Shifting scales of research on learning, media and technology

Felicitas Macgilchrist[a,b], John Potter[c,] Ben Williamson[d]

[a] Media Transformation, Georg Eckert Institute, Braunschweig, Germany

[b] Institute for Educational Science, University of Goettingen, Goettingen, Germany

[c] UCL Knowledge Lab, University College London, Institute of Education, London, UK

[d] Moray House School of Education, Centre for Research in Digital Education, University of Edinburgh, Edinburgh, UK

Felicitas Macgilchrist http://orcid.org/0000-0002-2828-4127

John Potter http://orcid.org/0000-0001-8762-944X

Ben Williamson http://orcid.org/0000-0001-9356-3213

As we write, England and Denmark have celebrated 'freedom days', yet parts of Australia are in their sixth lockdown, and families in Argentina still can't bury their loved ones as they would like to. We see colleagues around the world exhausted from the enduring pandemic. Many news outlets still prioritize COVID-19 updates, even in those few countries that are ostensibly getting back to 'normal'. The pandemic is in the foreground of attention; for many places in the world, it seems impossible – or irresponsible – to write about anything else.

Yet at the same time, important things are happening that we should not neglect. Daily life continues to unfold in communities, localities and educational spaces; we need to attend to the complex, messy details of lived experience. The Anthropocene rolls forward, pushed by planetary computation; we need more reflection on what this means for education. Cloud computing is expanding; we need to turn more fully to the techno-economic-ethics of clouds.

These issues force our attention to *smaller* scales than pandemics—grounded relations among bodies, texts, practices and artefacts—and to *larger* scales than pandemics—the planet and the clouds. These scales are inherently political. Priorities for learning cannot be made without taking lived experience into consideration. Priorities for regulating technology should not be made without taking the planetary dimension of computing and clouds into consideration. These scales *matter* in decisions made about education. Expanding the analytical, ethical and theoretical gaze of critical research in these directions strikes us as crucial at this moment, to understand contemporary trajectories of learning, media and technology.

When the detail loses its freedom

The focus on 'what works' in research can be at the expense of paying attention to 'what happens', or 'what appears to be happening'. When the focus is casually represented as 'what works' the result is a proliferation of solutions looking for problems, and an opportunity for corporate entities to step in and appropriate simplified and under-theorised research. At scale, the detail of lived experience becomes lost or embedded into 'the machine' with no context in, or connection to, the formal or informal spaces in which learning takes place. It creates a vacuum where ethics and governance should be. Of course, this is hugely attractive in education systems worldwide under populist political control, some of which remain dubiously connected to platforms, publishers and providers of curriculum and examination material which masquerades as fully and legitimately researched work, even when it is not.

Whilst *Learning, Media and Technology* is interested in research which explores the systems driving pedagogical change, we are also interested in work which explores the essence of the social world with all its attendant mess and its network of relations between bodies, texts, practices and artefacts. If we are keen to know more about the ways in which the detail of lived experience loses its freedom on the platform and in the algorithm, we also welcome work which seeks to describe it, to refocus attention on the minutiae of the social world and its attendant complexity in relation to learning, media and technology.

Our proposed expansion of the critical and ethical gaze in research extends, then, on a continuum from the macro to the micro. Some examples, from among many others, encompass work in the realms of critical new literacies (Burnett and Merchant 2020) data literacies (Pangrazio and Sefton-Green 2020) sociomateriality (Hawley 2021; Gourlay, Littlejohn, Oliver and Potter 2021) feminist edtech (to be fully explored in a forthcoming special issue of this journal), ecological frameworks of technology-in-use (Bonami and Nemorin 2021), social-emotional learning (Williamson 2017) , media literacy and the civic sphere (McDougall 2019), critical future-gazing around teaching and learning (Selwyn, Pangrazio, Nemorin and Perrotta 2020; Macgilchrist, Allert and Bruch 2020) and children's play and meaning-making using the resources of media and cultural texts (Potter and Cowan 2020).

These and other associated approaches to the detail of lived experience in learning, media and technology complement studies of systems at scale but still find ways to enter the discourse around issues such as datafication, platformisation and pedagogy. They are sensitive to the need to develop methodological approaches which approach the messy reality of the social world (Law, 2004) in particular as it applies to the contemporary milieu of educational debate where simplifying, codifying and measuring 'what works' only appears to serve the further commodification of learning. They are critical pieces of work, responsive to the changes we are seeing as the digital positions itself ever closer to the heart of interactions and events inside and outside formal and informal spaces of learning. They recognise the importance of weighing up sources, developing new methodological approaches and pushing theoretical boundaries when they find no existing, suitable ways to describe the various phenomena under examination, but they also build on established disciplines which have helped to construct the tools of analysis and criticality with which to represent and understand the past, present and future moments of learning, media and technology.

Planetary edtech

One present moment is exemplified when, in the run-up to COP26 in Glasgow in November 2021, UNESCO joined Microsoft's Minecraft Education on the 'Global Build Challenge 2021: Making Peace with Nature'. This initiative illustrates the hopes in the field of Education for Sustainable Development (ESD) that digital media or educational technologies can engage students in finding ways to address today's environmental crisis. While this does attend to the lived experience of young people with computer games, and while it surely is an effective way of winning students' attention, the irony is not lost on observers who have pointed to the massive scale of ecological destruction involved in producing the hardware students use for this challenge, in generating the power needed for web-based/cloud-based activities and in dealing with the e-waste discarded after devices have become obsolete. In ESD, however, edtech is generally seen as the solution, not as the problem (Selwyn 2021).

The planetary scale lifecycle of the tablets, notebooks or smartphones used for learning, as well as myriad other devices, is temporal and spatial. The geological 'deep time' of metals and minerals like copper for wiring, cobalt for circuits and coating copper wires, borax for microprocessors and camera chips, goes back millennia. 'Digital rubbish' (Gabrys 2013) leaves a long-term toxic impact on the Earth's surface. And if we write here of the hard labour conditions when mining for cobalt in the Democratic Republic of Congo, or recycling the hazardous components of e-waste in China or Sweden (Ceballos & Dong 2016), we can assume readers are already aware of this. The 'geology of media' is intimately tied up with political economy and ecological injustice (Parikka 2015). But given the vocal environmental and ecological justice movements, from Fridays for Future to Extinction Rebellion, we are largely beyond the need to sensitize people to the planetary impact of (over-)consumerism. As Žižek (1989, 29) has said,

drawing on Sloterdijk, most people 'know very well' about the unsustainable effects of our actions, purchases and policies, 'but still, they [we] are doing it'.

For those for whom 'progress stopped making sense' (Tsing 2015, 25), the question is thus not how digital technologies can help foster better progress, but how we can learn to 'live *in and with* climate change', with a 'lively planet' (Facer 2018, n.d.)? How can we find 'arts of living on a damaged planet' (Tsing et al. 2017; see also Ojala 2017)? Three recent atlases show the contours of this damaged planet. Crawford's (2021) *Atlas of AI* explores artificial intelligence as an extractive industry, where systems only work by extracting minerals, energy, labour and data. Not only AI, but 'planetary computation' in general is made possible by the earth's mineralogical layer. Early in the atlas, she visits lithium mines in Nevada that extract the core mineral for rechargeable batteries, essential for mobile devices. The map expands to Bolivia, Congo, Mongolia, Indonesia and Australia, 'other birthplaces of AI in the greater geography of industrial extraction' (2021: 33). Bloom's (2018) 'deep maps' in *This is Not an Atlas* similarly aim to dig down into the multiple layers of a place or an entity. Deep maps create relations among geology, history, peoples, speed, everyday things, practices and much more. In one deep map, oil is connected to petro-subjectivites via (among other things) food, health, shelter, computers, mobile phones, relay towers, server farms and conflict minerals. The *Feral Atlas* (Tsing et al. 2021) taps into a different set of metaphors: exploring 'the ecological worlds created when nonhuman entities become tangled up with human infrastructure projects', i.e. ecologies that were developed as human-built infrastructures but have 'spread beyond human control'. The Feral Atlas eschews the 'utopian world of green capitalism and planetary geoengineering' in which technology offers solutions and 'in which feral effects are, once again, swept under the rug'. Instead, it 'holds closer to the trouble, the better to consider constraints and possibilities' (Tsing et al. 2021, n.p.). What would an *Atlas of EdTech* include? What would a deep map of a learning management system show? What feral effects emerge from educational apps; which arts of living accompany them?

Some arts of living in these planetary ruins are emerging in research on learning, media and technology. For Selwyn (2021), for instance, drawing on the computing within limits and collapse informatics movements, we need an 'edtech within limits'. In this new paradigm of sustainable edtech, digital technologies would not be seen as an always-on phenomenon. Instead, edtech would be targeted towards populations who for a short term don't have access to regular educational institutions due to, e.g., pandemics or climate-related disasters. And edtech practices would be reconfigured. This includes designing for longevity (avoiding planned obsolescence), institutionalising the purchase of refurbished and reconditioned hardware, repairing (with DIY practices and with polices ensuring the right to repair) and developing commons approaches to the shared ownership of devices. These hardware priorities also flow over onto pedagogies, with 'slow pedagogy' arising alongside 'slow computing' (Schneider 2015). They are always entangled with economies (e.g., doughnut economics, degrowth;

[Raworth 2017]). Combining this with a geology of media, we wonder if alongside FabLabs, Makerspaces and Digital Labs, we need Zombie Media Labs, where 'zombie media' refer to the undead remains of media, after it 'decays, rots, reforms, remixes, and gets historicized, reinterpreted and collected' whether in the soil as the toxic residue of e-waste or 'through artistic tinkering methodologies' (Hertz and Parikka 2012, 430). How would education unfold in Zombie Media Labs, in which educators and students could experiment with an edtech within limits?

For other scholars reflecting on planetary edtech, the priority is to re-orient research away from an unreflexive anthropocentric focus on the Global North. Grünberger, for instance, welcomes the current trend in research on the ecological implications of edtech, but calls for a perspective which considers both the geological deep time of technology and a postcolonial perspective on the epistemic violence which is (re-)produced by planetary computation (Grünberger 2021, 219). Piattoeva (2021) proposes a stronger decentring of humans when we analyse technology at a planetary scale. Where the popularity of the concept of the Anthropocene has recentred human agency after post-humanism (and although alternative concepts such as Chthulucene or Capitalocene reflect more specifically on precisely which multispecies beings with which practices in which parts of the planet have created the current ecological crisis [Haraway 2016, Moore 2017]), Piattoeva draws attention to the triple entanglements of (ed)tech and ecosystems, with technology *shaping* how we understand ecosystems, while simultaneously *dependent on* and *damaging* those ecosystems. Zooming in on datafication, she urges proponents of critical data literacy to 'consider what criticality means from a more-than-human perspective, that is, beyond the consequences of surveillance and datafication or the structural inequalities and power imbalances of technologies for humans' (2021, n.p.).

A host of new research questions emerge at this intersection of an edtech within limits, the geology of edtech, and postcolonial, decolonial posthuman or chthulucenic approaches. These are not questions about how to best reach young people with digital technologies to understand ecology to make peace with nature. They are not about finding technological fixes for ecological problems. Instead, this planetary approach to edtech requires an expansion of our critical research to generate, reconfigure, observe, reflect upon, analyse and theorise current practices that enable (or: could enable) multiple liveable presents for humans and more-than-humans on our damaged planet.

Expanding clouds

Another scale at which education technology should be examined more fully is the scale of 'the cloud', over and above its ecological impact. Over the last decade, global cloud computing systems such as Amazon Web Services, Google Cloud, and Microsoft Azure have expanded rapidly to enable other businesses to access computational services on demand (Varghese et al

2019). Cloud computing is both a field of innovation in computing and a new business model that centralizes computing resources in a small number of technology corporations (Weinhardt et al 2009), which use their 'political, economic and technical resources to ensure that the clouds are the "default" infrastructure in as many domains as possible' (Fiebig et al 2021, 11). By the 2020s, the driving 'techno-economic' business model of these 'big tech' businesses had created 'a new multi-sided ecosystem' from which they could extract on-demand 'rent' for services and value from data (Birch & Cochrane, 2021, 5). Clouds are therefore 'architectures of market power' that serve as both essential infrastructure for other industries and as extractive infrastructures of mass datafication and value generation (Khan 2017). Google, Amazon and Microsoft in particular have sought to extend their share of the 'cloud infrastructure and platform services' market to encompass sectors such as government, healthcare and education (Bala et al. 2021).

The significance of the cloud for education is that global cloud operators host many of the digital services and platforms that schools, colleges, and universities depend upon for pedagogical, curricular, assessment, management, and data purposes. This operates in two ways. First, cloud operators—and especially AWS, Google and Microsoft—have become the 'default' infrastructure providers in many education institutions worldwide. A key feature of the cloud in education is the promise to create vast 'data lakes' and harness machine learning algorithms to derive insights from these reservoirs of heterogeneous data (Perrotta 2021). Universities in highly digitalized and marketized higher education systems in particular have become dependent on corporate cloud infrastructures for many of their core digital services and functions:

> Instead of running IT services with on-site teams and on infrastructure owned by organizations, services are now often deployed on public cloud infrastructure. … However, this operational paradigm shift also leads to a change in control. While, before, user data would remain on infrastructure controlled by an organization, this data is now stored and processed by an external operator. (Fiebig et al. 2021, 1)

The reliance on cloud services in education raises issues of 'infrastructure and data control' (*ibid*), as institutions' abilities to audit or implement privacy, ensure data protection compliance, or obtain meaningful informed consent for data collection and use are limited and constrained when they employ cloud operators. Clouds also exert control over curricula and govern the 'means of study' (*ibid,* 7) by determining what kinds of educational tasks are possible to implement. As Perrotta (2021, 68) notes, contemporary higher education 'relies increasingly on engineering "openings" for the seamless insertion of external big data and predictive technologies' which 'are appealing for their promise of computational efficiency, but also opaque and unknowable for their dependencies that extend deep into the broader ecosystems of Google and Amazon'.

Second, cloud operators are also integral to the edtech industry. Edtech companies depend on cloud storage and computing facilities for the functioning of their educational products and services. For example, AWS claims to be 'accelerating transformation in educational technology':

> The Amazon Web Services (AWS) Cloud enables education technology (EdTech) companies to accelerate development of scalable and secure technology solutions that support students and educators every day. AWS helps EdTechs realize the full potential of cloud computing with dedicated business and technical resources to support growth. (https://aws.amazon.com/education/ed-tech/)

Many of the most highly-capitalized edtech companies are integrated into AWS, including the major learning management system operators Blackboard and Canvas, and the multinational online learning platforms Coursera and 2U. To a significant extent, AWS enables the contemporary form of data-driven edtech that these companies represent to exist: without AWS, they could not deploy the array of services, data collection, processing and predictive algorithms that form their core business proposition to investors and customers. This reflects how global technology firms augment their techno-economic power through integrating 'outsiders' into their infrastructures and capitalizing on both the rents paid and increased data extraction capacities that result from their interoperation (Birch and Cochrane 2021).

Moreover, the major cloud operators Google and Microsoft host their own cloud-based education platforms and services. Google Classroom, for example, is an integrated platform of the Google Workspace for Education suite of cloud-based platforms and tools. With reach to over 150 million students worldwide reported by 2021 following pandemic lockdowns, Google has announced plans for its continued development as the default learning management system for schools on their return (Williamson 2021). Behind the platform is a specific application programming interface allowing third-party platforms to integrate with Classroom (Perrotta et al. 2021). Google has actively leveraged it to create a 'Marketplace' of thousands of third-party 'Classroom add-ons', enabling it to introduce new features by drawing down user data from others platform integrated into the marketplace. As Google describes it, 'These integrations save teachers and students time, and make it seamless to share information between Classroom and their favourite apps', and has recently monetized the model by requiring fees from schools for these integrated features (https://edu.google.com/intl/ALL_uk/products/classroom/apps/). Classroom is thus a platform intermediary between schools, third parties, and the Google Cloud, enabling schools to access cloud-powered services while Google, in return, can gather valuable data from users of Marketplace integrations for further product refinement, feature upgrades and other developments. It positions the Google Cloud as infrastructural to a vast segment of the edtech industry, as third-party vendors must adapt and agree to the rules set by Google to interoperate with the Classroom.

As part of this techno-economic business model, cloud computing promises advanced analytical and predictive capacities. Amoore (2020) approaches cloud computing in terms of its algorithmic powers of perception. The cloud, she argues, 'is a bundle of experimental algorithmic techniques acting in and through data', and 'contemporary cloud computing is about rendering perceptible and actionable … that which would be beyond the threshold of human vision' (*ibid*, 41). By extracting patterns, norms and anomalies from vast data collections, cloud computing condenses huge volumes of digital traces to single 'actionable' targets of intervention, which then 'open onto targets of opportunity, commercial and governmental' (*ibid*, 43). In the case of education, such 'targets' might include a student whose anticipated future academic progress or personal well-being is determined to require pre-emptive action in the present (Witzenberger and Gulson 2021). The promise of cloud architectures of data lakes, predictive analytics, and automated pre-emptive interventions is to configure a new kind of experimental cloud classroom or campus with advanced, automated perceptive powers and capacities to generate 'actionable' insights and targets of attention. It generates a new kind of 'targetable' student data subject constructed from informational 'bits' as the basis for evaluation, prediction and pre-emptive intervention (Pickup 2021).

The current expansion of cloud infrastructures is significant in education, then, because they shape pedagogic possibilities, open up advanced potential for the application of data analytics and predictive algorithms in edtech platforms and institutions, and foster the dependency of schools and universities on global 'big tech' companies. The cloud also embeds education in a new techno-economic business model, as institutions must pay subscriptions and rents for storage, computing, and analytics services, while cloud operators derive value from the user data generated from the integration of their infrastructures with educational institutions and platforms (Komljenovic 2021). Furthermore, the cloud raises fresh challenges for data privacy regulation, as student data may flow from institutions through platforms to offshored cloud data centres (Angiolini et al. 2020). As global architectures of market power, clouds may also escape the narrow framing of recent ethics frameworks and instrumentalist algorithmic accountability interventions in education (Sahlgren 2021). This cloud expansion therefore requires an expansion of the analytical and ethical gaze in critical education technology research to focus on the techno-economic business model and the experimental technologies that increasingly underpin and configure a wide array of educational practices.

Futures, pasts and presents

Just as the scale of the global cloud computing paradigm requires a concomitant re-scaling of critical research practice, so planetary edtech attunes scholarship to the temporal-spatial range and deep maps of learning, media and technology. Attending to these scales means zooming out, so that the view might seem too orderly. It is thus also vital to zoom in to the messy proximity of lived experience with media and technologies, in the complex relationality of bodies, texts,

sounds, things and practices. Also, in discussing these issues, we have tried in this editorial to attend to the present: These issues are not for the future, they are not anticipatory; they are already here. Alongside the expansions of the analytical and ethical gaze suggested above, this also calls—as previous editorials in *Learning, Media and Technology* often have—for further historical analyses to examine the historicity of these and similar phenomenon, and to resist the quick assumptions of novelty which often accompany analyses of technology.

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