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Rethinking sociocultural notions of learning in the digital era: Understanding the affordances of networked platforms

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Abstract

Understanding the affordances that networked platforms offer is a good place to start rethinking our notions of learning. The article discusses how social connectivity has changed, arguing that networking and networks have become foregrounded in how we perceive and experience our (digital) social worlds. Our aim is to understand the nature of networked structures, and the networked practices that these have enabled, to shed light upon how they 'work' for learning. While making use of the concept of affordances, the article discusses a selection of four affordances of digital networks (visibility, scalability, flexibility and persistence) and argues how these impact upon opportunities to learn through social media. The article finally critically reflects on how socio-cultural theories of learning need expansion and revision, given social changes involving the rise of social media, but it also shows how this perspective leads the way in pointing to new challenges for theorising learning.

Keywords

Affordances, online social networks, sociocultural learning theory, visibility, scalability, flexibility, persistence

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Introduction

There is a wealth of literature on learning in the 21st century covering a wide range of issues from how ICT could be implemented in education to skills that are essential for a new generation of learners. Underlying a large proportion of these studies is the need to understand the consequences of the relatively recent, now ubiquitous digitally networked forms of participation and interaction for learning and education. How to best leverage technological advancements to create meaningful learning experiences has been a central question against the backdrop of these developments. Yet, we are still figuring out how these socio-technological changes relate to our development and learning as individuals and as societies more fundamentally, and how we should rethink earlier concepts of learning and instruction considering these changes. In this conceptual review article, our aim is to understand the nature of networked structures as the fundament of social media, and the learning practices that these structures have facilitated, to shed light upon how they work for learning. We will both draw upon literature on 'what the affordances of social networks are' as well as on literature that shows how these networked affordances pose new challenges for learners. Finally, we apply the insights thus gained to what is needed in terms of a re-conceptualisation of learning theories. The key argument we will defend in this article is that understanding the affordances offered by social media is a good place to start rethinking concepts of learning.

Social media is designed to be a common ground for interaction, and the nature of interaction and social participation on social media is defined and influenced by 'bits' as the building blocks of digital domain. That is why social media, as ever expanding and shrinking collections of nodes and links, allow forms of interaction and learning that are fundamentally different from other media that 'carry' our interactions. The hypertextual structure of social media and their capacity for constant reconfiguration, for instance, have important implications for rethinking the connectivity or the kinds of social interaction that underlie most of our thinking about learning.

Situating ourselves in sociocultural approaches of learning, we ask what these new insights about networks mean for how we should conceptualise learning. While classical theories of learning have focused on individuals and their internal psychological processes – informed by behaviourist, cognitivist, information processing and other models – sociocultural approaches to learning have emphasised the social and distributional nature of learning (Cole and Wertsch, 1996; Vygotsky, 1978; Wertsch, 1985). From a sociocultural perspective, learning is explained by accounting for the complex relationships between history, culture, tools, communities, and individuals. Most of the theoretical concepts in sociocultural theory on how learning happens are based on observations of in-person interactions, dyadic relationships or small groups (e.g. Elbers 1996). However, since social media altered interaction dynamics significantly, it is necessary to carefully evaluate the underlying assumptions of these concepts. The types of connectivities and possible interactions afforded by social media necessitate 'a social media-age rethinking of Vygotsky' (Churcher et al., 2014: p.33). Vygotskian theory allows us to situate learning as part of potentially 'globally situated relations' and include the idea that social media reshape learners' 'modes of thought, imagined possibilities and agency freedoms' as Marginsons and Dang (2017, p. 127) express it.

In this article, our methodology is as follows. First, we reflect on how social connectivity has changed, arguing that networking and networks have become foregrounded in how we perceive and experience our (digital) social worlds. As a next step, we discuss networking as a social phenomenon while applying it to the concept of affordances. We will ask the question: how can we think of new learning spaces, shaped by social media, by considering the affordances such spaces offer to learners? Through a literature review, a detailed consideration of four select affordances will demonstrate how these affect opportunities to learn through social media. We see these affordances

not merely as characteristics of technology itself, but as complex socio-technological practices that have evolved over time through use of these technologies. Finally, as our last step, we return to sociocultural theory to evaluate how the new affordances of social networks impact the way we conceptualise theory itself.

Affordances of new networked connectivities

Digitally networked spaces create new forms of *connectivity*. Hypothetically, we can connect anytime, anywhere and to almost any information or to anyone (boyd, 2010). These connections are not only interpersonal but they can also entail 'following' public figures, news, companies, NGOs, concert and art venues or political parties and receiving regular updates from these resources. By enabling such diverse forms of connection, digital spaces that enable social networking simultaneously to facilitate observing, tracking, maintaining connections, content consumption, production and reproduction, contesting ideas and organising and mobilising resources, among other things. These characteristics make social media inherently relevant for learning. Social media create new possibilities for interactive or more collective forms of learning due to new possibilities to share, solve problems collectively and generate more transparency.

We see affordances as simultaneously reflecting the inherent features of a technology, as well as how people interact with and interpret these features. We understand affordances as "properties of the world defined with respect to people's interaction with it" (Gaver, 1991, p. 80 as cited in Graves, 2007).

Sociologists have argued that our social systems and the way we function in these systems have changed due to the increasingly digitally networked state of the world. Although most of these arguments apply to the society as a whole, they are equally applicable to more specific network formations, such as those formed on social media. In Castells' (2004) work on the network society the advent and global spread of 'networks powered by microelectronics-based ICTs' signifies the start of a new kind of social structure. He argues that networks as a form of organisation influence all domains of social, cultural and economic life around the world, as well as processes of power, production and participation. Castells (2004: p. 5) claims that networks are advantageous forms of organisation – in comparison to hierarchical forms – because of their flexibility, scalability and survivability. Castells (2004), in seeking to understand the changes societies have undergone after the information technology revolution, argues that networks now have become the main and most efficient form of social organisation, over, for instance, the more vertical, hierarchical organisation of the industrial society. In his argument he stresses the vital role of ICT's in enabling an infrastructure in which networked systems can flourish. The extension and augmentation of human interaction is empowered by information technologies, which are increasingly diffused throughout 'the entire realm of human activity' (Castells, 2004: p.7) but also able to reconfigure and reprogram communication networks. Networks are thus essentially flexible and endlessly reconfiguring.

Castells, (2004: p. 5–6) is relatively brief in his explanation of the core qualities of social networks he considers relevant: flexibility, scalability and survivability. Flexibility refers to the ability of networks to 'reconfigure according to changing environments, keeping their goals while changing their components'. Scalability is the capacity of networks to 'expand or shrink in size with little disruption'. Lastly, survivability indicates networks' lack of a centre: Networks 'can operate in a wide range of configurations' and they 'can resist attacks on their nodes and codes because the codes of the network are contained in multiple nodes that can reproduce the instructions and find new ways to perform'. Networks are self-organising, pervasive, adaptable systems: A meta-level organisation that is larger than the sum of its components. Castells describes these qualities based on

an abstract notion of social, technological, economical systems organised and supported by digital networks.

boyd (2010) has examined different aspects of social network sites, primarily from an ethnographic perspective, while conceiving social media as a genre of 'networked publics'. She understands networked publics as (imagined) collectives that are restructured by networked technologies and inhabit a particular networked 'space'. Networked publics are structured by technology, which means that they have particular characteristics. In other words, networked publics are shaped by affordances of the network technology that shapes them. For instance, network publics are shaped by the fact that they are constantly connected with others and linked in new and unexpected ways. We draw on her work not only to extend what Castells says about the affordances of networks but also to expand this discussion from a more ethnographic perspective. Her ethnographic perspective, often related to the production, distribution and consumption of information from literacy research, offers important insights that have implications for individual learners, while Castells' perspective is much broader and refers to the nature of social structures more generally.

Although boyd (2010) talks about the 'bit-based nature' of digital environments, focussing more on the nature of information rather the nature of networks, her goal is to show how the properties of bits inform the particular networked dynamics of these 'publics'. Others have also identified the affordances of social media technologies in different domains, such as Leonardi and Treem (2012), who identified how these technologies allowed individuals and organisations to alter conventional practices and other forms of computer-mediated communication in business and organisational settings. They identified four affordances – visibility, persistence, editability and association – based on a systematic literature review of social media use in organisations.

Below, we present a selection of the affordances of networked technologies we consider especially relevant for the new socio-technological contexts for learning: Visibility, scalability, flexibility and persistence. While this is not an exhaustive list of such affordances, these four dimensions significantly shape new possibilities to interact and, as such, to learn. Since affordances are inherent features of the technology as well as how people interact with and interpret those features, and since such interaction is continuously generating new socio-technical practices, it is impossible to pinpoint the precise affordances of digitally networked practices. Moreover, the networked structure is only one way to evaluate how digital technologies work for learning. Yet, we believe that thinking through the affordances of networked technology is a fruitful tool to reconsider notions of learning heavily based on social interaction, given their implications for the form these interactions can take. We introduce these dimensions and outline various compatible interpretations from the literature, and then discuss what these dimensions allow learners to do within the context of learning, when possible with empirical examples.

Visibility

What we can see in a physical environment is defined by our visual field and 'the spatial and temporal properties of here and now' (Thompson, 2005: p. 35, see also Thompson, 2011, Couldry and Hepp, 2018). What we see in social media, however, is always through a screen of a computer or mobile device, *and* always embedded in the social, physical context in which we are located. Social media reveal connectivities and content, such as (common) friends or interests, that are normally not visible in physical settings, thus turning connectivities into explicit, traceable and measurable information (Castells, 2004; Halpern and Gibbs, 2013). Increased visibility into behaviours and (personal) user-generated information also separates social media from other technologies

(boyd, 2010; Treem et al., 2020). A good example is this brief video (WebSonic, 2014), which shows the world map based on the 201.6 billion friend connections on Facebook formed since February 2004. We can see 'who is connected to whom' at a scale and level of detail not available prior to social media. The new connectivities and their visibility are crucial to understanding the 'terms and conditions' that apply in the contemporary world, to interpret our world and to understand our place in it, while also being aware of the potential risks of this, such as those related surveying and privacy issues (Marwicket al., 2017).

The added value of 'illustrated connectivity' is that individuals are now able to see a collection of connections: those with whom they are 'friends', 'friends of friends' or 'would like to be friends' (boyd and Ellison, 2007). This knowledge is not only about a display of connectivity but also about observing how these people present themselves in social media – their ideas, preferences and interests as they are shared in-person and/or with a broader audience. Ideas and interests are expressed, lessons learned 'happen' and are revealed not only in a much wider social realm than before but digital technology also provides maps, stats and overviews that show, often publicly, through which relationships and networks these are picked up, shared and appreciated.

What do these changes in terms of visibility mean for learning? The expanded visibility enabled by social media serves a couple of functions fundamentally related to learning. The first has to do with exposure to the vast amounts of information publicly visible in networks. Thompson (2005, 2011) observes that our ability to acquire information about others and symbolic content from sources other than our immediate contacts and our access to 'non-local knowledge' is increasingly incorporated into our self-formative process. There is some empirical evidence supporting Thompson's argument, such as anecdotes from students about their use of social media for learning, as reported in Mao (2014), revealing that, on social media, students think they get help from more people than they would offline. Some students also mention the importance of encountering diverse perspectives on life in social media for their personal development (Mao, 2014). Studies that focus on migrant youths' learning and literacy practices reveal that social media indeed facilitates the ability to *see* information beyond one's immediate localities and connect with people from migrant backgrounds with multiple homelands (e.g. De Haan, et al., 2014; Lam, 2014).

Visibility not only applies to content but also to the resources and relationships that generate or circulate this content. This affords learners the chance to navigate and orient themselves within social media and presents learners with options regarding the kinds of content, people or groups available with which to associate for a given subject (Leonardi and Treem, 2012). Like a sociogram can create insights into the social dynamics of, for instance, a classroom, social media allow learners to see flows of information between different actors at a scale that can expand to the global level (as demonstrated by the video example above) and is available at different levels of detail. Learners can map online networks and explore which actors (individual or otherwise) are most influential in creating connections and bridging between diverse groups of people, or they can see who is excluded, what subjects are trending or which languages are used (Treem, et al., 2020). This helps learners to locate information or communities of interest, but it also helps to understand how knowledge is socially valued and in which communities what knowledge is used or appreciated.

Researchers have argued that mapping information flows, interaction patterns and frequencies also mean analysing the characteristics and predicting the processes of networks (Haythornthwaite and De Laat, 2010). It is possible to observe how (personal) network configurations differ from each other and how various network configurations function for knowledge creation and circulation (e.g. how family-based and dense networks function differently for gathering knowledge than less dense peer networks; see De Haan, et al., 2014). For individual learners this means that they have more possibilities to 'see' their own networking potential related to others, which might be used to

consciously build their networks to have access to knowledge or learning experiences of their choice.

Scalability

Castells (2004) relates scalability to the easily variable nature of a network's size and spread. Technically scalability is the capacity of a system to accommodate growth (or decline) without hindering the system structure or performance (Bondi, 2000, 2014). Multiple variables define the scalability of social media, including how online interactions are spread out according to geographical, cultural or social factors; the simultaneous embeddedness of interactions in both online and offline contexts and the multiplicity of tools (e.g. software programs, mobile devices and the infrastructure that connects these technologies) that collectively create and facilitate social media. This multidimensionality draws attention not only to the technical aspects of connectivity but also to how the content is organised and circulated and how boundaries between aspects or variables cross or overlap.

Kraemer (2014) further complicates the issue of boundaries of geographical scales and social contexts. She shows that the networked spaces and networking practices are of multiple scales that operate simultaneously, while she notes that geographical terms like local, national or global are being reconstructed by everyday online practices. People's participation in multiple networks on social media transforms how they define and experience the local, regional or the transnational as spatial scales (Kraemer, 2014). boyd (2010) adds to these complications by pointing to the sometimes-unpredictable route that social media content takes and to how content may scale up unexpectedly in networks and suddenly receive great, sometimes unpredicted or unwanted, attention. She also notes that amplified content is determined by broader collective choices and is not always what individuals would like or anticipate receiving attention (e.g. seemingly insignificant or bizarrely funny content and actions). Scaling interacts with the social practices of media use in ways that can be volatile and beyond the control of individual agents.

What do these changes in scalability and the multidimensional aspect of network scales mean for learning? In conventional learning settings, content is often prepared for a specific population, keeping in mind the duration of the lecture or meeting and the capacities of the location (e.g. the available technical equipment). If this content, such as a lecture presentation accompanied with slides, is digitised, and shared on social media, the 'original' parameters relevant for the offline context may become barely discernible or even irrelevant. What applies instead of the 'original' parameters is the capacity of digital networks to scale the content up and down, and simultaneously operate on different scales. Online, this content can potentially find its way to a global audience and it can be appropriated to be used in other contexts. It can be made popular by others who take interest in the subject, who refer to or comment on it and share it within their personal networks. Learners 'make' the content travel as they share or search for it, and through this trajectory they make it available for multiple other interested individuals. Online content crosses communities, digital infrastructures and online and offline spaces.

Scalability weakens spatial, temporal and even cultural boundaries; automated translation functions can even reduce language barriers. Scalability makes online content and communities – as well as the learning opportunities these might provide – relatively 'independent' from familiar space–time constraints. Through sharing and seeking content related to a common interest, people find each other, collaborate, discuss, provide support or organise events more easily than before (Dabbagh & Kitsantas, 2012, 2015). People are also able to assist each other with on-demand guidance, support or information at multiple scales (Leander et al., 2010; Rainie and Wellman,

2012). There are many examples that display the reach of content and people across the globe for help and support, teaching and learning from each other. Tutorials on YouTube from cooking to photo editing, for example, can come from and reach to anyone, anywhere and stir a conversation through public commentary.

Flexibility

According to Castells (2000), flexibility is 'essential for managing tasks in a world as volatile and mutable as ours' (p. 695). He compares centralised, hierarchical forms of organisation with networked systems supported by ICTs. The former tend to be rigid, and effective distribution of resources and execution of tasks are highly dependent on hierarchy and central organisation. Networked systems, according to Castells, are rooted in the ideal of free and open technical innovation and are built on a decentralised, multi-directional and open infrastructure. The resulting systems are flexible and are able to coordinate purpose and decision-making while adjusting in a decentralised way, thus preventing collapse. They can easily shrink or grow and enable people to autonomously operate in variable conditions. Likewise, social media can easily shrink and grow, as these online networks are open for anyone to join or leave freely.

When navigating online networks, the hypertextual and thus decentralised, multi-directional structure enables users to explore non-linear and non-sequential paths in the discovery of digital content (Cousin, 2005). This virtual, digital network space is overwhelmingly rich with content. It is growing each day, so users can explore it forever, encountering new information on any possible subject. Users can, however, 'tame' this vast space according to their preferences, which is also an aspect of flexibility. They can organise and prioritise contacts and/or content, taking on the role of curator, or change the interface and certain design aspects of their network page (e.g. Dabbagh and Kitsantas, 2012). Using personalisation, users interact with a system that processes their information and can reconfigure itself and 'learn' from this interaction (e.g. Castells, 2004), although it would be naïve to claim that social media services and content are entirely controlled by their users, given the commercial nature of the companies providing these services (e.g. Facebook).

How does the flexibility of networks work for learning? The flexibility of network systems in general and social media in particular, induces relatively 'open' learning settings, in which learners are not set to follow a prescribed path as in conventional learning environments. The hypertextual structure of the internet offers multiple exit and entrance paths to users' learning interests (Cousin, 2005). Through clicking on links and navigating the internet learners encounter different content, ideas and worldviews which can make the learning experience relatively more heterogeneous (Cousin, 2005). This also puts pressure on learners to make sense of and take a position in the midst of multiple perspectives. Learners can, however, design their online network profiles such that the most interesting and relevant content and updates from prioritised connections are readily available (Dabbagh and Kitsantas 2012). Personalisation ensures that learners receive and can access content that is most important for them, but perceiving the consequences of flexibility solely from the individual learner's perspective is insufficient, as networks always involve multiple other users (learners) and 'smart' software that co-determines the content and shapes the environment. In this sense, social media is not a 'background "upon" which human activity is played out', but rather provides spaces that provoke learners to think, act and interact (Leander and Mckim, 2003, p. 212). Social networks have the potential to be provocative spaces in which learners are challenged to approve or dismiss the visible information, or to evaluate and react (individually or in groups), which makes such networks important for stimulating thinking or discussion.

Persistence

The last attribute we address, persistence, is technically more related to the nature of digital content and to bits as the 'building-blocks' of this content. Social media are communication written in digital code, and this directly affects the persistence of social connections and networks. The 'writing' becomes interface content, which is everything that a network user would see once they log in to their account, including texts, photos and videos and also connections like friendship requests. Beyond the surface, this bit-based content travels through the grid between user accounts. Unlike the ephemeral character of face-to-face interactions, the content of digital networks is recorded and, often by default, publicly displayed (boyd, 2010). The content persists when and where it was posted, so the content is accessible asynchronously. As time goes by, social media accounts thus turn into personal archives of the continuities and discontinuities of our digital lives, relationships, interests and preferences as we construct them online.

Persistence does not, however, mean that the content or the connections remain unchanged or anchored in time and space to the point when and where they were posted: social media content is also editable and replicable in nature. An online conversation thread could potentially go back years, and it is possible to read all of it and see how the conversation evolved or search for a specific dialogue within it. It is also possible to multiply the conversation by copying and pasting it somewhere else or to edit its text or its form by assembling and mixing the text with visuals, for example, online memes – digital artefacts that often use text, visuals, icons, popular culture references or quotes – are good examples of editable and replicable online content. Memes often circulate on social media, and they are re-interpreted and modified by those who use them (Gal et al., 2016; Knobel and Lankshear, 2007).

Although we are aware that editability and replicability afford different possibilities for users, and therefore could be treated as separate affordances, we foreground persistence, and discuss them in this relationship here because both relate to the idea of how content endures over time, how modification and re-interpretation (in editing processes) and repetition (in copying processes) function together.

How does the persistent content of networks function for learning? Social media content such as comments to a post, conversation threads developed among peers or retweeted content altogether constitute a personal history. Not only does this content provide clues about the current interests of the learner but also about his/her progress, collaborations and transformations of ideas, experiences and self-expression over time. For instance, the history of comments of others and reactions on these comments related to a self-made video on YouTube may reflect how the learner has received, adopted and responded to critique to it. This aspect is also directly linked to memory. Through social media users receive nearly continuous collections of memory cues, which might lead to individuals actively managing their memories in the near future (Davies, et al., 2015; Harvey et al., 2016). Davies et al. (2015) describe several scenarios of how social media technologies might reinforce learning by triggering or aiding memory during gaining a new skill (language learning) or solving a problem.

Editability and replicability have different implications for learning. Editability allows learners to take their time crafting a message before it is posted online, as is the case in stand-alone editing on a computer. In social media settings, however, learners can change or edit content even after publication (Leonardi and Treem, 2012; Sun et al. 2020). Sometimes multiple people can simultaneously work on the same content, and all changes are automatically logged for others to see, as in wikis. Content replicability ensures that the content is easy to disseminate and find online.

One-click plugins make replicability on social media even easier, and this allows learners easily to gather information from different resources.

Editability and replicability are valuable capacities because they make possible active and creative engagement with the content, which combined with the relative short cycle of editing-publishing and re-editing, offers unique opportunities for reflection on content, for the curation of content assembled and for the expression and circulation of ideas. This may also complicate the distinctions between copies and authentic content (boyd, 2010), making it easier for learners to create deceptive messages or commit plagiarism. This is an important challenge for learning (especially in formal settings) that entails issues of credibility and authenticity of information and the accountability of individuals.

Discussion: How do these affordances challenge us to rethink sociocultural theory?

Acknowledging the core hypothesis of sociocultural theories – that the psychological make-up of individuals is largely based on and mediated by their observations and participation in common activities and practices of the culture – we can assert that, likewise, when people engage with social media, it becomes part of their psychological make-up. This seems especially valid for the younger generations of learners who are born into the world surrounded and operated by these technologies and who thus have long personal histories with them, especially during formative learning periods. The existing models of learning, formulated in an era without these technologies, do not do justice to the affordances these offer to learners, nor to the prospects for how new technologies and networks are transforming individuals as learners. As we have argued before (in Ünlüsoy, et al., 2013), to understand new forms of widely distributed activity, a network perspective on learning is useful and provides a fruitful expansion of activity system approaches. While activity or functional system approaches to learning have served a significant role in conceptualising system-wide mediation in processes of learning and identity (e.g. Barab et al., 2002; Cole & Engeström, 1993; Engestroóm, 2014; Prior, 1998) forms of activity involving new media and technologies pose challenges for systems approaches. Below, we elaborate on these claims by rethinking sociocultural theories on learning from the perspective of the affordances of digital networks.

V*isibility* as an affordance of digitally networked platforms, translates into different practices and levels of 'seeing' and access, signifying that we not only have multiple possible connections available but also that our connections to each other become explicit, traceable and measurable structures when they are replicated online. For instance, a video clip of a tutoring session placed on YouTube would be one out of many that are available for individual learners when they would navigate their networks. And learners would be able to see these kinds of learning options by the access they have of how they are connected to others online. As argued, this expanded affordance in practice multiplies the options of learners and allows them to make more conscious choices for particular resources and relationships.

The notion of visibility has been written about in sociocultural and practice theory in different ways, including the idea of transparency and opaqueness of learning within the realm of apprenticeships. Lave and Wenger (1991) focus on processes of learning and their relative visibility, particularly concerned with relative (in)visibility as a sociocultural concern. Generally speaking, a rich learning environment could be conceived as one in which formerly invisible processes, relationships, and resources are "materialized" – are taken out of the realm of either private knowledge or abstracted ideas and put into material form. Social media expose a great deal of information that would otherwise only be accessible to particular social circles, with certain forms of expertise or

within certain shared geographical locations. Visibility also occurs through discussions of social groups engaged in knowledge-making, and these discussions may appear in many different modalities (e.g. writing, video and images). In face-to-face social practices, or those discussed in Lave and Wenger (1991) involving craft apprenticeships, such discussions were more localised to specialised communities, less recorded and less present in multi-modal forms. Visibility and accessibility go hand in hand.

New challenges for learning are less concerned with invisibility, however, much more focussed on the problem of how to manage and organise an overwhelming flood of resources. In networked learning, new capacities for curating resources (e.g. locating, organising and making selections) are key. A shift from an information scarcity model to an information overload model has taken place. New critical problems of invisibility have also arisen with social media such as monopolisation of media channels by a few media monopolies (e.g. Google and Facebook) (Taplin, 2017) or algorithms that track people's online preferences and habits and accordingly shape their media content with suggestions (such as on YouTube) (Narman & Atiquazzaman, 2015).

Scalability allows the network in which a resource is located to shrink and grow, scaling up and down. Being easily scalable weakens a network's spatial, temporal and even cultural boundaries. In practice, this movement allows learners to share and seek content or networked communities with similar interest more readily than before. Scalability is perhaps the greatest challenge for sociocultural theory with respect to learning, which has tended to associate learning with individuals or small craft communities, and less so with entire institutions. While learning-on-the-move studies are proliferating, many of which draw from sociocultural inspiration (e.g. Sefton-Green and Erstad, 2017), the highly scaled-up learning community is largely unexplored, as is the idea of the ways in which learning scales up and down, and what these different scales and their movements might mean for a social and cultural view of learners who are changing in relation to a network.

As with the discussion of visibility, we believe that the dimension of scalability shifts the problem for learners from the earlier formulation of context (e.g. determining the 'situatedness' of information within a context) towards a newer, more complex and more open problem of 'moving' information and knowledge across multiple scales. 'Scaling' knowledge through new tools and networks permits learners to (re)consider knowledge across temporal and spatial scales that were previously inaccessible. How do some actors or agents appear at one scale and then disappear at another? The learning process of scaling does not eliminate the need for the more basic processes of contextualisation, but it greatly complicates this process by multiplying the number of relevant contexts and requiring learners to consider what kinds of effects might move across contexts (e.g. Lemke, 2000). The process of scaling-to-learn may also be described as a new social practice of learning in networks, involving understanding the myriad ways in which scaling is possible, including through spatial information on maps, network analysis, analysis of big data, historical analysis of particular moments and information archived online.

Flexibility allows media to travel and creates infrastructure that is decentralised, multi-directional and open. When navigating online networks, a decentralised and multi-directional structure enables users to seek, explore discover media in a non-linear and sometimes unexpected way. The flexibility of social media environments also makes it possible for a particular learning video to appear as a suggestion for one learner, while another learner might encounter it relatively randomly – through a completely unpredictable path. Learning thus becomes unexpected and unpredictable – emergent. This is in contrast to earlier images in sociocultural theory, where learning and teaching have been presented as relatively manageable and designable.

Flexibility challenges schooled versions of learning, and perhaps the 'schooling' of sociocultural theory, as much or more than any other dimension. While the idea of separating the practice of

learning from any necessary or required practice of teaching has been formulated for a number of years (e.g. Lave and Wenger, 1991; Maier and Valsiner, 1996), reconsidering the 'object' of learning as shaping a particular direction seems fundamentally necessary for thinking about mediation. However, with networked media, the specific endpoints for a learner's engagement are often more diffuse, changeable and difficult to manage or contain by either the learner or the mentor. The openness and multi-directionality of networks affords, and even encourages, divergence. Such forms of divergence may come into conflict with schooled desires for convergence, where students' journeys are directed towards teacher endpoints or designs for learning. Flexibility creates learning situations that are much more improvisational, more given to emergence and more given to lines of flight away from prescribed directions and towards unpredictability. Thus, the outcomes of learning are more difficult to determine, and the possible lateral connections can be at once rich, broad and messy. This may be a poor fit for more settled and systemic views that assume learning is a form of preparation for known forms of activity (e.g. labour). What networked activity amounts to, in learning, can only be seriously reduced if we measure such learning by a pre-network, modernist perspective on what is known and where such knowledge is located.

Persistence allows, for instance, a particular YouTube video that was publicly available at one point, and later deleted, to be linked through and archived in personal online spaces. Such personal and collective archives serve important functions as external memories for learners and can function as extensions of culturally organised memory, which in sociocultural theory is opposed to natural memory (Vygotsky, 1978). Instead of just extending the operation of memory beyond the biological dimensions of the human nervous system and becoming collectively shared tools and signs, these digital archives become mediated memories characterised by an almost continuous presence that potentially changes the memory work of individuals (see also Säljö, 2012 for a similar argument).

What does it mean to have ongoing access to a record of one's life or learning pathways? The dimension of persistence relates to sociocultural theory in that the historic production of personhood – what Holland and Lave (2001) call 'history in person' – is now made available as an online, ever-present resource for reflection, consideration and connection to the present. Through social media technologies, users receive nearly continuous collections of memory cues, which are already leading individuals to actively managing their memories. A concrete example of this is Facebook's 'On this Day' feature, which was implemented in early 2015. With this feature, Facebook users are presented, through an algorithm, with something they had posted 'on this day' one, two or perhaps several years ago (the 'Year in Review' is an annually available tool with a similar function). This representation is offered up to the Facebook user as something they can decide to publicly re-post or not. As a memory prompt, the technology has no real ability to discriminate between preferred and deprecated parts of one's past: all past postings are considered fodder for nostalgia. Some popular media reports of reactions to 'On this Day' have included traumatic reactions to past photos of friends who have since committed suicide, marriages that have ended in divorce or pets that have died (Dzieza, 2015). Important for the study of memory and social media, none of these postings and associated memories was 'called up' by the individual person or their social relationships. Rather, memory – as nostalgia – functions via the application and its algorithms. Persistence thus does not mean that the archives of the past cannot be re-interpreted and even revised – the label itself is perhaps misleading, as persistent archives in networks are most interesting not merely because they are present, but also because they are editable. The capacity to have access to, but also to combine and edit records of the past opens up possibilities for learning and identity work that could not have been imagined by those developing sociocultural theory with a more static and linear view of history and the movements of people over time.

Across the affordances we have discussed (visibility, scalability, flexibility and persistence), we have approached the potential of social media for learning rather optimistically, focussing on the increased possible connections or options available or the flexibility in different available roles as a learner. We are also aware of the many challenges in perceiving and using the pedagogical capacities created by social media. Perhaps the most important developmental process or threshold for learners to cross in leveraging social media for learning is perceiving how these affordances function. It is crucial, however, that the broader social context, including formal schooling, acknowledges and supports the use of these affordances (Day & Llyod, 2007). The (over)abundance of content in social media can also be a constraint on learning – there may be real limits to the possibilities of diversion we have discussed previously. The possible use of (mis)information (e.g. rampant reports of 'fake news') and misrepresentation of one's expertise further complicates the notion of learning in networked spaces. Another significant issue concerns the old and newly defined social divides amplified by the use of these technologies (or the lack thereof). For willing or non-willing non-participants of social media, the possibilities to be seen and heard in the offline world are significantly reduced (Castells, 2000). Despite social media being open to participation, it is not and has never been independent from the biases and inequalities of offline spaces, including the divisions around gender, age, race and socioeconomic status (boyd, 2010).

Conclusion

Understanding how learning is afforded by new digitally networked practices and how the evolution of the Internet is shaping and redefining the possibilities for 'self' formation is an urgent issue. Recently, this issue has gained even more urgency, given the social debate on how commercial platforms afford or nudge certain behaviour for commercial purposes (Marwicket al., 2017) and how network information is used for this purpose. Creating more insight into how this might work is of key importance for the learning sciences, particularly as we start to realise that many of our theories are still based on learning in environments and settings that deviate fundamentally from these digitally networked practices. Our contribution to this question is inspired by analyses of the socio-technological affordances offered by networked platforms. Looking at how the 'nature' and characteristics of digital networks have enabled digital practices that can be leveraged for learning leads to the more general question of how the Internet enables new ecologies for learning, and thus how we should rethink our conceptualisations of learning and teaching. The changing social fabric has particular consequences for prior concepts of teaching and learning that are based on how particular types of social relationships mediate learning, as in the case of sociocultural approaches of learning. It might be less relevant for concepts of learning based on, for instance, attention or memory without such explicit theorisation of the relationships between the social fabric, learning and cognition.

Although we have pointed out how earlier notions of sociocultural theory are limited for the task of imagining the learning that takes places in digitally networked spaces, our analyses have also pointed to continuity in theory formation. The idea that digital networks are easily scalable and weaken a network's spatial, temporal and even cultural boundaries – and thus in contrast with the bounded nature of a one-to-one tutor–tutee or a classroom situation – is in fact a continuation of the earlier critique that our theories of learning tend to ignore how learning extends and is distributed beyond particular settings of learning and teaching (Salomon, 1993).

Our analyses also show the relevance and robustness of a sociocultural perspective on learning, as for each of the affordances it is possible to point to new challenges for learning that derive directly from how digitally networked structures allow or obstruct certain practices that are key for learning.

By pointing out the capacity of networks for constant (re)configuration or their hypertextual and horizontal structure, for instance, it does not become clear that models for learning and teaching based on hierarchically organised and fixed interactive structures do not represent what goes on in these digitally networked learning ecologies, which yield new challenges for learning in coping with divergence, improvisation and unpredictability. Sociocultural perspectives remain relevant for insight into how new social infrastructures pose new challenges for learning, and we hope our analyses can point the way for new considerations.

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