Technology criticism and data literacy:
The case for an augmented understanding of media literacy

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ABSTRACT

Reviewing the history of media literacy education might help us to identify how *creating media* as an approach can contribute to fostering knowledge, understanding technical issues, and to establishing a critical attitude towards technology and data. In a society where digital devices and services are omnipresent and decisions are increasingly based on data, critical analysis must penetrate beyond the "outer shell" of machines – their inter*faces* – through the technology itself*,* and the data, and algorithms, which make these devices and services function. Because technology and data constitute the basis of all communication and collaboration, media literate individuals must in the future also have a sound understanding of technology and data literacy. This article examines the relevance of this broader definition of literacy and delivers a forward-looking defense of media literacy education in schools. It also posits the thesis that the digital transformation represents a challenge, which is confronting society, politics, and education alike.

Keywords: *media literacy, digital transformation, big data analytics, machine learning, activity orientation*.

INTRODUCTION

Digital technology – because it is based on *hardware*, *network technology* (Gapski, 2016; Knaus, 2017b; Knaus, 2020a), and *software* (Knaus, 2017a; Knaus, 2020a; Manovich, 2008) – makes it possible for new ideas to be transformed into new products and services relatively simply and quickly. The intervals between cycles of technological innovation are becoming ever shorter. *Data*, irrespective of whether they have been collected by human beings or machines for economic or scientific reasons, generated as code, or simply come into being as a consequence of everyday media activity (D'Ignazio & Bhargava, 2015; Gapski, 2015; Letouzé et al., 2015), constitute the core basis for *decision-making, analysis,* and *assessment* (Knaus, 2020a) – activities, which (just like *learning*) were until recently the preserve of individual human beings.

Data can therefore be seen as the "new oil" – as the new resource behind innovation and social progress. The data and algorithms that are used to generate the data are therefore constantly generating new questions to which society must find answers (Knaus, 2020a, pp. 46–54). This article seeks to answer a number of these new questions, such as: how much should human beings know about technology, algorithms, and data? What does the concept of *data literacy* mean; and how does it relate to media literacy? What approaches can people use to experience data and its effects in modern society, and what approaches are suitable for their experience in educational contexts? To answer these questions, this article looks back through the history of criticism as well as media literacy education.

As we transition from the *mass* medium to the *participative* medium, it has become clear that media literacy must include more than simply knowledge about media, and an analytical, reflexive, and ethical *critical media literacy* – as called for by the Frankfurt School (Adorno, 1971; Enzensberger, 1970; Horkheimer & Adorno, 1969). Participative media have opened the way for people to creatively and actively design media – *to create media* – and have given rise to new ways of accessing it (Dewey, 1950). Taking a theoretical-conceptual approach, this article seeks to show that these dimensions of media literacy (Baacke, 1996; Buckingham, 2004) have lost none of their relevance – even taking *digital* media into consideration and bearing in mind the broadening of media literacy to include *digital* literacy (Hobbs, 2011). Yet, in light of the current development in technology, there is actually a need for a further discussion to take place to reflect historical development: although technical hardware and networks, software and data constitute the basis of all *digital* media (Knaus 2020a; Manovich 2008), they remain very hard for people to grasp at the purely analytical and receptive level. This is especially true for data literacy as a core component of media, digital, informational, computational, statistical and scientific literacy (Letouzé et al., 2015). Nevertheless, literacy is not born out of reception alone; it arises first and foremost from *doing*.

It is for this reason that action-oriented approaches such as *active media work* (Schell, 1989), *making*, *coding*, *tinkering* (Aufenanger et al., 2017; Blikstein, 2013; Knaus 2020b) and *computational thinking* (Wing, 2006), which foster people's creative design of hardware, software and media, are appropriate educational methods for developing data literacy, because they turn abstract data into something that people can experience.

Criticism and binary truths

A look back through the history of criticism reveals – most prominently among the thinkers of antiquity and the Enlightenment – that criticism is a process of establishing the truth, of establishing a distinction between what is *true* and what is *not true*. Interestingly, the *binary* numeral system, which serves as the basis for all of the data and processes in digital applications, shows that this attempt by the philosophers of antiquity to establish the truth might indeed be possible. After all, a world of *one*s and *zero*s has a good deal in common with any attempts we might make to establish the difference between what is true and what is not true. Yet, now, confronted as we are by the complexities of digitized social transformation, we find that viewing the world in this binary way is no longer appropriate.

In a world in which most people communicate using media and in which most people therefore have the potential to access mass audiences, it is multiple truth*s* – in the plural – which are becoming the norm. *The* truth is dissolving in the face of more pluralist understandings of truth (and at times even *alternative truths*). The world is moving on from simple binary perceptions. So, whilst truth claims continue to exist, it is becoming ever-increasingly difficult to rely on them as the basis for generalizations or criticism (i.a., Pörksen & Detel, 2012). This begs the question: how is criticism still possible if people are being confronted by multiple truths in their everyday lives?

The implication is that whilst the process of establishing the truth in a digital age is becoming increasingly complex, so is society's *judgment* about what constitutes socially appropriate behavior, together with its subjective discussion and evaluation (Stalder, 2016). It is largely for this reason that *critical reception* has always retained its relevance.

From critical recipient to active subject

The aim of creating a *critical recipient* (Kübler, 2006) is to prevent any historical repetition of small numbers of people with dangerous utopian ideas once again exploiting large numbers of people for their own ends. This core principle of media criticism was considered a mediapedagogical ideal back in the 1970s: enlightenment traditions and particularly *critical theory* made it imperative to counteract *manipulative influences* [Manipulationsmächte] and *misleading representations* [Verblendungszusammenhänge] in the mass media (Adorno, 1971; Horkheimer & Adorno, 1969; Kellner & Share, 2007; Kübler, 2006). It was with this in mind that Günther Vogg defined the normative objective of media literacy education as

"the encouragement and support people need to use media reasonably (behavior), and to have an objective and self-oriented approach to using the opportunities offered by the mass media to access information, education and entertainment, and engage in personal fulfillment. This includes the ability to show discernment in our choice of programs and levels of consumption as well as knowing how to deal with negative influences"[1] (Vogg, 1967, p. 133).

Using media in one's own best interest begins with the freedom[2] to decide whether or not to use media to pursue one's personal goals, or to refuse to accept certain media or media content in the process of one's own media appropriation (Schorb, 2005).

The primary objective of achieving media literacy was and remains the creation of an *active subject* (Hurrelmann, 2002; Knaus et al., 2017; Kübler, 2006; Schorb, 1995; Tulodziecki, 2018) with a *self*-oriented *use* of media. However, in times when *hate messages* are

on the increase, the critical *producer* is, together with the critical recipient, also gaining in importance. This is because media articulation in the digital age is no longer the exclusive preserve of professional publishers (Hobbs, 2018; Pörksen & Detel, 2012).

The technically empowered subject

Fourteen years ago, Hans Dieter Kübler compared two positions on critical media literacy. These were firstly the findings of the 2003 Cologne Workshop Discussions and secondly the guidelines released by the Federal Centre for Political Education (bpb) in 1987. He came to the conclusion that many issues had remained the same or similar, even if the way they were formulated had changed (Kübler, 2006). What had changed, however, was the *target group*: in 1987, the guidelines were primarily directed at journalists and teachers, whereas in 2003, *all* people were included in the critical media literacy target group (Kübler, 2006).

The shift from mass media for *information and entertainment* towards digital *communication* media has increased the numbers of media producers. Whilst early media were produced by a few people for the many, digital and *social* media now make it possible and easier to have many-to-many communication (Hobbs, 2018; Van Dijk, 2013). This means: All people are potentially in a position to use digital tools to produce media artifacts and publish them or – to phrase this differently – to use media to express themselves publicly. Hanne Detel and Bernhard Pörksen refer to the *fall of the media production monopoly* as "barrier-free publishing" (Pörksen & Detel, 2012). Here, formerly *recipient* subjects are transformed into *constitutive* subjects by becoming media producers.

The relevance of critical media literacy increases as a result, not only because the media are omnipresent, but also because digital media – due to their digital-technical, networked, and data-based structure (Brinda et al., 2020; Gapski, 2016; Knaus, 2017b; Letouzé et al., 2015) – have the potential to turn every person into a

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[1] Translation by the author; original: "Anregung und Anleitung zum sinnvollen Gebrauch (Verhalten), zu einer sachlichen und persönlich orientierten Nutzung der Möglichkeiten der Massenmedien zur Information, Bildung, Unterhaltung und Erbauung. Das schließt die sinnvolle Programmauswahl und das rechte Maß im Konsum ebenso ein wie die Bewältigung negativer Einflüsse".

[2] Presuming such a high level of autonomy has attracted understandable criticism: Horst Niesyto surtitled his doubts about the *autonomous recipient* as the "fiction of free choice" (Niesyto, 2006, p. 61) and justified his criticism by saying that not all productive, reality-processing subjects had comparable economic, social and cultural capital at their disposal (Bourdieu, 1984; Kommer, 2016). This implies that the question of subjective critical media literacy is also a question of an individual's resources (Niesyto, 2006).

media producer.[3] This brings to fruition one of Dieter Baacke's dearest wishes: he called for people

> "as competent communicators [and] active media users" to have the "technical instruments" made available to them that enable them "to express themselves through this medium" (Baacke, 1996, p. 7).

Bernd Irrgang states that *technology* (diverging from the engineering sense) is not an inflexible system of artifacts; technology does not consist of its technical or media artifacts, of its basis or its outward manifestation, "but in the production and use of technical applications, in short: their technical practice"[4] (Irrgang, 2001, p. 5). Accordingly, technology manifests itself not only in the medium or in the technical artifact but in the *social use* of technology (Irrgang, 2001). Here, media practice and technical practice can be understood as implicit knowledge in dealing with artifacts (Irrgang, 2001), although, it is still largely understood as a form of expert knowledge, which is only accessible for people with a technical education (Knaus, 2020a; Knaus & Engel, 2015). However, at a time in which software can potentially receive commands (Manovich, 2008) from anybody and everybody, people can now with relative ease (as opposed to the days when hardware was still prevalent or before the introduction of graphical user interfaces[5]) design technology by themselves (i.a., Allert & Richter, 2011; Knaus & Engel, 2015; Mammes, 2013).

In processes like these, software and data become the *material* from which users can generate and combine useful technical tools (Knaus, 2017b; Knaus & Engel, 2015). But what if we were not only limited to using the technology, which was available to us? What if we could not only individualize and customize it but actually *design* it for the most part ourselves? We would become – thanks to the data and software-based *adaptivity* of digital technology – *technically empowered subjects*.

We would then be able to design and alter more than just the "outer shell" of the machine – its outward media manifestations and inter*faces* – but also the *technology itself* (Knaus, 2017a; Knaus, 2020a).

Visual codes and objectivity

Media criticism is a key constituent element in the objective, which media education strives to achieve, namely *media literacy* (Buckingham, 2004 and 2018; Kellner & Share, 2007; Kress, 1992). It includes people's fundamental evaluative and decision-making skills: their ability to differentiate between, to compare and evaluate facts, characteristics, and qualities whilst recognizing the link between the changing role of media in society and their own individual media practice (i.a., Baacke, 1996; Bennett, 2008; Buckingham, 2004; Niesyto & Moser, 2018). Media criticism can be subdivided into several categories, which build on one another: perception skills, decoding skills, analytical skills, reflectivity, and discernment (Ganguin, 2004; Kellner & Share, 2007). For instance, one aspect of reflective discernment is a person's ability to evaluate the objectivity of what they are seeing and experiencing. This is no trivial matter, because we intuitively ascribe truth content to what we encounter visually, such as pictures and images – they seem real or "objective" to us (Bruce, 2008; Knaus, 2009; Knaus, 2018). However, we know that pictures and images are fundamentally open to manipulation (Bruce, 2008; Doelker, 1997).

Firstly, digital data and tools have made it easier to manipulate pictures and moving images. Secondly, media exert an influence on more than just the entertainment and information industries; their symbols and communicative elements are becoming increasingly dominant in communicative acts as well (Knaus, 2009). Whilst we already possess considerable levels of experience with text-coded forms of communication, our use of visual codes for the way we communicate ourselves – that is, the way we deal with the connotative function of pictures and videos and the way we engage in scholarly reflection about them – is still relatively new

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[3] Because these responsibilities are relatively new, *self-criticism* (Karmasin, 2006) and the need for media users "to reflect on the consequences of their own publishing activity" (Süss et al., 2013, p. 113, translation by the author) have become an essential constituent of critical media literacy in the digital age.

[4] Translation by the author; original: "sondern die Herstellung und Anwendung technischer Mittel, kurz technisches Handeln".

[5] Taking Web-editors and CMS by way of an example, it is possible to show that in the first instance designing an appealing website needs good ideas, appropriate text, graphics and photos, but no longer any knowledge of HTML – in the foreseeable future it will probably be the case that only relatively few people actually know what "HTML" is any more. Even now, it is comparatively easy to set up and install the technical basis for a website – the web server (further examples can be found in Knaus, 2020a). It is roughly equivalent to the level of technical know-how required to use, individualize and customize a smartphone.

(Bruce, 2008; Doelker, 1997; Knaus, 2009; Lucht et al., 2013; Marotzki & Niesyto, 2006).

Criticism of data, algorithms, and machine learning

The *adaptivity* (which is a result of the data-based structure and the programmability) of every digital tool makes it possible to manipulate far more than just *media* artifacts. Due the Fourth Industrial Revolution, digital technology and data – as the basis for all new, transformed, and converged media – are becoming established in all spheres of life. For instance, anybody going to a bank nowadays to ask for a loan will no longer have to convince their local bank manager of their credit-worthiness, but an algorithm instead. Whilst it was still the case not so long ago that people were deciding about the trustworthiness of other people, this task is now – in the digital age – undertaken by machines (Knaus, 2020a).

The assumption is that the decision-making capacity of data and algorithms is more reliable than human decision-making. However, are the data and the algorithms they use to generate the data really objective? It is, of course, true that humans can be (mis-)guided by emotions and visual attractions or distractions. And in the case of so-called recruitment-bots or career-bots, the principle *algorithm trumps human knowledge* might well apply. Nevertheless, whilst the bots themselves are free of prejudice or antipathies towards applicants applying for a job, the data they use are historical and often infused with racial and gender bias. Because these codified guidelines for action are the product of human hands, their claim to objectivity is untenable. Just like texts and images, all artifacts – and therefore all technology, algorithms and data – are potentially flawed. In other words, if the world is biased, the data is too. And if we use this (historical) biased data, the results of all algorithmic decision-making are biased too. In addition, the algorithms we use to generate the data carry the fingerprints and opinions of their creators in their code – intentionally or unintentionally – so algorithms might contain hidden third-party interests and allow subjective desires and objectives to take a dominant position in ostensibly "objective" decision-making processes (Beranek, 2020; Devlin, 2017; Knaus, 2020a). And whilst we are able to tell if another person is deceiving us, it is much harder to tell when a machine is doing so.

These biased algorithms and data are particularly problematic if human beings lack the cognitive ability to comprehend them due to their size. When machines are used to alleviate mental activity and work (i.a., Nake, 1992; Schelhowe, 2007; Schelhowe, 2016) and even increasingly to undertake tasks for which people lack the cognitive capacity, people become dependent on technology. In this vein, the growing importance of data science in the Fourth Industrial Revolution has spawned a new term: *big data analytics*. This is the term given to processes in which important decisions are taken for individuals and societies based on volumes of data which are otherwise too large for human beings to handle (D'Ignazio & Bhargava, 2015; Gapski, 2015; Letouzé et al., 2015), and which people can only grasp in the most rudimentary way. Media criticism must therefore not merely focus on the *outer shell* of the machine at the media and application level – namely the visible technology, the interfaces and their organizational conditions – but must also include the technical basis, the data and operating procedures – especially as these regulate the media interface based on *in-scribed* (programmed) or independent (machine-learned) instructions (for further reading see Knaus, 2020a). Children, adolescents, and most adults do not, as a rule, come into contact with "digital technology in its raw state" (GMK, 2016), but with its social, media and communicative fields of application (Tulodziecki, 2018). However, when *digital* technology such as so-called artificial intelligence (AI) extends beyond the function of a medium by producing content and conducting its own interpretations (Knaus, 2017a), then, we should focus our attention on other aspects of media literacy, namely, knowledge of the technical and organizational context behind media production (Baacke 1996).

Our objective is to demystify technology and information processes. This, in parallel to public debates on values and norms, requires society to adopt a critical position on codes and algorithms and the data they generate: will machine-based instructions be thoroughly tested when the first results appear plausible? Who will set the operational parameters and thresholds upon which machines base their decisions? What consequences will there be for a society in the digital age if it is largely *male* programmers who generate the codes? How transparent and verifiable are algorithms – especially those, which process personal data and, as in the above example, even generate them?

In order to be able to ask and discuss these questions in social, political, and economic contexts, it is necessary for users to possess not only media literacy but also technology literacy (Buhr & Hartmann, 2008), digital literacy (Hobbs, 2011), information literacy and

computational literacy (Brinda et al., 2020; Mammes et al., 2016), something which – in parallel to *active media work* (i.a., Baacke, 1996; Schell, 1989) – is best promoted through one's own practical experience of media and technical activity (Dewey, 1950). It is for this reason that media literacy in the digital age must be understood in broader terms. The time in which media *use* was optional and in which it was possible for the subject to adopt responsibility in the sense of *informational self-determination* has passed (Knaus, 2018).

The limitations of autonomous data literacy

Media literacy is a concept, which, in its traditional sense, has relatively little to do with technology (i.a., Baacke, 1996; Kress, 1992; Schelhowe, 2007) but which, in everyday use, is erroneously reduced to the narrower meaning of *technical* skills (Aufenanger, 1997, p. 3; Buckingham, 2004; Knaus, 2017a). When Dieter Baacke (1973) coined the term based on the concept of (linguistic) competence put forward by Noam Chomsky (1968) and on the works of Karl-Otto Apel and Jürgen Habermas (1981), it was not technology or media tools that Baacke had in mind, but communication and cooperation. His focus lay on people's ability to use media and media-based tools autonomously for their own needs and purposes and for them to reflect upon them in the context of themselves, the media, and the society in which they lived (Baacke, 1973). He was interested in people's ability to act in a creative and participatory manner and to acquire knowledge in a structured and analytical way (Baacke, 1996). In this light, it is still less an issue of technology even today, and more a matter of how and why we (desire to) use digital technology and tools. Foremost among the reasons are still essentially communication and cooperation – just that they are primarily and increasingly in media form and have a digital basis.

The primary focus of media criticism is therefore the education of humanity [Bildung des Menschen]. Nevertheless, in a digital age, the *socially empowered subject* must also be media literate, as already mentioned. Increasingly, however, even media literate individuals are no longer able to retain control over their own (personal) data. The so-called *informational self-determination* is increasingly endangered (Westin, 1970). Irrespective of how cautious we might be in surfing the WWW or using social media, it is illusory to think that we can retain control over our own data when

inconspicuous apps and internet services are continuously collecting our personal data.

The following section lists a number of developments, which cannot, from the current perspective, be accurately appraised, but which indicate the trends, which underline both the social relevance of digital technology and its changing social and cultural functions (Stalder, 2016). These current changes in meaning imply, among other things, that individuals are (ought to be) increasingly shifting elements of technology and data criticism onto the stage of public debate.

For the purposes of identification, timekeeping, and access management, a company is planning to inject chips under the skin of its employees between their thumb and index finger (GI, 2017). Another example: so-called "intelligent loudspeakers" such as *Amazon Echo* (Alexa) carry out permanent surveillance in people's homes so that they can respond to key words with spontaneous functionality. Similar technology is already being used in children's toys. And now a third example: in order to use the *WhatsApp* Messenger, it is necessary for users to share their address books. By sharing their address books, users make available the names and contact details of people who have potentially decided against using this service. The people who are saved in the private address book of another WhatsApp contact are no longer free to decide independently and on a case-by-case basis about whether their data are saved or passed on to third parties.

Digital transformation as a socio-political task – an opportunity with inequalities

Occasional protests challenge these impositions by states and companies, such as legal action being taken against undamped data collection by CCTV in public places (e.g. mounted on drones) or against being involuntarily filmed using smart glasses (such as *Google Glass*). However, many people value the benefits of digital tools and either accept their new functions after weighing up the potential risks and benefits to themselves, or accept them without any greater thought. Others, such as the employees in the first example cited above, simply have no choice – apart from changing their employer. It is therefore necessary, in addition to subjective reflection and the critical approach to using (digital) media, which should be practiced in families and schools, to initiate a social discourse about what technology and globalized and globally networked

institutions should and should not be allowed to do with our data.

Our world has become richer because it is now possible and, with the help of digital technology, increasingly easy for *all* people not only to receive media, but also to become creative designers of media artifacts, media tools, and technology themselves. This goal continues to be a desirable objective because plenty of inequalities continue to exist with regard to technical progress. There is a long list of countries in which people are only gradually gaining access to digital devices, services and (broadband) Internet (i.a., Van Audenhove & Fourie, 2014). In developing countries, in particularly, access to technology and networks is important for promoting opportunity. And even in the technologically advanced countries, which are fully equipped with smartphones, computers, and internet access (MPFS, 2020), there is still a digital divide. Whilst all people have personal access to digital devices, we now know that children's and adolescents' media use is largely dependent on media use in the family, while how young people access media depends on their social environment (Kommer, 2016; MPFS, 2020). For instance, the degree to which media are used in the context of children's primary socialization to access information as well as for entertainment purposes correlates directly with their parents' educational background and the way they themselves use media (i.e. Hargittai & Hinnant, 2010; Van Dijk, 2020). The mediatization and digitization of all areas of life (Hepp, 2020) is eroding the traditional ways people have used media and is creating recurring periods of radical change, which regularly sweep away older media paradigms and undermine parents as role models. For example, very few parents have any experience of the (constantly updated) *new* digital media, services, and tools. This explains to some degree the need for media literacy to be fostered in children's secondary socialization context: their school (i.a., Andersen, 2020; Burn & Durran, 2007; Mammes, 2013). But the speed of technological transformation makes this necessary not only in school but also in other educational fields such as cultural education and adult education as well. But doing this, namely promoting learners' understanding of technology and informational processes as a precondition for advancing their media literacy in the digital age, means pursuing a further

objective, namely – despite all of the difficulties this involves – fostering equality of opportunity.

Digital transformation as an educational task – a challenge with promise

Media education does not only set standards for educational policymakers or institutions, it is also in a position – thanks to the above-mentioned conceptual particularities of digital technology – to provide new approaches to learning *with* and *about* media, because following on from action-oriented approaches (i.a., Baacke, 1996; Burn & Durran, 2007; Dewey, 1950; Schorb, 1995; Tulodziecki, 1997), there are now new potential areas opening up in teaching and education due to the more extensive opportunities for media production, distribution, and design offered by digital technology. Examples include makerspaces, fablabs, codespaces, and hackerspaces; and the first attempts to use the experience and ideas of the *maker movement* for media education and teaching – in the sense of *educational* makerspaces – in cultural and youth work, in adult education, in schools and universities (Aufenanger et al., 2017; Autenrieth et al., 2018; Knaus, 2017b; Knaus, 2020a; Knaus, 2020b). By using action-oriented approaches, like *active media work* (Schell, 1989) and *making* (Aufenanger et al., 2017; Blikstein, 2013; Knaus, 2020b), it is possible to equip children and youngsters with an enhanced ability to criticize and reflect upon media and the digital technology and data behind them. Ultimately, the objective is to enable all people to improve their ability to communicate and participate (Jenkins et al., 2006), irrespective of their stratum of education.

In a society in which fundamental decisions are made by data and algorithms, "the computer which is capable of remembering things […] can begin to take part in society's communication in a way previously reserved only for human beings"[6] (Baecker, 2007, p. 9), and in a society in which social participation is synonymous with human-machine interaction (Knaus, 2020a; Meder, 1998; Swertz, 2007), media literacy must move forward from its elementary task of advancing the principles of autonomous and self-determined media *use* – in its reflexive, ethical, and analytical dimensions – and become something more all-encompassing. Digital technology provides the impetus behind media

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[6] Translation by the author; original: "der gedächtnisfähige Computer [...] in der Gesellschaft mitzukommunizieren beginnt, wie man dies bisher nur von Menschen kannte".

development in society: digital media enable us not only to interact with our environment – we can also use them to create our own realities. But whilst socialization research has made solid progress in understanding what the media are doing to us, it has yet to devote sufficient attention to what *we* are doing with digital media. The still relatively new social function of digital media means that they are developing from a mere *data interchange interface* into a *communicative interlocutor*. They are becoming the catalyst for formative subjective and social construction processes. Their increasing relevance means that media criticism should not be restricted to the medium itself – the "outer shell" of technology (Knaus, 2020a). The analysis of their interaction must penetrate deeper, giving a rise to a *criticism of technology*, media artifacts, like videos and computer code, and information processes, like data, algorithms, and machine learning. In the future, only those people who are equipped with the knowledge of what takes place behind the user interface will be considered media literate. A conceptual understanding of technology – of which data literacy is a constituent part (Letouzé et al., 2015) – is therefore an essential element of any broad-based media literacy.

Possessing a rudimentary understanding of technology and informational processes is an essential precondition for acquiring this augmented kind of media literacy. Media literacy therefore remains – even and especially in the digital age – a key skill, which we need to promote and foster with effort and energy in schools and universities (Andersen, 2020; Mammes, 2013), in cultural, and adult education (Buhr & Hartmann, 2008), and in the entire education sector. Because wherever possible, *all* people should benefit from it, and this is why media literacy education must exploit further educational fields. In turn, school can also profit from the approaches, which have already been tried and tested in non-formal contexts (Knaus et al., 2017; Knaus, 2020a).[7]

A media literacy, which includes an understanding of technology and a better understanding of what globalized and globally networked institutions are able

to do with our data is critical for people's capacity to act autonomously [Mündigkeit] and their ability to participate in social contexts (Jenkins et al., 2006). It is this *augmented* understanding of media literacy that enables people to assume responsibility as constructors of reality. Only if we all contribute as technically empowered subjects to shaping the digital world, can politics draw the boundaries – provide guardrails – for our actions. It is up to us to fill any gaps creatively – including becoming involved in politics – in order to identify new opportunities and boundaries. These opportunities and boundaries shift with every new technological innovation. And, not least because of the above-mentioned adaptivity of digital technology, these cycles of innovation are taking place at ever-shorter intervals. It is for this reason that a broad-based media literacy education is crucial if we wish to enable people to participate fully in a digital society.

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[7] Unfortunately, there have been to date only a handful of universities in Germany which offer media literacy programs to prospective teachers, thereby giving them the opportunity to acquire *mediapedagogical competence*, or offer media education as a second field (Knaus et al., 2017). University programs therefore need to be expanded and improved. Given the current (and, in the short term, virtually insurmountable) skills gap, it would seem expedient to pursue deeper cooperation between schools and extramural youth and

cultural work – not least in the hope that a traditional institutional borderline might be challenged and, following the positive experience, which is to be anticipated, be permanently erased. It might be conducive to partially open schools for project work in media education and encourage similar collaborations between schools and providers of extramural cultural and youth work (Brüggen et al., 2017; Wagner & Ring, 2016).

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