The seven structural biases of digital media are consequential for consciousness, even when we are not conscious of their consequences. Indeed, communication technologies are even more likely to shape our consciousness and influence our modes of information processing when we are unaware of and unreflective about their biases. As Marshall McLuhan explains, “any new structure for codifying experience and moving information, be it alphabet or photography [or digital media], has the power of imposing its structural character and assumptions upon all levels of our private and social lives—even without benefit of concepts or of conscious acceptance” [85] (p. 106).

As such, my aim in this section is to identify the habits of mind that digital communication technologies foster and promote in the Western world and more specifically in US society as a consequence of their structural biases. In pinning these habits of mind to US society, I am trying to emphasize that while the structural biases of technology are universal, the ways those biases manifest themselves are always cultural and contextual. The seven digital habits of mind in US culture are, I argue, obstinacy, narcissism, associative reasoning, impulsivity, insecurity, alienation, and confirmation bias. Because the seven digital habits of mind shape the way we process information, they also shape our collective psychology and, as I illustrate, animate many of our contemporary social problems.

Obstinacy refers to both the simplicity and the stubbornness of our thought and its expression today [20]. It arises from our repeated exposure to the binary logic of computers.

While the digitality of computing is largely invisible to us, technologies nonetheless train us to view the world like them. As Neil Postman once said, “To a man [sic] with a hammer, everything looks like a nail. Without being too literal, we may extend the truism: To a man with a pencil, everything looks like a list. To a man with a camera, everything looks like an image” [52] (p. 14). To a person with a digital device, everything looks—especially on social media—like a binary choice: to post or not, to like or not, to swipe left or not, to comment or not, to follow or not.

This binary way of thinking fuels both polarization and dogmatism, an unwillingness to entertain alternative viewpoints or to compromise. In short, as Brian Ott explains, “repeated exposure to digitization fosters intransigent thought. . . . thought that is dichotomous and dogmatic” [20] (p. 8). Nicholas Kardaras agrees, writing that, “The constant immersion in polarizing social media platforms has changed the architecture of our brains and the way that we process information[.] . . . Indeed, as social media has swallowed up our world, we’ve developed a type of societal binary black-and-white thinking—which is the opposite of nuanced critical thinking” [33] (p. 8).

Narcissism describes a disproportionate sense of self-importance and a lack of regard for the feelings of others. According to Tomas Chamorro-Premuzic, “we’re living in a self-obsessed era, a narcissistic epidemic” [31] (p. 84) in which “evidence points to a bidirectional link between narcissism and social media use” [31] (p. 85). This habit of mind arises from the logic of publicity, which invites us to share everything. In encouraging us to share indiscriminately, social media platforms teach us that everything we think and feel matters. While social media also invite us to respond to others, the public nature of our responses makes those responses about us, too. So, while digital technologies tell us our personal thoughts and feelings matter regardless of their triviality or insignificance, they do not cultivate other-orientedness. Narcissism in our digital world is also tied to the algorithmic character of digital media, which continuously deliver personalized experiences. As Nicholas Kardaras succinctly puts it, digital inhabitants do not just “*think* that the world revolves around them; it *does* revolve around them” [33] (p. 24).

Associative reasoning favors nonlinear, nonsequential, and decontextualized modes of sensemaking [77,86]. The technologies of writing and print created a world where the word was rigidly fixed in space. Ideas and information were subordinated to other ideas and information, fostering causal reasoning, which led, in turn, to the scientific revolution [43,56]. Digital media, by contrast, are networked and nonhierarchical; they create a flat structure where everything is potentially related to everything else [79,87]. This invites us to see associations among things that may not be connected in direct or causal ways. It is the logic of the “link”, which according to Dennis Cali, alters how people think about and process information [86] (p. 397). While associational reasoning helps us to navigate the sea of information that defines our digital environment, it also fuels the spread of conspiracy theories [23].

Impulsivity reflects a habit of mind that combines impatience with affectivity. It is a product of our digital environment in which everything is accelerated. Thanks to the ever-increasing power of microprocessors, computers are more efficient, and communication is more instantaneous [20]. As people are repeatedly exposed to the structural bias of instantaneity, they have become less patient and more emotional. People are less patient because the efficiency of digital technology offers instant gratification. People are more emotional because rational, deliberative thought, which is associated with words, is slow, while automatic, emotional thinking, which is associated with images, is fast [88]. “As humans attempt to mimic computer efficiency,” observes Ott, “they rely more heavily on instinct and affect. In short, as humans try to speed up their information processing and decision-making capabilities, they are less careful and rational and more impulsive and affective” [20] (p. 10). Going forward, our growing dependence on so media platforms, explains Chamorro-Premuzic, “will further increase our impulsivity levels, which explains why [a few] seconds of buffering are sufficient to trigger frustration in a typical modern adult” [31] (p. 48).

Insecurity captures the unstable, ungrounded, and free-floating character of thought and its expression in a digital environment. In contrast to the technologies of writing and print, which favor a fixed point-of-view, digital technologies produce an anxious and unsettled mind. Humans depend upon stable and consistent symbolic structures to ground their sense of themselves and their world. However, the indeterminate (malleable and mutable) character of digital content and its organization undermines this footing, as does rapid technological innovation and the continuous proliferation of information [82]. Because humans struggle to adapt to change, especially brisk change [89], instability in our social environment takes a psychological toll, often leading to overstimulation of the senses, a feeling of information overload, and decision paralysis among other psychosocial effects [90]. In psychological terms, the unmoored mind reflects the spreading sense of uncertainty, uneasiness, and anxiety in our digital world [91–93]. As Jonathan Haidt explains in *The Anxious Generation*, “Anxiety and its associated disorders seems to be the defining mental illness of young people today” [93] (p. 27).

Alienation speaks to the growing sense of loneliness and isolation in our digital world [94,95]. It is a habit of mind that emerges as a consequence of the interactive character of digital media, as well as the repeated exposure to fragments and incomplete context. While one might think that interactivity would foster a sense of community or belonging, it does precisely the opposite. The interactive bias of digital media facilitates human–machine interaction, rather human–human interaction. According to the US Surgeon General’s 2023 report, *Our Epidemic of Loneliness and Isolation*, digital technology “displaces in-person engagement, monopolizes our attention, reduces the quality of our interactions, and even diminishes our self-esteem. This can lead to greater loneliness, fear of missing out, conflict, and reduced social connection” [96] (p. 20). Relatedly, the discontinuous and decontextualized nature of bits can produce an experience of *fragmentia*, a “new cognitive disorder where one feels cut off from a sense of wholeness” [97] (p. 37).

Confirmation bias is a habit of mind in which people seek out information that affirms their existing views and beliefs and dismiss information that challenges them [98]. It is related to the structural bias of immersivity, which allows people to construct a social world that bears little resemblance to the complex and contested character of material existence. On social media platforms, users create carefully curated senses of themselves and their world based on the content they post, the stories they like, and the people they follow. In short, they construct a simulated environment that reflects their biases, biases that are reinforced by computer algorithms, which limit what they see [99]. Because the simulated self is constructed by surrounding oneself with narrowly selected images, it severely limits exposure to alternative ideas, information, and viewpoints [32,100].

Table 2 summarizes the seven structural biases of digital media and their corresponding habits of mind. In the final section of this essay, I discuss how an understanding of these biases and habits benefits the project of digital literacy.

Table 2. The structural biases of digital media and their corresponding habits of mind.

Structural Biases	Habits of Mind
digitality	obstinacy (simplicity + stubbornness)
publicity	narcissism
connectivity	associative reasoning
instantaneity	impulsivity (impatience + affectivity)
indeterminacy	insecurity
interactivity	alienation
immersivity	confirmation bias

5. Critical Implications

I began this essay by stressing two points. The first point was that digital communication technologies favor modes of thought and expression that undermine our humanity and, thus, threaten our future. This is, in my judgment, a significant challenge to sustainability,

if not a widely recognized one. The second point was that not only do the structural biases of digital technologies directly undermine a sustainable future, but they also endanger efforts to solve other, more traditional sustainability concerns by impeding effective and ethical communication.

While digital literacy offers a possible solution to the problems caused by digital communication technologies, the two prevailing literacy paradigms—the competency model and critical model—both perpetuate the myth of technological neutrality. This myth, I argued further, is not only mistaken but dangerous. It is dangerous because it wrongly assumes that if people become more proficient in their use of digital technologies and more critical in their consumption of digital content, then we can create a healthier digital environment. However, the character of our digital environment, along with its attendant social problems, is not a consequence of incompetent use or uncritical engagement; it is a consequence of technological bias.

As such, I proposed an alternative paradigm of digital literacy, one rooted in the intellectual tradition of media ecology. This alternative, a consciousness model, teaches people to recognize the structural biases of individual mediums or technologies and to situate those biases in a proper historical context. As the prominent media ecologist Neil Postman noted in January 1996 during *PBS Online NewsHour*, “If students get a sound education in the history, social effects and psychological biases of technology, they may grow to be adults who use technology rather than be used by it” [101] (n.p.). In an effort to ensure that technology does not use us to simply reproduce its biases, my aim in this closing section is twofold: to reflect on a few of the challenges and consequences of adopting a consciousness model of digital literacy.

5.1. Challenges: Some Clarifications on the Consciousness Model

The consciousness model of digital literacy is not without its challenges, and I wish to reflect on three in particular: the interanimation of structural biases; the need to map the unique traits of individual digital devices, platforms, and technologies; and the dialectical relation between social environments and culture.

First, while my analysis of digital technologies treated structural biases and habits of mind in a 1:1 ratio for the purpose of conceptual clarity, the reality is considerably more complex. In pairing structural biases with specific habits of mind, I potentially fostered the misperception that biases and habits do not overlap or interanimate one another. To be clear, they do.

For instance, while I paired impulsiveness (impatience + affectivity) with the structural bias of instantaneity, the intensely affective character of our digital environment is also closely tied to interactivity and immersivity, as well as connectivity and publicity. While primary orality privileges hearing and the literate era privileges sight, electronic media privilege touch through the interactive character of touch screens and the haptic visuality associated with images, especially those in digital domains [70,71]. Moreover, the connected nature of digital media creates an ideal public network for the transmission of affect. What, after all, are memes if not charged affects—shared public sensibilities—that spread quickly across the network?

Similarly, while I explicitly linked confirmation bias to the structural bias of virtuality, it is also closely tied to instantaneity and digitality, and, indeed, confirmation bias leads to faster, less reflective decision-making [102]. In other words, it is probably more accurate to think of both structural biases and habits of mind as a constellation of interrelated dynamics that reflect our digital environment than as simple 1:1 relations.

Second, given my broad concern with digital literacy in this essay, I sought to identify and analyze the structural biases that extend across our digital environment. Our digital environment comprises a wide array of devices, platforms, and technologies that, while unified, also possess their own unique structural biases. Previous research on Twitter has, for instance, highlighted the logic of simplicity, impulsivity, and incivility [103], while work on YouTube has stressed the themes of video sharing, participatory culture, and advertising

and marketing [104], and the analysis of generative artificial intelligence has focused on the way it heightens polarization, deception, and exclusion and bias [105]. If we wish to develop a robust understanding of our digital environment, then it is crucial that we continue to bring the insights of media ecology to bear on the diverse media forms that comprise our digital environment.

Third, while my explicit emphasis in this essay has been on the ways that social environments shape communication, culture, and consciousness, I appreciate that the relationship among these elements is dialectical. Influence flows in both directions. There is little question, for instance, that even as our social environment influences our cultural norms, values, practices, and forms, culture also influences our social environment. Consider, for instance, the very different car cultures that have emerged in the US and Europe. While the structural biases of the automobile are relatively distinct and fixed, the way those biases impact a social environment is modified by cultural attitudes. Whereas cars are associated with freedom and movement in the US, they are viewed more pragmatically in Europe, which has led to smaller, more efficient vehicles as well as to a greater emphasis on walking, cycling, and public transit. These differences suggest that the work of media ecology needs to be situated in a proper cultural, as well as historical, context.

5.2. Consequences: Not All Technologies Are Created Equated

Adopting the consciousness model of digital literacy would necessarily alter the implementation of both the competency and critical models. If scholars and practitioners take seriously the idea of technological bias, they would conclude that digital technologies are not equally suited and appropriate for all communication goals and tasks. While it is not possible to highlight the suitability of digital media for every purpose, a few examples are instructive.

The technologies of writing and print foster linear, rational thought that is methodical and deliberate [56] (p. 112). This serves society well not only in advancing science but also in diagnosing and addressing complex social problems. The structural biases of digital media, by contrast, favor modes of information processing and habits of mind that are obstinate, associational, impulsive, and affectively charged [20]. This mindset aligns well with the aims and purposes of advertising and marketing [106], where the explicit goal of communication is to manipulate people into purchasing goods and services. However, in those contexts where citizens value systematic, detached, objective thinking, we ought to avoid digital media in general and social media in particular. Social media are structurally ill-equipped to promote the kind of deliberative problem-solving that is demanded by policy-making, and we should strive to keep it out of our politics.

Similarly, in contexts where building strong social relationships is important, digital technologies function as poor tools. Because digital technologies teach us to value our own needs and interests over those of others, they are not well suited to creating community, belonging, and mutual commitment. We need to stop confusing being connected to someone via technology with being committed to a meaningful relationship. Followership on social media platforms is not the same as friendship. While digital technologies are not especially helpful for creating or sustaining lasting social relationships [30], they can serve an important role in administrative functions like planning and organizing face-to-face meetings where genuine community-building can occur.

Finally, in the educational arena, we must stop perpetuating the dangerous and destructive idea that online learning and face-to-face learning are equivalent. A global study conducted by UNESCO and published as the 2023 book, *An Ed-Tech Tragedy?* found that the shift to remote learning caused by the COVID-19 pandemic resulted in “the largest global disruption to education in history” [44] (n.p.). Specifically, the study found that most learners were left behind, class and racial inequalities were exaggerated, learners engaged less, achieved less, and left education, education was narrowed and impoverished, and immersion in technology was unhealthy. These conclusions should not surprise us since we know, for instance, that people learn less from video than from live interaction [32] (p. 105).

However, despite the clear harms associated with remote learning, the private sector and educational industrial complex, especially in the USA, continues to extol the virtues of digital educational technologies, which it props up with studies that employ questionable methodologies [44] (p. 155).

These examples point primarily to the ways the consciousness model of literacy can enhance the competency model by helping us to evaluate the appropriateness of a technology to a specific task. This paradigm also stands to benefit the critical model of digital literacy in which students are taught to interrogate how the production, content, and reception of media messages potentially reproduce ideological biases [77]. While this model is useful, for instance, in highlighting the extremist (and potentially racist, sexist, or classist) views that underlie a particular media message, it is less equipped to explain why some mediums produce extremism in the first place.

The consciousness model, by contrast, would show how the structural biases of a particular technology (platform, device, or medium) foster affective polarization and political tribalism. Without first examining the structural biases of technologies, we are unlikely to be able to eliminate the ideological biases even if we manage to identify them. Identifying hateful ideologies and combatting them are not the same thing, and we cannot reasonably expect to eliminate them if we do not understand the ways that various technologies breed and perpetuate them. It is vital, therefore, that critical literacy be taught as an extension of consciousness literacy.

Recently, several scholars have begun to gesture in this direction. In response to the spread of digital media platforms, Carlos Scolari et al., for instance, have proposed the idea of “transmedia literacy” instead of teaching critical media skills [107]. While this approach stresses user skills and thus has echoes of the competency model, it draws heavily on the insights of media ecology to build those skills. Similarly, rejecting more traditional approaches that focus on “the actions of individual humans”, Nichols and LeBlanc suggest an orientation to media education “grounded in ‘ecology’ rather than ‘literacy’” [108] (p. 389). Finally, Luke Meekan has highlighted the “critical potential of media ecology frameworks to address the limits of the media literacy frameworks prevalent in visual culture art education pedagogies” [109] (p. 91). What each of these interventions have in common is a recognition that media ecology offers a uniquely apt basis for the project of media education in the digital age.

Thus, going forward, educators at all levels need to work to incorporate a consciousness-based model of digital literacy into the curriculum. First, students need to be introduced to the perspective and assumptions of media ecology. Second, using that perspective, students need to be shown a series of anti-environments to help demystify the world in which they live. Teaching students about how primary orality fostered community will, for instance, help them to better understand why the connectivity of the digital age does not foster community [95], for “[o]nline, even ‘shared’ experiences are inherently individualistic” [110] (p. 36). The outline of anti-environments presented in this essay can serve as a starting point for that objective. Third, students need to be taught to analyze the structural biases of communication technologies so that they can make motivated decisions about which technologies are best suited—both in terms of ethics and effectiveness—for realizing particular communication goals and tasks.

The aim of such a project is not to have people “opt out” of digital technologies, as has been suggested by some writers [111], but to have them make more conscious and motivated choices about technology use. Cal Newport’s work on “digital minimalism” offers an excellent model of how we might renegotiate our relationship with social media and other digital technologies [112]. Similarly, David Sax has written extensively about how to build a sustainable future for humanity by striking a better balance between analog and digital experience [110]. The one recommendation that nearly all scholars of digital media stress is the need for us to engage in more face-to-face communication, even if it means strategically scheduling it. As Sherry Turkle writes, “Face-to-face conversation is the most human—and humanizing—thing we do” [95] (p. 3).

5.3. Closing Thoughts

Adopting a consciousness model of digital literacy rooted in media ecology avoids the myth of technological neutrality, and better positions learners, educators, and citizens to make thoughtful, responsible, and ethical choices about the technologies they use to accomplish specific communication goals and tasks. Only when we are cognizant of the demands that technologies place on us because of their inherent structural biases can we truly become co-creators of the social environments that we inhabit and that, by extension, inhabit us. As such, going forward, advocates of digital literacy must commit to putting the agency of humans ahead of the agency of machines and technologies. Failure to do so will continue to ensure the erosion of our humanity.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The original contributions presented in the study are included in the article; further inquiries can be directed to the corresponding author.

Acknowledgments: The author is grateful to Jay Howard for the helpful conversations related to this essay.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Newig, J.; Schulz, D.; Fischer, D.; Hetze, K.; Laws, N.; Lüdecke, G.; Rieckmann, M. Communication regarding sustainability: Conceptual perspectives and exploration of societal subsystems. *Sustainability* **2013**, *5*, 2976–2990. [CrossRef]
2. Genç, R. The importance of communication in sustainability & sustainable strategies. *Procedia Manuf.* **2017**, *8*, 511–516.
3. Weder, F.; Karmasin, M.; Krainer, L.; Voci, D. Sustainability communication as critical perspective in media and communication studies: An introduction. In *The Sustainability Communication Reader*; Weder, F., Krainer, L., Karmasin, M., Eds.; Springer VS: Wiesbaden, Germany, 2021; pp. 1–12.
4. Godemann, J. Communicating sustainability: Some thoughts and recommendations for enhancing sustainability communication. In *The Sustainability Communication Reader*; Weder, F., Krainer, L., Karmasin, M., Eds.; Springer VS: Wiesbaden, Germany, 2021; pp. 15–29.
5. Urša Golob, U.; Podnar, L.; Zabkar, V. Sustainability communication. *Int. J. Advert.* **2022**, *42*, 42–51. [CrossRef]
6. Walton, G. “Digital Literacy” (DL): Establishing the boundaries and identifying the partners. *New Rev. Acad. Librariansh.* **2016**, *22*, 1–4. [CrossRef]
7. Audrin, C.; Audrin, B. Key factors in digital literacy in learning and education: A systematic literature review using text mining. *Educ. Inf. Technol.* **2022**, *27*, 7395–7419. [CrossRef]
8. Reddy, P.; Chaudhary, K.; Hussein, S. A digital literacy model to narrow the digital literacy skills gap. *Heliyon* **2023**, *9*, e14878. [CrossRef]
9. Tinmaz, H.; Lee, Y.; Fanea-Ivanovici, M.; Baber, H. A systematic review on digital literacy. *Smart Learn. Environ.* **2022**, *9*, 21. [CrossRef]
10. Smith, E.E.; Storrs, H. Digital literacies, social media, and undergraduate learning: What do students think they need to know? *Int. J. Educ. Technol. High. Educ.* **2023**, *20*, 29. [CrossRef]
11. Huvila, I. *Information Services and Digital Literacy: In Search of the Boundaries of Knowing*; Chandos Publishing: Oxford, UK, 2012.
12. Knight, J.; Dooley, M.; Barberà, E. Getting smart: Towards critical digital literacy pedagogies. *Soc. Semiot.* **2023**, *33*, 326–349. [CrossRef]
13. Polizzi, G. Internet users’ utopian/dystopian imaginaries of society in the digital age: Theorizing critical digital literacy and civic engagement. *New Media Soc.* **2023**, *25*, 1205–1226. [CrossRef]
14. Milenkova, V.; Lendzhova, V. Digital citizenship and digital literacy in the conditions of social crisis. *Computers* **2021**, *10*, 40. [CrossRef]
15. Mokhtari, F. Fostering digital literacy in higher education: Benefits, challenges and implications. *Int. J. Linguist. Lit. Tradit.* **2023**, *6*, 160–167. [CrossRef]
16. Digital Literacy. Scholarly Community Encyclopedia. Available online: <https://encyclopedia.pub/entry/32039> (accessed on 30 November 2022).
17. Gere, C. *Digital Culture*, 2nd ed.; Reaktion Books: London, UK, 2008.
18. Miller, V. *Understanding Digital Culture*, 2nd ed.; Sage: Los Angeles, CA, USA, 2020.
19. Carr, N. *The Shallows: What the Internet Is Doing to Our Brains*; W.W. Norton & Company: New York, NY, USA, 2010.

20. Ott, B.L. The digital mind: How computers (re)structure human consciousness. *Philosophies* **2023**, *8*, 4. [CrossRef]
21. Aimeur, E.; Amri, S.; Brassard, G. Fake news, disinformation and misinformation in social media: A review. *Soc. Netw. Anal. Min.* **2023**, *13*, 30. [CrossRef]
22. Olan, F.; Jayawickrama, U.; Arakpogun, E.O.; Suklan, J.; Liu, S. Fake news on social media: The impact on society. *Inf. Syst. Front.* **2024**, *26*, 443–458. [CrossRef]
23. Zeng, J.; Schäfer, M.S.; Oliveira, T.M. Conspiracy theories in digital environments: Moving the research field forward. *Convergence* **2022**, *28*, 929–939. [CrossRef]
24. Iyengar, S.; Lelkes, Y.; Levendusky, M.; Malhotra, N.; Westword, S. The origins and consequences of affective polarization in the United States. *Annu. Rev. Political Sci.* **2009**, *22*, 129–146. [CrossRef]
25. Mason, L. *Uncivil Agreement: How Politics Became Our Identity*; University of Chicago Press: Chicago, IL, USA, 2018.
26. Webster, J.G.; Ksiazek, T.B. The dynamics of audience fragmentation: Public attention in an age of digital media. *J. Commun.* **2012**, *62*, 39–56. [CrossRef]
27. Ott, B.L.; Hoelscher, C.S. The digital authoritarian: On the evolution and spread of toxic leadership. *World* **2023**, *8*, 726–744. [CrossRef]
28. Reveley, J. Understanding social media use as alienation: A review and critique. *E-Learn. Digit. Media* **2013**, *10*, 83–94. [CrossRef]
29. Peled, Y. Cyberbullying and its influence on academic, social, and emotional development of undergraduate students. *Heliyon* **2019**, *5*, e01393. [CrossRef]
30. Bugeja, M. *Interpersonal Divide: The Search for Community in a Technological Age*; Oxford University Press: New York, NY, USA, 2005.
31. Chamorro-Premuzic, T. I, *Human: AI, Automation, and the Quest to Reclaim What Makes Us Unique*; Harvard Business Review Press: Boston, MA, USA, 2023.
32. Aiken, M. *The Cyber Effect: A Pioneering Cyberpsychologist Explains How Human Behavior Changes Online*; Spiegel & Grau: New York, NY, USA, 2016.
33. Kardaras, N. *Digital Madness: How Social Media Is Driving Our Mental Health Crisis—And How to Restore Our Sanity*; St. Martin's Press: New York, MA, USA, 2022.
34. Strate, L. If it's neutral, it's not technology. *Educ. Technol.* **2012**, *52*, 6–9.
35. Pangrazio, L.; Selwyn, N. 'Personal data literacies': A critical literacies approach to enhancing understandings of personal digital data. *New Media Soc.* **2019**, *21*, 419–437. [CrossRef]
36. Garcia, A.; Mirra, N. Writing toward justice: Youth speculative civic literacies in online policy discourse. *Urban Educ.* **2021**, *56*, 640–669. [CrossRef]
37. Tebaldi, C.; Nygreen, K. Opening or impasse? Critical media literacy pedagogy in a posttruth era. *Cult. Stud. ↔ Crit. Methodol.* **2022**, *22*, 143–153. [CrossRef]
38. Boyd, D. Did media literacy backfire? *J. Appl. Youth Stud.* **2017**, *1*, 83–89.
39. Boyd, D. You think you want media literacy. . . do you? *Medium*. Available online: <https://medium.com/datasociety-points/you-think-you-want-media-literacy-do-you-7cad6af18ec2> (accessed on 9 March 2018).
40. Burnett, C.; Merchant, G. The challenge of 21st Century literacies. *J. Adolesc. Adult Lit.* **2015**, *59*, 271–274. [CrossRef]
41. Burnett, C.; Merchant, G. Revisiting critical literacy in the digital age. *Read. Teach.* **2019**, *73*, 263–266. [CrossRef]
42. Burnett, C.; Merchant, G. Returning to text: Affect, meaning making, and literacies. *Read. Res. Q.* **2020**, *56*, 355–367. [CrossRef]
43. McLuhan, M.; Fiore, Q.; Agel, J. *The Medium Is the Massage: An Inventory of Effects*; Random House: New York, NY, USA, 1967.
44. West, M. *An Ed-Tech Tragedy? Educational Technologies and School Closures in the Time of COVID-19*; United Nations Educational, Scientific and Cultural Organization (UNESCO): Paris, France, 2023.
45. Ott, B.L. The visceral politics of V for Vendetta: On political affect in cinema. *Crit. Stud. Media Commun.* **2010**, *27*, 39–54. [CrossRef]
46. Burke, K. *Attitudes toward History*, 3rd ed.; University of California Press: Berkeley, CA, USA, 1984.
47. Mumford, L. *The Myth of the Machine: Technics and Human Development*; Harcourt Brace Jovanovich, Inc.: New York, NY, USA, 1967.
48. Strate, L. Media ecology. In *The International Encyclopedia of Communication Theory and Philosophy*; Jensen, K.B., Craig, R.T., Eds.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2016; pp. 1–8.
49. Strate, L. *Media Ecology: An Approach to Understanding the Human Condition*; Peter Lang: New York, NY, USA, 2017.
50. Granata, P. *Introduction to Media Ecology: Thinkers, Schools of Thought, Key Concepts*, Independently Published. 2021.
51. Meyrowitz, J. Medium theory. In *Communication Theory Today*; Crowley, D., Mitchell, D., Eds.; Stanford University Press: Stanford, CA, USA, 1994; pp. 50–77.
52. Postman, N. *Technopoly: The Surrender of Culture to Technology*; Alfred A. Knopf: New York, NY, USA, 1992.
53. Dickinson, G.; Ott, B.L. Three enduring stories Americans tell about guns. In *The Conversation on Guns*, Densley, J., Ed.; Johns Hopkins University Press: Baltimore, MD, USA, 2023; pp. 13–19.
54. McLuhan, M.; Fiore, Q.; Agel, J. *War and Peace in the Global Village*; McGraw-Hill Book Company: New York, NY, USA, 1968.
55. McLuhan, M. *Counterblast*; Harcourt, Brace & World, Inc.: New York, NY, USA, 1969.
56. Chesebro, J.W.; Bertelsen, D.A. *Analyzing Media: Communication Technologies as Symbolic and Cognitive Systems*; The Guilford Press: New York, NY, USA, 1996.
57. Ong, W.J. *Orality and Literacy: The Technologizing of the Word*, 30th Anniversary ed.; Routledge: New York, NY, USA, 2002.

58. Hublin, J.J.; Ben-Ncer, A.; Bailey, S.E.; Freidline, S.E.; Neubauer, S.; Skinner, M.M.; Bergmann, I.; Le Cabec, A.; Benazzi, S.; Harvati, K.; et al. New fossils from Jebel Irhoud, Morocco and the pan-African origin of *Homo sapiens*. *Nature* **2017**, *546*, 289–292. [[CrossRef](#)]
59. Pagel, M. Q&A: What is human language, when did it evolve and why should we care? *BMC Biol.* **2017**, *15*, 64.
60. Cassier, E. *An Essay on Man: An Introduction to a Philosophy of Human Culture*; Yale University Press: New Haven, CT, USA, 1944.
61. Buettner-Janush, J.; Day, M.H. Human evolution. In *The New Encyclopedia Britannica*; Encyclopedia Britannica: Chicago, IL, USA, Volume 18, 2007; pp. 930–980.
62. Deacon, T.W. *The Symbolic Species: The Co-Evolution of Language and the Brain*; W.W. Norton & Company: New York, NY, USA, 1998.
63. Havelock, E.A.; Hershbell, J.P. (Eds.) *Communication Arts in the Ancient World*; Hastings House Publishers: New York, NY, USA, 1978.
64. Carpenter, E.; McLuhan, M. Acoustic space. In *Explorations in Communication: An Anthology*; Carpenter, E., McLuhan, M., Eds.; Beacon Press: Boston, MA, USA, 1960; pp. 65–70.
65. Diringer, D. *Writing: Ancient Peoples and Places*; Thames and Hudson: London, UK, 1962.
66. Logan, R.K. *The Alphabet Effect: The Impact of the Phonetic Alphabet on the Development of Western Civilization*; St. Martin's Press: New York, NY, USA, 1986.
67. McLuhan, M. *The Gutenberg Galaxy: The Making of Typographic Man*; University of Toronto Press: Toronto, ON, Canada, 1962.
68. Manovich, L. *The Language of New Media*; The MIT Press: Cambridge, MA, USA, 2001.
69. Stephens, M. *The Rise of the Image the Fall of the Word*; Oxford University Press: New York, NY, USA, 1998.
70. Marks, L.M. *Touch: Sensuous Theory and Multisensory Media*; University of Minnesota Press: Minneapolis, MN, USA, 2002.
71. White, M. *Touch Screen Theory: Digital Devices and Feelings*; The MIT Press: Cambridge, MA, USA, 2022.
72. Postman, N. *Amusing Ourselves to Death: Public Discourse in the Age of Show Business*; Viking Penguin Inc.: New York, NY, USA, 1985.
73. Day, M.S. *Bits to Bitcoins: How Our Digital Stuff Works*; The MIT Press: Cambridge, MA, USA, 2018.
74. Ong, W. *Language as Hermeneutic: A Primer on the Word and Digitization*; Cornell University Press: Ithaca, NY, USA, 2017.
75. Negroponte, N. *Being Digital*; Alfred A. Knopf: New York, NY, USA, 1995.
76. Goody, J. *The Domestication of the Savage Mind*; Cambridge University Press: New York, NY, USA, 1977.
77. Ott, B.L.; Mack, R.L. *Critical Media Studies: An Introduction*, 3rd ed.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2020.
78. Bowden, B.V. The circuit components of digital computers. In *Faster Than Thought: A Symposium on Digital Computing Machines*; Bowden, B.V., Ed.; Sir Isaac Pitman & Sons Ltd.: London, UK, 1963; pp. 32–66.
79. Weinberger, D. *Everything Is Miscellaneous: The Power of the New Digital Disorder*; Henry Holt and Company: New York, NY, USA, 2007.
80. Gleick, J. *Faster: The Acceleration of Just about Everything*; Pantheon Books: New York, NY, USA, 1999.
81. Naisbitt, J. *Megatrends: Ten New Directions Transforming Our Lives*; Warner Books: New York, NY, USA, 1982.
82. Ott, B.L. *The Small Screen: How Television Equips Us to Live in the Information Age*; Blackwell Publishing Ltd.: Malden, MA, USA, 2007.
83. Taylor, M.C. *The Moment of Complexity: Emerging Network Culture*; University of Chicago Press: Chicago, IL, USA, 2001.
84. Baudrillard, J. *Simulacra and Simulation*; Glaser, S.F., Translator; The University of Michigan Press: Ann Arbor, MI, USA, 1994.
85. Benedetti, P.; DeHart, N. *Forward through the Rearview Mirror: Reflections on and by Marshall McLuhan*; The MIT Press: Cambridge, MA, USA, 1996.
86. Cali, D.D. The logic of the link: The associative paradigm in communication criticism. *Crit. Stud. Media Commun.* **2000**, *17*, 397–408. [[CrossRef](#)]
87. Barabási, A.-L. *Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life*; Penguin Group: New York, NY, USA, 2002.
88. Kahneman, D. *Thinking, Fast and Slow*; Farrar, Straus and Giroux: New York, NY, USA, 2011.
89. Hoffer, E. *The Ordeal of Change*; Harper & Row, Publishers: New York, NY, USA, 1963.
90. Toffler, A. *Future Shock*; Random House: New York, NY, USA, 1970.
91. Primack, B.A.; Shensa, A.; Escobar-Viera, C.G.; Barrett, E.L.; Sidani, J.E.; Colditz, J.B.; James, A.E. Use of multiple social media platforms and symptoms of depression and anxiety: A nationally-representative study among U.S. young adults. *Comput. Hum. Behav.* **2017**, *69*, 1–9. [[CrossRef](#)]
92. Ruscio, A.M.; Hallion, L.S.; Lim, C.C.; Aguilar-Gaxiola, S.; Al-Hamzawi, A.; Alonso, J.; Andrade, L.H.; Borges, G.; Bromet, E.J.; Bunting, B.; et al. Cross-sectional comparison of the epidemiology of DSM-5 generalized anxiety disorder across the globe. *JAMA Psychiatry* **2017**, *74*, 465–475. [[CrossRef](#)]
93. Haidt, J. *The Anxious Generation: How the Great Rewiring of Childhood Is Causing an Epidemic of Mental Illness*; Penguin Press: New York, NY, USA, 2024.
94. Turkle, S. *Alone Together: Why We Expect More from Technology and Less From Each Other*; Basic Books: New York, NY, USA, 2011.
95. Turkle, S. *Reclaiming Conversation: The Power of Talk in a Digital Age*; Penguin Press: New York, NY, USA, 2015.
96. Our Epidemic of Loneliness and Isolation: The, U.S. Surgeon General's Advisory on the Healing Effects of Social Connection and Community; Office of the U.S. Surgeon General: Washington, DC, USA, 2023.
97. Shenk, D. *Data Smog: Surviving the Information Glut*; HarperCollins: San Francisco, CA, USA, 1997.

98. Nickerson, R.S. Confirmation bias: A ubiquitous phenomenon in many guises. *Rev. Gen. Psychol.* **1998**, *2*, 175–220. [[CrossRef](#)]
99. Rose-Stockwell, T. *Outrage Machine: How Tech Amplifies Discontent, Disrupts Democracy—And What We Can Do about It*; Legacy Lit: New York, NY, USA, 2023.
100. Bail, C. *Breaking the Social Media Prism: How to Make Our Platforms Less Polarizing*; Princeton University Press: Princeton, NJ, USA, 2021.
101. Postman, N. Neil Postman ponders high tech. *PBS's Online NewsHour: Online Forum*, 17 January 1996.
102. Nikolopoulou, K. What is confirmation bias? Definition & examples. *Scribbr*, 10 March 2023.
103. Ott, B.L. The age of Twitter: Donald J. Trump and the politics of debasement. *Crit. Stud. Media Commun.* **2017**, *34*, 59–68. [[CrossRef](#)]
104. Soukup, P.A. Looking at, through, and with YouTube. *Commun. Res. Trends* **2014**, *33*, 3–34.
105. Walters, H.L. Generative artificial intelligence and the world Postman warned us about. *Explor. Media Ecol.* 2024; *accepted*.
106. Ott, B.L. YouTube and the restructuring of play: A media (auto) poetics of toy unboxing videos. *Explor. Media Ecol.* **2023**, *22*, 331–348. [[CrossRef](#)]
107. Scolari, C.; Masanet, M.-J.; Guerrero-Pico, M.; Establés, M.-J. Transmedia literacy in the new media ecology: Teens' transmedia skills and informal learning strategies. *Prof. Inf.* **2018**, *27*, 801. [[CrossRef](#)]
108. Nichols, T.P.; LeBlanc, R.J. Media education and the limits of “literacy”: Ecological orientations to performative platforms. *Curric. Inq.* **2021**, *51*, 389–412. [[CrossRef](#)]
109. Meeken, L. From digital literacy to critical digital ecology: Curricula as digital places in art education. *Vis. Arts Res.* **2024**, *50*, 91–108. [[CrossRef](#)]
110. Sax, D. *The Future Is Analog: How to Create a More Human World*; Hatchett Book Group, Inc.: New York, NY, USA, 2022.
111. Lanier, J. *Ten Arguments for Deleting Your Social Media Accounts Right Now*; Henry Holt and Company: New York, NY, USA, 2018.
112. Newport, C. *Digital Minimalism: Choosing a Focused Life in a Noisy World*; Penguin Random House LLC: New York, NY, USA, 2019.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.