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Providing a definition of Algorithmic Literacy that leverage mechanology and retro-engineering perspectives

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Abstract

The article aims to pave the way for a new form of literacy called algorithmic literacy, that will enable users to identify and understand how algorithms work and impact their daily lives. The goal of algorithmic literacy is to help users acquire new skills to counter the recurrent problem of opacity and biases in algorithmic processing of data and information. We examine first the context and origins of this literacy and its proximity to other literacies. We then analyze the possible bridges that can be built towards the many fields of social sciences that study algorithms and their effects. We demonstrate the importance of associating this literacy with the mechanological angle developed by Gilbert Simondon and, more recently, Bernhard Rieder. We then look at possible correlations that this literacy could establish with retro-engineering efforts to help understand the algorithmic processes at play.

Keywords: Literacy, Algorithmic literacy, Algorithm, Mechanology, Documentation, Retro-engineering

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The organization of the world and the arrangement of its elements initially captivated encyclopedists and experts in knowledge organization, as they sought to discern universal laws. However, the era of classification has gradually been called into question, particularly due to the overwhelming volume of available data, and has been challenged by more efficient approaches that have shifted from tree-based models to labyrinthine ones (Eco, 2011). At the same time, manual or documentary indexing methods have been supplemented by various forms of automated indexing, with the most recent advancements being in the field of artificial intelligence.

The current period is characterized by new approaches to information processing that encompass data collection, streamlining production, and personalized content dissemination, all facilitated by new technological actants (in Bruno Latour's sense) that have become indispensable in the digital ecosystem: algorithms.

While the principles of ordering and performative ranking are not new, they have gained considerable prominence in the daily interactions of information system users in recent years, extending their scope far beyond the mere rational organization of data. Algorithms have transitioned from ordering information content to a form of "ordering of existences" (Day, 2014), to the extent that a concept of "algorithmic governance" (Rouvroy and Berns, 2013) has become a cause for concern. It affects everyone across various domains and leads to social and political repercussions that raise questions for researchers, citizens, and decision-makers alike (O'Neil, 2018; Zuboff, 2019). For some, the "power of algorithms" has reached a point where there is an urgent need to launch a serious counter-offensive incorporating both computational and legal components.

In this article, we argue that it is futile to condemn the use of algorithms entirely and reductionist to view them merely as computer objects (Beer, 2017; Kitchin, 2017). However, it is crucial to shed light on their impact on the professional practices of information actors and, more broadly, on the daily lives of citizens. In this regard, an approach rooted in literacy would be worthwhile to consider as it would make the power of digital algorithms more transparent through specific forms of mediation. This "algorithmic literacy" would be capable of addressing the phenomenon of data overexploitation, also known as data colonialism (Couldry and Mejias, 2019).

From a theoretical perspective, this article draws upon the works of Simondon (1989), particularly those related to the philosophy of technology. It builds upon previous research conducted in the field of informational and digital literacies. Following in the footsteps of Dogruel, Masur, and Joeckl (2021), this article introduces a distinction between "awareness" and "knowledge". The article aims to explore a civic culture of algorithmic information with the potential for educational development through a didactic approach. It

relies on the methodologies of critical algorithm studies (Ananny and Crawford, 2012; Drumond et al., 2018; Gillespie, 2018; Kitchin and Dodge, 2011; Steiner, 2012) to accomplish this objective.

Our standpoint favors a pragmatic approach, moving away from the idealized interpretations of machine power that Deleuze and Guattari already criticized in 1972. Several years later, Guattari revisited the issue to advocate for a measured perspective regarding the impact of machines

That machines are capable of articulating statements and recording facts at the pace of nanoseconds and perhaps, in the future, picoseconds, does not mean that they are diabolical forces threatening to dominate humanity ¹. (Guattari, 1989, p. 10)

1. Methodology

The article begins by conducting a critical review of the scientific literature surrounding the topic of algorithmic literacy. It provides an overview of studies that address the issue of the “power of digital algorithms” (Cardon, 2018) beyond a strictly mathematical or computational perspective. To accomplish this, the article draws on a collection of articles and books that reframe the study of algorithms within a literacy framework. Lastly, the article examines pedagogical works and new initiatives related to algorithm watching, which aim to identify algorithm biases and raise awareness for the purpose of alerting and preventing potential issues.

The first part explores the context of this literacy, its origins, and its connections to other literacies, particularly informational and digital literacies (Valtonen et al., 2018), as well as disciplines that study algorithms and their societal effects (Beer, 2017; Seaver, 2017). This is followed by a reflection on the mechanological perspective, drawing upon the pioneering works of Simondon (1989) and the recent contributions of Rieder (2020), who recontextualized Simondon’s insights within the realm of contemporary digital environment. Lastly, we will describe the significance of correlating this emerging literacy with documentation processes that encompass aspects of reverse engineering and the description of informational processing conducted by platforms, applications, or websites. This discussion will draw upon potential developments within the field of journalism.

2. Definitions and proximities.

Gaining an understanding of the role and functioning of algorithms in the digital ecosystem and learning how to navigate and communicate about their impact, constitutes a new form of literacy that would complement existing literacies in a context where the latter are continuously discussed, revised, and expanded.

¹ « Que les machines soient à même d’articuler des énoncés et d’enregistrer des états de fait au rythme de la nano-seconde et, peut-être demain, de la pico-seconde, elles n’en sont pas pour autant des puissances diaboliques qui menaceraient de dominer l’homme. »

2.1 Yet another literacy ?

The development of media spheres and users' daily exposure to a wide variety of information has led to the emergence of information literacies (Basili, 2008; Webber and Johnston, 2005) and media literacy (Livingston, 2004), which have generated a significant body of scientific and professional literature. It is worth noting that since the anthropological works of Goody (1979) and Graff (1985), the concept has acquired multiple meanings, often combined, surpassing basic alphabet literacy skills to encompass functional and operational literacy within society.

Furthermore, the challenges surrounding digital reconfiguration (Bawden, 2001) and the strong connections, particularly between media literacy and information literacy, sometimes grouped under the same name (Media and Information Literacy, MIL), demonstrate an expansion of competency domains and the intertwining of multiple areas. The necessity to unite training efforts and establish bridges between literacies has led to the concept of transliteracies (Thomas et al., 2007) or metaliteracies (Michelot, 2020), allowing for a broader perspective and collaboration across literacy domains.

Data literacy (Arruabarrena, Kembellec, and Chartron, 2019), on the other hand, has emerged in response to new demands expressed by professionals working with data, as well as concerned citizens regarding the utilization of their personal data by third parties.

Information literacy, media literacy, digital literacy, data literacy, and now algorithm literacy... this combination of literacies raises questions about their theoretical and pedagogical connections, as it becomes challenging to separate them and treat them as distinct territories. However, this "gathering of literacies" (Le Deuff, 2012) can also lead to confusion if conceptual distinctions are not taken into account or if the effort to bring them together results in a form of hierarchization, with certain literacies given more importance than others

Furthermore, it would be counterproductive to approach the discussion solely from the perspective of computer science, which neglects the "social" aspect (Beer, 2017) of the actions produced by algorithms, as it is no longer reasonable to view these literacies solely as skills dependent on the proper use of tools.

2.2 Ambition and definition

Algorithmic literacy encompasses varying levels of ambition depending on how it is defined. If we consider the proposition put forward by Head, Fister, and MacMillan, it can be seen as a subfield of information literacy:

Algorithmic literacy — a subset of information literacy, algorithmic literacy is a critical awareness of what algorithms are, how they interact with human behavioral data in information systems, and an understanding of the social and ethical issues related to their use. (Head, Fister et MacMillan, 2020, p. 51)

This definition aligns with a traditional perspective (critical education) of information sciences. However, today's digital ecosystem also requires a better technical understanding of systems that can be partly achieved by exploring algorithmic processes inherent to

search engine operations (search engine literacy, Le Deuff, 2018). Following this approach, Ridley and Pawlick-Potts (2021) suggest bridging algorithmic literacy with both the critical and civic dimensions of information literacy, as well as the perspectives of explainable artificial intelligence (XAI). This can be achieved by producing dedicated tools for demonstrative and educational purposes.²

When considering algorithmic literacy, it is important to address issues concerning information research and evaluation, as well as broader “computational”³ aspects related to understanding the flow of information on the web and the utilization of data, including personal data. Dogruel, Masur, and Joeckel (2021) propose a dual-level hypothesis that emphasizes the significance of both awareness of the presence and impact of algorithms as a starting point, followed by the acquisition of knowledge and skills to exercise caution and potentially navigate around specific algorithms. Consequently, the way individuals engage with algorithms unveils a digital divide (Cotter and Reisdorf, 2020) between those who find themselves in a “minority” position when faced with technical devices and those who possess the ability to attain a “majority” status. Simondon’s work highlights the limitations of solely relying on conventional practices at the initial level.

The minority status is one in which the technical object is primarily seen as an object of use, necessary for daily life, and part of the environment in which the human individual grows and develops. Technical knowledge is implicit, unreflected upon, and customary.⁴ (Simondon, 1989, p. 85)

Algorithmic literacy, therefore, involves providing users with the means to understand the effects of their actions on the web (such as the queries they make on search engines) and the algorithmic processing that determines their access to information and how criteria for personalizing the results of their actions are taken into account.

The integration of algorithmic literacy with the recent data literacy, which aims to educate individuals on the importance of personal data and the benefits of efficient skills in the job market, is evident here, as algorithms require data to function and demonstrate their

² The authors recommend using and developing these tools within libraries. In line with this approach, we can also mention a specific project called “The Algorithm Literacy Project,” designed for young audiences by Kids Code Jeunesse (KCJ) and the Canadian Commission for UNESCO (CCUNESCO). Its objective is to “raise awareness and educate children about the influence of algorithms on our digital experiences.”

³ The PIX framework developed in France and the training plan for “digital competence” developed in Quebec include references to algorithms. What’s more, dedicated courses on PIX have a disciplinary focus on computer science.

⁴ « Le statut de minorité est celui selon lequel l’objet technique est avant tout un objet d’usage, nécessaire à la vie quotidienne, faisant partie de l’entourage au milieu duquel l’individu humain grandit et se forme. [...] Le savoir technique est implicite, non réfléchi, coutumier. »

effectiveness. Pedagogical approaches that emphasize the issue of ranking criteria enable a reconnection with basic literacy by examining one of its primitive forms: the “list” (Goody, 1979).

From a scientific standpoint, this implies a renewal of approaches that move information anthropology (Cordier, 2015) towards analyses that better integrate technical devices. Consequently, it is important to connect algorithmic literacy with various scientific domains that study algorithms.

3. The different fields of study (Algorithm Studies)

In order to explore the didactic approach to algorithms and create a literacy project that can be applied in diverse educational contexts, it is essential to go beyond the traditional boundaries of computer science and mathematics and consider scientific approaches from various disciplines. This calls for a transdisciplinary definition of algorithms. In this article, we have adopted Cardon’s definition because it transcends the purely mathematical understanding of algorithms and encompasses the computational processes and information processing involved.

An algorithm is a series of instructions that enables the attainment of a result. Operating at high speed, it performs a set of calculations based on vast amounts of data (referred to as “big data”). It prioritizes information, anticipates our interests, selects preferred goods, and endeavors to assist us in numerous tasks. ⁵ (Cardon, 2015, p. 7)

Beer goes further in this endeavor to construct an operational definition for the field of social sciences and humanities. By delving into the functioning of algorithms, which relies on a dual technical and human contribution (machine and human agency), Beer suggests examining algorithms through the lens of their social function, specifically their capacity to “influence decisions” (Beer, 2017). In this article, we present the scientific approaches that have studied algorithms with social implications and whose findings and methodologies enable a didactic transposition within algorithmic literacy.

3.1. The technician approach: *Code Studies* and *Software Studies*

Algorithms were initially considered from a socio-technical perspective, focusing on their structure and implementation in the digital space, with particular attention to their performance in the automation of decisions. Numerous research have explored their ability to generate, collect, and process massive amounts of data, examining their procedural mechanics, predictive dimension, and their role in the functioning of online platforms (Burrell, 2016; Miyazaki, 2012).

⁵ « Un algorithme est une série d’instructions permettant d’obtenir un résultat. À très grande vitesse, il opère un ensemble de calculs à partir de gigantesques masses de données (les « big data »). Il hiérarchise l’information, devine ce qui nous intéresse, sélectionne les biens que nous préférons et s’efforce de nous suppléer dans de nombreuses tâches. »

The study of algorithms involves considering technical objects, often platforms, applications, or websites where algorithmic sorting takes place. This dimension encompasses software studies (Gras, 2015) and critical code studies (Marino, 2020), disciplines that investigate software and associated code libraries. Their goal is to examine the mechanisms of software action and organization, exploring the grammar of action through information and document encoding mechanisms, as well as implemented programming languages.

Data formats, structures, and choices in information sorting are studied by observing the algorithms that underpin these choices. Among the best-known algorithms are those responsible for relevance sorting (correlation between the query and the number of occurrences), audience sorting (number of site visits or resource views), popularity sorting (number of citations, links, or likes), date sorting (chronological or reverse chronological ranking), as well as similarity and affinity algorithms.

What is of interest here are the methods used to ensure performance in terms of selection and visibility parameters of information contained in catalogs, as well as the development of methods that allow for more efficient sorting of information, i.e., targeted, fast, and with minimal server resource utilization (Jean, 2020). These performative logics have faced criticism due to the potential ethical contradictions in the objectives of their developers and implementers (O’Neil, 2018), and concerns about potential biases and the emergence of a new algorithmic governance (Rouvroy and Berns, 2013) are often raised.

3.2. The socio-political approach and attentional risks

The study of the role and significance of algorithms in the digital ecosystem has expanded beyond informational and mathematical logics to include semiotic, socio-political, and ethical considerations. Researchers have raised questions about the profound transformations that algorithms bring about in terms of social organization (Gillespie, Boczkowski, & Foot, 2014), our perception of reality (Dowek & Abiteboul, 2017), and our digital identities (Delalande, 2019).

Alongside these studies, several investigations have targeted the threats posed by algorithms to individual freedoms in an increasingly opaque digital ecosystem. Experts have pointed out the shift from the idealized public space envisioned by the founding fathers of the web to a ruthless arena where it is increasingly difficult to distinguish the combatants. According to Zuboff, we are now living in the era of “surveillance capitalism” (Zuboff, 2019), which completely transforms our world and lives into information. Web giants exploit this information, using algorithms to capture users’ identity, behavioral, and contextual data in order to guide their journeys and decision-making processes. As a result, users find themselves trapped in a pervasive surveillance system where power asymmetries continuously arise between data holders/manipulators and others. Allouin and Pierre emphasize the importance of integrating the affective dimension into the study of these mechanisms.

Collectively, these platforms, data production and capturing systems, programs, and algorithms can be seen, in a more comprehensive perspective, as “affective

infrastructures” whose informational responses to user interactions are tailored to their emotions. ⁶ (Alloing and Pierre, 2020, p. 7)

In this context, algorithms take on the form of “traps” (Seaver, 2019), becoming even more formidable as they operate in an attention-driven economy (Citton, 2014). However, users often remain unaware, lacking the necessary “awareness” (Dogruel, Masur, and Joeckel, 2021; Gran, Booth, and Bucher, 2021), which can be seen as the initial step towards algorithmic literacy. Ethical considerations then emerge, conflicting with economic interests that exploit attentional design for marketing purposes. Proposed solutions to address these concerns encompass regulatory and political measures, enforcing rules on personal data (such as the GDPR), and establishing ethical charters with dedicated personnel responsible for evaluating and implementing these requirements from the outset of the design process. Yet, the alignment of web giants with these conditions is never fully assured, as the prevalence of ethical washing strategies persists. This exacerbates tensions between these immensely powerful actors and their numerous critics. However, this confrontation carries inherent risks, fueling a technophobic perspective that hinders a genuine understanding of algorithmic literacy, often limited to perceiving risks and dangers—an impasse reminiscent of past tensions surrounding social networks (Boyd, 2007).

3.3. Approaches in information media studies

One of the sectors deeply disrupted by the rapid implementation of digital algorithms is the press industry. Within a few short years, algorithms have bypassed the traditional role of journalists, who are tasked with “researching, verifying, contextualizing, prioritizing, shaping, commenting on, and publishing quality information” as outlined in the Professional Ethics Charter (SNJ, 1918/38/2011).

The emergence of infomediaries (Rebillard and Smyrnaio, 2010), followed by the utilization of algorithms by social media networks to deliver their content, has led to a series of “dispossessions”. The press not only lost its monopoly on information production but also relinquished its primary position as an intermediary between facts and the public (Joux and Bassoni, 2018).

In the present day, the algorithms of infomediaries like Google or Facebook play a significant role in determining the circulation of information by closely analyzing user behavior. Factors such as time spent on web pages, accessed media, selected topics, likes, shares, as well as the profiles of friends and contacts, collectively shape the information landscape for each individual. This phenomenon, that could lead “filter bubble” (Pariser, 2011), not only restricts internet users but also affects the press. As a result, the traditional

⁶ « L’ensemble de ces plateformes, de ces dispositifs de production et de captation de données, de ces programmes et ces algorithmes peuvent être envisagés, de manière plus globale, comme des « infrastructures affectives » dont les réponses informationnelles aux interactions des usagers s’adapteraient à leurs ressentis. »

editorial model based on the supply of information is gradually being replaced by a demand-driven approach.

Newsrooms have deployed numerous efforts to adapt to this evolving landscape. One of the key challenges has been to redefine their editorial offer to align with the demands of platforms and their ranking algorithms. The algorithm is seen as a marketing tool, particularly effective in tailoring the information to individual users. While it influences editorial content, it can also serve as a supportive “technological actant” (Weber and Kosterich, 2018), empowering journalists to streamline their productions, gather and analyze data, and distribute information to their target audience. Additionally, algorithms can aid in journalistic writing when it involves repetitive tasks. This has led media organizations such as *The New York Times*, *The Washington Post*, and *Le Monde* to explore the realm of “robot journalism” for generating weather forecasts or providing summaries of sports and financial results (Linden, 2017).

The examination of algorithms’ impact in the field of journalism is timely, as it creates a connection between traditional approaches to media education and a perspective that seeks to incorporate the study of algorithmic processes in accessing information. The computational operations can be seen as metamedia, encompassing ” “The computer metamedium is simultaneously a set of different media and a system for generating new media tools and new types of media.” ” (Manovich, 2013, p. 102).

This necessitates a rethinking of media studies by integrating digital and algorithmic processes within their scope. While the question of whether search engines and social networks should be classified as media was a focus in previous years, the discourse has shifted towards typological issues (Salaün, 2012) and the importance of considering mediologies as forms of digital mechanologies.

4. The mechanological perspective

The study of technological mechanisms has often been neglected in the realm of social sciences, with a greater emphasis placed on studying user behavior and patterns. However, it is hard to comprehensively analyze a system without understanding the underlying technical processes involved. This approach involves examining the machine in a similar vein to Guattari’s proposal, viewing it as an object that exists prior to its physical realization (1989). It is essential to consider the practical aspects of the machine even before its technical implementation, as Simondon suggests. This perspective enables a deeper understanding of the mechanisms that contribute to the construction of inputs and outputs within the system, moving away from a linear and systemic view.

And while the examination of the “black box” of algorithms (Pasquale, 2015) may seem opportune, there is a risk of assuming that everything occurs solely within it, neglecting the complexity of the broader systems at play (Hargittai et al., 2020). Therefore, it is crucial to focus on studying specific aspects of the systems, particularly concerning information filtering.

In the short run, we do not need to know anything about the architecture of Facebook’s data centers to study how users integrate the service into their daily

lives. However, in specific cases, such as the News Feed filtering mechanism, the way a particular task or function is performed may be indispensable for assessing its contributions and consequences. An apprehension of technical forms and, consequently, of technical possibilities can shed light on these cases. More importantly still, it can inform broader apprehensions of a world that increasingly constitutes and maintains itself technologically. (Rieder, 2020, p. 82)

4.1. Organology of algorithmic devices

The mechanological perspective offers a way to delve into the system not only from a technical standpoint but also by studying the machine that generates effects and is conceptualized even before its actual realization. However, it is precisely this process that lacks transparency in tools and platforms that operate using algorithms, despite continually producing documents and data that warrant and necessitate careful scrutiny. In essence, the mechanological perspective becomes a grammatology (Derrida, 1967) that focuses on studying the writings produced during the design process. These writings can encompass various aspects, including managerial, administrative, political, economic, mathematical, and computer-related elements. Numerous professions and skills come into play throughout the creation process, such as “requirements analysis, software architecture, interface design, testing and debugging, deployment, maintenance, just to name a few.” (Rieder, 2020, p. 90).

Consequently, a simplistic understanding of the notion of “accountability” (Siebert, 2018) that would simply require algorithm producers to reveal the mathematical formula they employed would be inadequate as it fails to consider the underlying processes that informed such decisions. True transparency necessitates access to documents that provide insights into the process within its production and reception contexts. It also involves understanding and analyzing the documentary forms (documentology) and the computational frameworks that enable the capture, storage, and processing of data.

This requires the ability to establish connections among the various elements of the system using graphical representations, for instance. Such representations facilitate a comprehensive understanding through a “schematic” approach (Estivals, 2002), allowing for a deeper comprehension of the underlying organizational dynamics at play. Schematizing helps comprehend the environment and visually depict it. Understanding the algorithm is impossible without access to a comprehensive record of the strategic choices made, the technical constraints that were addressed, and the data collection processes that enable the system to function ⁷.

⁷ An excellent illustration of this is the website VisualAlgo, which enables graphical representations of algorithms. It offers various visualizations for different algorithms, enhancing the understanding of their input and output through visual means. You can explore more at <https://visualgo.net/en>.

4.2. Algorithmic culture as a new technical and informational culture

To comprehend an algorithm, it is necessary to avoid isolating it from its effects and instead consider all the factors that enable its operation. This understanding goes beyond mere coding proficiency and involves grasping the implications of computational thinking. Developing a precise vocabulary, along with the necessary technical knowledge and skills, becomes indispensable for engaging in algorithmic literacy, which closely resembles digital literacy in its demand for both comprehension and the ability to actively create and produce.

Algorithms are frequently portrayed in an imprecise and sometimes irrational manner within the media discourse. They are often associated with a mythologized concept of artificial intelligence that, instead of promoting understanding, further alienates users by either celebrating their seemingly magical effects or depicting them as harmful. As a result, discussions surrounding algorithms tend to revolve around opposing factions of technophobes and technophiles. To move beyond this divisive narrative, a more effective approach is to view algorithmic as an integral part of a digital and technical culture. This perspective fosters a balanced relationship between individuals and technical tools, enabling users to express and comprehend their actions and the resulting effects. Embracing this cultural dimension also necessitates acknowledging the affective aspects, including the algorithmic imaginaries described by Bucher.

The algorithmic imaginary is not to be understood as a false belief or fetish of sorts but, rather, as the way in which people imagine, perceive and experience algorithms and what these imaginations make possible. Using the theoretical lens of affect, understood as mood and intensity corresponding to ‘forces of encounter’ [...] the aim is to understand how algorithms have the capacity ‘to affect and be affected’. (Bucher, 2017, p. 31).

This affective relationship plays a role in the process of individuation, as described by Simondon, which necessitates a balanced connection with the corresponding technical environment. Such a relationship enables both technical innovation and psychological individuation (Simondon, 2005). However, it is essential to avoid dissociating the technical milieu (Stiegler, 2008), meaning it should not become imbalanced to the point of creating systems that capture and manipulate individuals’ attention and data, thereby bypassing the individuation process.

Nonetheless, this digital culture encounters limitations imposed by service companies that steer and dictate user behavior, undermining the development of a culture that would enable individuals to modify parameters and truly take ownership of the device, as well as understand the methods employed and the data utilized. Striphas (2015) highlights how algorithmic culture influences cultural practices comprehensively, ranging from accessing audio-visual resources to shaping political discourses, as also observed by Mike Annany.

Algorithms do not simply accelerate commerce, journalism, finance, or other domains — they are a discourse and culture of knowledge that is simultaneously social and technological, structuring how information is produced, surfaced, made sense of, seen as legitimate, and ascribed public significance.” (Annany, 2016, p. 6)

This algorithmic culture, which is considered “structuring” or even “instituting” (Napoli, 2014), possesses a grammatical potential that parallels the observations made by Auroux (Auroux, 1995) and Derrida regarding the phenomena of gramma-latinization. It has the capacity to subject all cultures to devices capable of interpreting them through a limited set of basic models. As a result, algorithmic literacy cannot rely solely on optimized practices that aim to ensure the responsible use of personal data.

Engaging in algorithmic literacy necessitates a willingness to question the system, aiming to grasp its decision-making mechanisms and information processing. Similar to how information literacy surpasses the simple act of conducting a search query on a search engine, algorithmic literacy demands the ability to decode the operations taking place, encompassing both communication and information strategies.

This demands specific competencies to document the unfolding processes, observe the outcomes, potentially make comparisons, or at the very least, comprehend the documentation that elucidates the filtering mechanisms. Consequently, we can put forth the following definition of algorithmic literacy:

Algorithmic literacy comprises the understanding of algorithmic mechanisms, their effects and emotional influences, as well as their potential limitations and biases in data processing and information sorting. It incorporates a critical dimension that empowers individuals to make informed choices regarding the applications they utilize and to maintain a critical stance when interpreting the outcomes.

Our definition emphasizes the distinction between the competence to effectively utilize a tool and the aspiration to attain a comprehensive understanding of it.

5. Documentation and retro-engineering of algorithmic processes

Gaining an understanding of algorithmic mechanics involves comprehending the intricacies of information circulation and reception, as well as the inherent biases associated with this process. With this knowledge, it becomes possible to not only take preventative actions against algorithmic risks but also implement strategies that empower users to reclaim control over the flow of information on the web. Furthermore, this context introduces the concept of leveraging influence over process involved in data gathering and processing.

Simply put, data leverage refers to influence that members of the public have over tech companies because important computing technologies rely on the public’s data contributions. Data leverage catalyzes power achieved by harming data-dependent technologies as well as power achieved by improving alternative data-dependent technologies and thereby creating increased competition. (Vincent et al., 2021, p. 215)

5.1. Documentation and technical culture

The objective is to recontextualize algorithms, along with algorithmic literacy, within the framework of technical culture as defined by Simondon. This culture aims to rationally articulate the individual’s relationship with the technical object in a society that has

achieved a “state of majority.” According to Simondon and more recently Rieder, it is essential to differentiate between procedural skills and mechanological comprehension, distinguishing between practical know-how and theoretical knowledge since “The often lauded ‘digital natives’ are certainly competent users, but there is little reason to believe that this task-oriented competence translates into mechanological awareness.” (Rieder, 2020, p. 87).

In fact, these skills involve more than just technical proficiency with devices; they require the ability to articulate, decode, record, and schematize the inner workings of these systems. Simondon’s analysis of Diderot and d’Alembert’s encyclopedia highlights its significance in documenting the technical processes and objects that enable the replication of experiments. Technical culture is expressed through descriptions and diagrams ⁸ that provide a comprehensive understanding of devices, including their utilization of multiple code libraries and reliance on APIs. Similarly, effective algorithmic literacy necessitates a similar approach, leveraging code documentation tools to fully comprehend the underlying processes. This approach aligns with the principles of “doing and redoing” emphasized by Simondon and echoed in the philosophy of the open-source movement (Masure, 2014).

This emerging challenge raises concerns among information professionals who are accustomed to utilizing tools that streamline their tasks of information collection, monitoring, and selection. It also applies to journalists who, in their daily work, are increasingly confronted with algorithms both as mediating objects and potential subjects of investigation.

5.2. Retroengineering

In certain newsrooms, particularly in the United States, algorithms have become fertile grounds for investigation. Journalists, often with a strong affinity for hacking culture and well-versed in data journalism methods, have developed innovative investigative techniques to uncover biases in algorithms. This approach, known as algorithmic accountability reporting (Diakopoulos, 2015), aims to deconstruct the power dynamics shaping algorithm design and implementation, with a specific focus on identifying discriminatory practices. Utilizing a method similar to reverse engineering, these journalists simulate the operations of these code lines to reconstruct and understand their functioning.

The interface effects produced by algorithmic information ordering involve their own forms of dissociation and critical understanding therefore requires that we investigate the mechanisms at work below the surface. (Rieder, 2020, p. 86).

Diakopoulos, however, emphasizes that this method is only effective when combined with in-depth interviews with actors in the field, a recommendation also echoed by Kitchin.

⁸ Some educational programming software, such as Scratch, offer a visual and enjoyable way to comprehend the impact of code and the sequence of instructions.

Getting access to a credit rating agency's algorithmic system then might give an insight into its formula for assessing and sorting individuals, its underlying logics and principles, and how it was created and works in practice, but will not necessarily provide full transparency as to its full reasoning, workings or the choices made in its construction. (Kitchin, 2017, p. 21)

As algorithms are inherently technological artifacts, their actions and reactions occur within a fundamentally social system that requires analysis (Weber and Kosterich, 2018). Unveiling the inner workings of algorithms, therefore, entails examining not only the functioning of the code but also the motivations of their creators and the interactions they engender with users (Diakopoulos, 2015; Pasquale, 2015). The biases that are observed and reported should prompt inquiries into both the algorithmic infrastructure and the social infrastructure. Reverse-engineering ultimately reveals representations that are shaped not solely by the algorithm itself but by the social and cultural perspectives of its designers and users. Recognizing the multitude of these issues is essential for journalists seeking to explore these matters, especially when assessing the scope of accountability. Demanding accountability goes beyond code transparency and necessitates addressing the dissatisfactions and inconveniences generated by algorithms, as advocated by Annany (2016, p. 17).

This calls for examining algorithmic assemblages not only in terms of their internal mechanisms (inside) but also in the broader effects they generate (across) (Annany and Crawford, 2018, p. 974) ⁹. Several tools and guides are beginning to be put forth ¹⁰, while new training requirements are also arising. Algorithmic mediations offer a fertile ground for investigative teams of journalists who embrace collaborative work approaches and involve engaged users.

In this context, the most studied algorithms are those of the major web leaders. Highly dynamic, they operate in a complex and opaque manner, prioritizing capturing user attention rather than satisfying their needs, particularly their informational needs. Collaborative reverse-engineering operations, however, face challenges as bots used to reverse engineer an algorithm are usually blocked. *The Citizen Browser project*, developed by the independent news organization *The Markup*, to measure the effects of Facebook's advertising system, particularly in terms of political information, has faced this sort of problem. The process of reverse-engineering exposes the power struggles within the realm of information and requires investigative work that can lead to significant revelations. A recent example of this was whistleblower Frances Haugen, who provided a consortium of journalists with access to thousands of documents revealing the decision-making processes

⁹ However, we caution here against the risk of absolving algorithm creators from responsibility by attributing biases solely to user representations or to a systemic issue that is seen as pertaining to society as a whole rather than the company. Criticizing the limitations of transparency can easily lead to a sense of resignation in the face of the immense task described by Annany and Crawford.

¹⁰ <https://www.spj.org/algorithm/part-2-story-ideas.asp>

that determine Facebook's algorithmic choices. The investigators tasked with analyzing this data faced the challenge of comprehending and uncovering the outputs generated by these algorithms, as well as explaining the underlying processes that drive their implementation.

Such investigations are only possible if journalism professionals acquire the necessary skills to understand the algorithmic mediations at play. This underscores the recommendations made by Owens (1976) regarding information literacy as a prerequisite for democracy.

5.3. Understanding algorithmic mediations

Therefore, a key aim of algorithmic literacy is to empower users to articulate their informational needs in a free or, at the very least, reflective manner, without the pressures, directives, and biases introduced by algorithms from Google ¹¹ and other infomediaries.

As a result, this literacy has the potential to empower internet users, granting them greater agency. However, achieving this goal requires the collaboration of intermediary professional groups, such as researchers, journalists, and engaged individuals or collectives. These networks of algorithm watchers play a crucial role in not only comprehending the processes at play but also alerting the public to any potential malfunctions that may arise.

It is thus important to consider introducing courses on algorithmic literacy within information science and journalism programs, equipping future professionals to tackle the challenges posed by algorithms. As part of these educational initiatives, the development of investigative protocols for digital algorithms that permeate various aspects of our lives could be explored. This includes algorithms employed by public administrations to determine taxation, allocate assistance, manage employee mobility, shape students' educational trajectories, and more, as well as those utilized by private companies to establish pricing policies (e.g., Uber), make personalized recommendations (Netflix, Amazon, etc.), calculate routes (Google Maps), facilitate connections between individuals (Tinder), enable medical diagnostics (SkinApp), and beyond. Recognizing that all algorithms are fallible and can give rise to adverse effects, biases, and discriminatory situations, information professionals and journalists should possess the ability to identify, analyze, and effectively communicate such issues to the public.

While various projects in the United States are being carried out to assist journalists in their inquiries into algorithms, such as those developed by Diakopoulos' team at Northwestern University, similar initiatives in France are still uncommon.

¹¹ Training initiatives have emerged that seek to make informational algorithms more accessible, enabling users to grasp the various methods employed in sorting search engine results. A notable example is the Webfinder website, established in 2016 with the aim of providing users with insights into the algorithms utilized by search engines, using a deliberately limited set of web pages. Developed by Florian Reynaud, the platform specifically targets relevance, popularity, and audience algorithms, highlighting their impact on search engine result rankings. To explore this resource, visit:
<https://iddocs.fr/webfinder/>

In light of this, algorithmic literacy could become a tool to counter an imbalance described by Striphas.

So, on the one hand, we have algorithms – a set of mathematical procedures whose purpose is to expose some truth or tendency about the world. On the other hand, we have algorisms – coding systems that might reveal, but that are equally if not more likely to conceal.

Achieving this objective of restoring balance would also help us move beyond the technophilic or technophobic approaches criticized by Simondon.

Conclusion

Algorithmic literacy goes beyond the claims of transparency made by platforms (Cotter, 2021) in managing algorithms, whether it is to understand the underlying mechanisms or to empower users to configure their accounts and manage their personal data.

Although it is important to build trust relationships between users and platforms to the extent that they become a Tango duo, as Nick Clegg, Vice President of Global Affairs at Facebook, suggests,¹² this dual logic must be complemented by mechanisms of checks and balances that enable transparency through documentation and reverse-engineering. Moreover, it is essential to educate citizens about responsible use and empower them to make informed choices, access information, and gain knowledge about the processes that significantly influence their everyday lives.

The development of algorithmic literacy relies on a better integration of algorithms into culture, both as a technical culture and as a culture open to advances in the humanities and social sciences. While algorithmic literacy can lead to greater empowerment of users, it requires both individual capacities and collective and collaborative processes to resist algorithmic logics often driven by a culture of enjoyment (Drumond, Coutant, & Millerand, 2018). As we have shown in this article, the guiding principle of algorithmic literacy lies in the perspective of an ecology of reason, the only perspective capable of addressing power imbalances.

References

Alloing, C. et Pierre, J. (2020). Le tournant affectif des recherches en communication numérique. *Communiquer. Revue de communication sociale et publique*, (28), 1-17.

Ananny, M. (2016). Toward an Ethics of Algorithms: Convening, Observation, Probability, and Timeliness. *Science, Technology, & Human Values*, 41(1), 93-117. doi : <https://doi.org/10.1177/0162243915606523>

¹² Nick Clegg. “You and the Algorithm: It Takes Two to Tango”, <https://nickclegg.medium.com/you-and-the-algorithm-it-takes-two-to-tango-7722b19aa1c2>

- Ananny, M. and Crawford, K. (2018). Seeing without knowing: Limitations of the transparency ideal and its application to algorithmic accountability. *New Media & Society*, 20(3), 973-989. doi : <https://doi.org/10.1177/1461444816676645>
- Arruabarrena, B., Kembellec, G. et Chartron, G. (2019, mars). *Data litt ratie & SHS : d velopper des comp tences pour l'analyse des donn es*. Communication pr sent e au colloque CODATA-France, Universit  Paris-Est Marne-la-Vall e.
- Auroux, S. (1995). *La r volution technologique de la grammatisation*. Mardaga.
- Basili, C. (2008, janvier). Theorems of information literacy. Dans _UNESCO-CEI Workshop on "Information literacy Initiatives for Central and Southeast European Countries_" (preliminary. In version), 14th International Conference on Library: The Key to Users Success. Ljubljana (Slovenia)
- Bawden, D. (2001). Information and digital literacies: A review of concepts. *Journal of Documentation*, 57(2), 218-259. doi : <https://doi.org/10.1108/EUM0000000007083>
- Beer, D. (2017). The social power of algorithms. *Information, Communication & Society*, 20(1), 1-13. doi : <https://doi.org/10.1080/1369118X.2016.1216147>
- Boyd, D. (2007). _Why Youth (Heart) Social Network Sites: The Role of Networked Publics in Teenage Social Life_. Dans D. Buckingham (dir.), *Youth, Identity, and Digital Media Volume*, MacArthur Foundation Series on Digital Learning. Cambridge, MA : MIT Press.
- Bucher, T. (2017). The algorithmic imaginary: Exploring the ordinary affects of Facebook algorithms. *Information, Communication & Society*, 20(1), 30-44. doi : <https://doi.org/10.1080/1369118X.2016.1154086>
- Burrell, J. (2016). How the machine 'thinks' : Understanding opacity in machine learning algorithms. *Big Data & Society*, 3(1), 2053951715622512. <https://doi.org/10.1177/2053951715622512>
- Cardon, D. (2015). *  quoi r vent les algorithmes : Nos vies   l'heure des big data*. Paris, France : Seuil.
- Cardon, D. (2018). "Le pouvoir des algorithmes", *Pouvoirs*, 1(164), 63-73. doi : [10.3917/pouv.164.0063](https://doi.org/10.3917/pouv.164.0063).
- Citton, Y. (2014). *Pour une  cologie de l'attention*. Seuil.
- Couldry, N. and Mejjias U. A. (2019). *The Costs of Connection: How Data Is Colonizing Human Life and Appropriating It for Capitalism*. Stanford,  tats-Unis : Stanford University Press.
- Cordier, A. (2015). *Grandir connect s : les adolescents et la recherche d'information*. Caen, France : C&F  ditions.
- Cotter, K. and Reisdorf, B. C. (2020). Algorithmic Knowledge Gaps: A New Horizon of (Digital) Inequality. *International Journal of Communication*, 14. 745-765.

- Cotter, K. (2021). "Shadowbanning is not a thing": Black box gaslighting and the power to independently know and credibly critique algorithms. *Information, Communication & Society*, 1-18. doi : <https://doi.org/10.1080/1369118X.2021.1994624>
- Day, R. E. (2014). *Indexing It All: The Subject in the Age of Documentation, Information, and Data*. Cambridge, MA : MIT Press.
- Delalande, B. (2020). Quand les algorithmes prennent la parole. Prise en charge et automatisation de l'écriture de soi en contexte numérique. *Interfaces numériques*, 8(2), 288-288. <https://doi.org/10.25965/interfaces-numeriques.3898>
- Deleuze, G. et Guattari, F. (1972). *L'anti-Œdipe : Capitalisme et schizophrénie*. Paris, France : Éditions de minuit.
- Derrida, J. (1967). *De la grammatologie*. Paris, France : Éditions de Minuit.
- Diakopoulos, N. (2015). Algorithmic Accountability. *Digital Journalism*, 3(3), 398-415. doi : <https://doi.org/10.1080/21670811.2014.976411>
- Dogrueel, L. (2021). Folk theories of algorithmic operations during Internet use : A mixed methods study. *The Information Society*, 37(5), 287-298. doi : <https://doi.org/10.1080/01972243.2021.1949768>
- Dogrueel, L., Masur, P. and Joeckel, S. (2021). Development and Validation of an Algorithm Literacy Scale for Internet Users. *Communication Methods and Measures*, 1-19. doi : <https://doi.org/10.1080/19312458.2021.1968361>
- Dowek, G., et Abiteboul, S. (2017). *Le temps des algorithmes*. Pommier
- Drumond, G. S. M., Coutant, M. et Millerand, F. (2018). La production de l'utilisateur par les algorithmes de Netflix. *Les Enjeux de l'information et de la communication*, 19(2), 29-44.
- Eco, U. (2011). *De l'arbre au labyrinthe*. Paris, France : Le Livre de Poche.
- Estivals, R. (2002). *Théorie générale de la schématisation*. Paris, France : L'Harmattan.
- Gillespie, T., Boczkowski, P. J., & Foot, K. A. (Éds.). (2014). *Media Technologies : Essays on Communication, Materiality, and Society* (Illustrated edition). The MIT Press.
- Gillespie, T. (2018). *Custodians of the Internet: Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media*. New Haven & London, États-Unis : Yale University Press.
- Goody, J. (1979). *La raison graphique. La domestication de la pensée sauvage*. Paris, France : Éditions de Minuit.
- Graff, H. J. (1985). *The Labyrinths of Literacy: Reflections on Literacy Past and Present*. Pittsburgh, États-Unis: University of Pittsburgh Press.

Gran, A.-B., Booth, P. and Bucher, T. (2021). To be or not to be algorithm aware: A question of a new digital divide? *Information, Communication & Society*, 24(12), 1779-1796. doi : <https://doi.org/10.1080/1369118X.2020.1736124>

Gras, S. E. (2015). Éthique computationnelle et matérialisme numérique : l'apport des *Software Studies. Critique*, 8-9(819-820), 667-679. doi : <https://doi.org/10.3917/criti.819.0667>

Guattari, F. (1989). *Cartographies schizoanalytiques*, Paris, France : Galilée.

Hargittai, E., Gruber, J., Djukaric, T., Fuchs, J. and Brombach, L. (2020). Black box measures? How to study people's algorithm skills. *Information, Communication & Society*, 23(5), 764-775. doi : <https://doi.org/10.1080/1369118X.2020.1713846>

Head, A. J., Fister, B. and MacMillan, M. (2020). Information Literacy in the Age of Algorithms: Student Experiences with News and Information, and the Need for Change. *Project Information Literacy*. Repéré à <https://eric.ed.gov/?id=ED605109>

Jean, A. (2019). *De l'autre côté de la machine. Voyage d'une scientifique au pays des algorithmes*. Paris, France : L'Observatoire.

Jeanneret, Y. et Souchier, E. (1999). Pour une poétique de "l'écrit d'écran", *Xoana*, (6), 97-107.

Joux, A. & Bassoni, M. (2018). Le journalisme saisi par les Big Data ? Résistances épistémologiques, ruptures économiques et adaptations professionnelles. *Les Enjeux de l'information et de la communication*, 19(2), 125-134

Kitchin, R., and Dodge, M. (2011). *Code/Space : Software and Everyday Life*. MIT Press.

Kitchin, R. (2017). Thinking critically about and researching algorithms. *Information, Communication & Society*, 20(1), 14-29. doi : <https://doi.org/10.1080/1369118X.2016.1154087>

Koenig, A. (2020). The Algorithms Know Me and I Know Them: Using Student Journals to Uncover Algorithmic Literacy Awareness. *Computers and Composition*, 58(1), 102611. doi : <https://doi.org/10.1016/j.compcom.2020.102611>

Le Deuff, O. (2009). Penser la conception citoyenne de la culture de l'information. *Les Cahiers du numérique*, 5(3), 39-49.

Le Deuff, O. (2012). Littératies informationnelles, médiatiques et numériques : de la concurrence à la convergence ? *Études de communication*, (38), Université de Lille, 131-147. doi : <https://doi.org/10.4000/edc.3411>

Le Deuff, O. (2018). Search Engine Literacy. Dans S. Kurbanoglu *et al.* (dir.), *Information Literacy in the Workplace*, 5th European Conference, ECIL 2017, Saint- Malo, France, September 18-21, 2017, 359-365, Cham : Springer International Publishing. doi : https://doi.org/10.1007/978-3-319-74334-9_38

Le Deuff, O. (2019). Riposte digitale. Pour des maîtres d'arme des réseaux. Publie.net

- Lindén, C.-G. (2017). Algorithms for journalism : The future of news work. *The Journal of Media Innovations*, 4(1), 60-76. <https://doi.org/10.5617/jmi.v4i1.2420>
- Livingstone, S. (2004). What is media literacy? *Intermedia*, 32(3), 18-20.
- Lloyd, A. (2019). Chasing Frankenstein's Monster: Information literacy in the black box society. *Journal of Documentation*, 75(6), 1475-1485. doi : <https://doi.org/10.1108/JD-02-2019-0035>
- Manovich, L. (2013). *Software Takes Command*. New York, États-Unis : Bloomsbury.
- Marino, M. C. (2020). *Critical Code Studies*. Cambridge, Etats-Unis : MIT Press.
- Masure, A. (2014). *Le design des programmes, des façons de faire du numérique*. Thèse de doctorat, Université Paris 1 Panthéon-Sorbonne, UFR Arts plastiques, novembre. Repéré à <http://www.softphd.com>
- Miyazaki, S. (2012). Algorhythmic : Understanding Micro-Temporality in Computational Cultures. *Computational Culture*, 2. <http://computationalculture.net/algorhythmic-understanding-micro-temporality-in-computational-cultures/>
- Michelot, F. (2020). *Quelles pensée critique et métalittérature des futur.e.s enseignant.e.s à l'heure des fausses nouvelles sur le Web social ? Une étude de cas collective en francophonie*. Thèse de doctorat. Université de Montréal.
- Napoli, P. M. (2014). Automated Media: An Institutional Theory Perspective on Algorithmic Media Production and Consumption. *Communication Theory*, 24(3), 340-360. doi : <https://doi.org/10.1111/comt.12039>
- O'Neil, C. (2018). *Algorithmes. La bombe à retardement*. Paris, France : Les Arènes.
- Owens, Major. S. (1976). _The state_ Government and Libraries_. *Library Journal*. 101_(1), 19-28.
- Pariser, E. (2011). *The Filter Bubble : How the New Personalized Web Is Changing What We Read and How We Think*. Penguin.
- Pasquale, F. (2015). *The Black Box Society: The Secret Algorithms That Control Money and Information* (Reprint Edition). Cambridge, Etats-Unis : Harvard University Press.
- Rebillard, F. et Smyrnaiois N. (2010). Les infomédiaires, au cœur de la filière de l'information en ligne. Les cas de google, wikio et paperblog, *Réseaux*, 2-3(160-161), 163-194.
- Ridley, M. and Pawlick-Potts, D. (2021). Algorithmic Literacy and the Role for Libraries. *Information Technology and Libraries*, 40(2). doi : <https://doi.org/10.6017/ital.v40i2.12963>
- Rieder, B. (2020). *Engines of Order: A Mechanology of Algorithmic Techniques*. Amsterdam, Pays-Bas : Amsterdam University Press.
- Rouvroy, A., & Berns, T. (2013). Gouvernamentalité algorithmique et perspectives d'émancipation. *Réseaux*, n° 177(1), 163-196.

- Salaün, J. M. (2012). *Vu, lu, su : Les architectes de l'information face à l'oligopole du Web*. Paris, France : La Découverte.
- Seaver, N. (2017). Algorithms as Culture: Some tactics for the ethnography of algorithmic systems. *Big Data & Society*, 4(2). doi : <https://doi.org/10.1177/2053951717738104>
- Seaver, N. (2019). Captivating Algorithms: Recommender Systems as Traps. *Journal of Material Culture*, 24(4), 421-436. doi :<https://doi.org/10.1177/1359183518820366>
- Shin, D., Rasul, A. et Fotiadis, A. (2021). Why am I seeing this? Deconstructing algorithm literacy through the lens of users. *Internet Research*. doi : <https://doi.org/10.1108/INTR-02-2021-0087>
- Siebert, J. (2018). Algorithm Accountability, Algorithm Literacy and the hidden assumptions from algorithms. Dans M. Tichy, E. Bodden, M. Kuhrmann, S. Wagner et J.-P. Steghöfer (dir.), *Software Engineering und Software Management*. Bonn, Allemagne : Gesellschaft für Informatik.
- Simondon, G. (1989). *Du mode d'existence des objets techniques*. Paris, France : Éditions Aubier.
- Simondon, G. (2005). *L'individuation à la lumière des notions de forme et d'information*. Grenoble, France : Éditions Jérôme Millon.
- Steiner, C. (2012). *Automate this: How algorithms took over our markets, our jobs, and the world*. New York, NY: Portfolio.
- Stiegler, B. (2008). *Prendre soin : Tome 1, De la jeunesse et des générations*. Paris, France : Flammarion.
- Striphas, T. (2015). Algorithmic Culture. *European Journal of Cultural Studies*, 18(4-5), 395-412. doi : <https://doi.org/10.1177/1367549415577392>
- Thomas, S. (2007). Crossing divides. *First Monday*, 2007, Volume 12 Number 12—3.
- Valtonen, T., Tedre, M., Mäkitalo, K. and Vartiainen, H. (2019). Media Literacy Education in the Age of Machine Learning. *Journal of Media Literacy Education*, 11(2), 20-36.
- Vincent, N., Li, H., Tilly, N., Chancellor, S. and Hecht, B. (2021). Data Leverage: A Framework for Empowering the Public in its Relationship with Technology Companies. *FACCT 2021 - Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency*, Association for Computing Machinery, 215-227. doi : <https://doi.org/10.1145/3442188.3445885>
- Webber, S. and Johnston, B. (2005) Information literacy in the curriculum: selected findings from a phenomenographic study of UK conceptions of, and pedagogy for, information literacy. Dans C. Rust (dir.), *Improving Student Learning: Diversity and Inclusivity: Proceedings of the 11th ISL symposium*, Birmingham, 6-8 September 2004, 212-224, Oxford : Oxford Brookes University.

Weber, M. S. and Kosterich, A. (2018). Coding the News_ The role of computer code in filtering and distributing news _Digital Journalism,_6_(3), 1-20. doi : <https://doi.org/10.1080/21670811.2017.1366865>

Zuboff, P. S. (2019). *The Age of Surveillance Capitalism : The Fight for a Human Future at the New Frontier of Power* (Main édition). Profile Books Ltd