Mapping and navigating the entanglements of peace, education and (post) digitalisation in the age of polycrisis

MAPPING AND NAVIGATING THE ENTANGLEMENTS OF PEACE, EDUCATION AND (POST)DIGITALISATION IN THE AGE OF POLYCRISIS

"Be it those … who study global health, be it those who concern themselves about peace or weapons, we cannot afford to deal with manifestations. We have to deal with root causes. … I see, probably more acutely than others, that what we are facing is a very serious case of technofascism: the fact that some people matter less, that some people for others are dispensable… the greatest danger to both health and peace is the assumption that some people matter more than others."

Ursula Franklin, 2014

"The computer. The Internet. Artificial intelligence. These are military technologies, first and foremost. … Audrey Watters, 2025

1. Introduction

This paper was originally written for and presented (in an earlier form) to the Georg Arnhold International Summer Conference 2025.[1] The intention of the conference was to explore "The Quest for Peace and Equality under the "Postdigital Condition", examining "the intersections of the "postdigital condition" and peace/violence, (in)equality and (in)justice in the realm of education, with their significance for pressing contemporary challenges". At the heart of the original call was a recognition of the ambiguous or ambivalent nature of digital technology and educational media – the fact that they can (potentially) bring benefits for learners and for society but also reproduce or amplify existing patterns of injustice or violence. My initial response to the call was to consider that, whilst this recognition of the dual-sided nature of education, technology and educational media is necessary, it is not sufficient to help us understand or make ethical judgements about the adoption of digital technologies in education. How do we define and evaluate harms and benefits arising from digitalisation – from the perspective of individual learners, social groups or societies? Over what timeframe or geographic scale? In human or also ecological terms? On the other hand, if we adopt 'peace and equality' as our standard or frame, as the conference call suggested, perhaps (following Ursula Franklin, quoted above) this brings us back to root causes – to questions about the underlying drivers of 'unpeaceful relations', the patterns and logics of social and ecological violence – and to the role of (digital) technology in relation to these?

To make this more concrete, it is useful to consider a recent report by the Brookings Institute on AI and education (Burns, Winthrop, Luther, Venetis, & Karim, 2026). The report is one of the most comprehensive reviews of AI-based or enhanced technology in education (ed tech) since the launch of ChatGPT in 2022. The report is ultimately concerned with the potential of AI, but it is not uncritical. Indeed, the main headline is that currently, and on the basis of the available evidence, the risks of AI in education overshadow the benefits. So, how are risks and benefits defined?

[1] Leibniz Institute for Educational Media, Georg Eckert Institute, Germany.

The evaluation criteria in the Brookings report are derived from "decades of research in developmental science" (Burns et al., 2026, p. 10): what we understand about how young people learn and develop. The risks it identifies are thus defined in terms of impacts on 'foundational development'. It finds that (uncritical) adoption of AI in education is leading to reduced cognitive, social and emotional development, negative impacts on social and emotional well-being, weakened relationships and trust in peers and teachers, risks to safety and privacy, and increased social inequality (Burns et al., 2026, p. 12). Likewise, the potential benefits of AI in education are defined in terms of the educational process itself: expanding access to education, enriching learning, optimising teacher time, and improving inclusivity. These are presented as meaningful but also highly conditional: "well-designed tools and platforms can offer students a number of learning benefits *if* deployed as part of an overall, pedagogically sound approach" (Ibid).

The Brookings Report is very useful in providing credible evidence of the current 'state of play' regarding AI-adoption in schools. But its definition of risks and the conditions needed to realise the potential benefits of AI are very narrow, despite clear calls for holistic analysis. There is little to no consideration of the wider and ultimately political conditions that shape the adoption and application of digital technology in schools and universities – it is treated as inevitable. There is no discussion of the wider societal implications of reduced cognitive or social development – such as how this might impact on democratic participation in and outside schools. There is no reference to concerns about the environmental impacts of AI technologies or the growing political power of technology corporations (Cadwalladr, 2025). There is some limited discussion of data privacy and surveillance, but not in relation to current observable trends vis-à-vis growing authoritarianism and polarisation (Heck, 2024; Ricaurte, 2022). Remedies to the risks presented by AI are considered mainly at the level of pedagogic design and regulation, in mostly reformist terms. The report offers the somewhat naïve conclusion that addressing the "multifaceted safety and security concerns [of AI] require[s] good-faith participation from everyone: legislators, policymakers, AI developers, educators, civil society organisations, families and students" (Burns et al., 2026, p. 125). (It is also not considered whether there are alternative and less risky ways to achieve improvements in education).

This paper aims to develop a perspective on digital technology, AI and education from a different starting point, drawing on more systemic approaches to analysis associated with polycrisis and peace research, and foregrounding the highly integrated nature of prevailing socio-technical, political and environmental trends. As such, it seeks to establish a framework for thinking about the ethics of digitalisation in education that explicitly takes account of causal connections between digitalisation, education and forms/patterns of violence that are not always visible to end users of AI and digital educational media (including educators). This means the focus is not directly on specific examples of digital technology or education media, but rather on the systems and interests that shape their production and use. Ultimately, the paper asks what standard or measure is most appropriate in the evaluation of digitalisation in education, if we are serious about 'the quest for peace and equality'.

Central to this endeavour are ideas and assumptions drawn from some different but overlapping bodies of work on technology and society, including work on the polycrisis (e.g. (Albert, 2024; Lawrence et al., 2024), the 'postdigital condition'(Jandrić et al., 2018), social technological science (Jasanoff, 2015) and peace research. As a full literature review is beyond the scope of the paper, I begin with a brief explanation of some key terms and working assumptions that inform the development and orientation of my approach. There is then a methodological section explaining the rationale and steps for network and causal loop diagramming as an approach to

theory development. This is followed by a presentation and narration of two 'maps' showing hypotheses about causal connections between digitalisation, education and the polycrisis, and the key actors involved. The final section of the paper considers the validity, limitations and implications of this analysis in relation to the core themes and concerns introduced above.

Foundational Premises

This paper is grounded in five premises that shape the focus and approach to inquiry.

Technology is culturally constitutive

Culture, technology and society evolve in tandem. As Neil Postman says, "[t]echnological change is neither additive nor subtractive. It is ecological. ... A new technology does not merely add something, it changes everything. We no longer have the old society plus the new society; we have an entirely new environment" (Postman, 1993, p. 52). This is important in relation to influential discourses about technology, including artificial intelligence, in which it is presented or treated as a neutral 'tool', independent of the conditions and context that shape its development, application or effects. Already we can see how access to generative AI is shaping social habits, expectations in the workplace (increased efficiency), or definitions of creativity and authorship. We saw above in the Brookings report that AI is impacting on the foundational development of young people. These are profound and multifaceted effects which influence norms, behaviours and society.

Sheila Jasanof's concept of a 'sociotechnical imaginary' is useful for capturing the relationship between technology and culture. A sociotechnical imaginary is defined as "collectively held, institutionally stabilised and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff, 2015, p. 17). Sociotechnical imaginaries "condition and constrain", shaping notions of what is possible or desirable, sometimes marginalising or discrediting "other ways of seeing and reasoning" (Jasanoff, 2015, p. 12). The important point here is that this conditioning or constraint is not only discursive but found within or articulated through technologies themselves.

A 'postdigital' culture is emergent in and beyond education

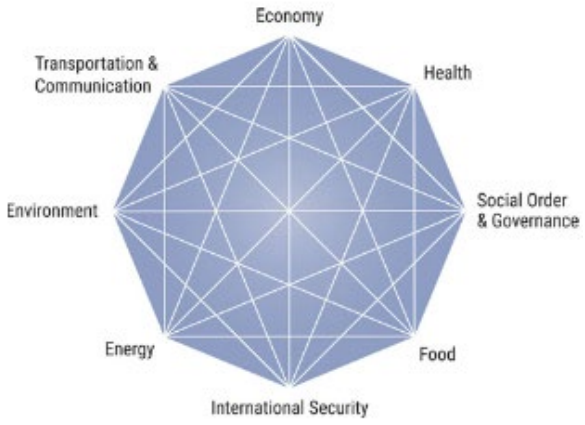
Reflecting the above assumption, the term 'postdigital' has emerged to describe a state in which digital technologies have become so deeply embedded within society that (arguably) distinctions between the human, material and digital realms are less definite. As Jandric et al (2018) write "[w]e are increasingly no longer in a world where digital technology and media is separate, virtual, 'other' to a 'natural' human and social life". Or as Feenberg puts it (2019) puts it, "the postdigital no longer opposes the virtual or cyber world to the world of face-to-face experience. The digital is integrated and imbricated with our everyday actions and interactions". The prefix 'post' here does not signify 'after', as though we are beyond the world of digitalisation, but instead a blurring of boundaries, the difficulty of disentangling the human, material and digital dimensions of our world(s) (Cramer, 2014). This indicates that cultural change associated with digitalisation is profound. This includes profound changes to cultures of education, including the ways in which knowledge is constructed, communicated and encountered through educational media, where and how learning happens, and the interests and agendas that shape educational practice (Weich & Macgilchrist, 2023).

The postdigital condition shapes and is shaped by the polycrisis

The concept of the postdigital is not merely descriptive, but an invitation to critique, "a 'holding-to-account' of the digital that seeks to look beyond the promises of instrumental efficiencies, not

to call for their end, but rather to establish a critical understanding of the very real influence of these technologies as they increasingly pervade social life" (Jandrić & McLaren, 2020; Knox, 2019). The point here is to question assumptions or claims that digitalisation is benign ('just a tool'), politically neutral or inevitable – that it is merely "virtual, ethereal, and without 'real' consequences". Instead, the concept of postdigital inspires, for some, a 'disenchantment' with digitalisation (Cramer, 2014) and more critical attention to the cultural changes, the shifting forms and locus of power, the social harms that digital technology brings or enables (Carvalho & Oliveira, 2025; Jandrić et al., 2018; Ruiz, Gallagher, & Najjuma, 2025). For example, Callum argues that it becomes a prompt for "reflexive recognition of the need to think dialectically about the way in which digital immateriality is entangled with and premised upon regimes of environmental despoilation, exploitation and expropriation". (Jandrić et al., 2018, p. 177).

This paper draws on the definition of "global polycrisis" and the framework for polycrisis research proposed by Lawrence et al (2024). They define a polycrisis as "the causal entanglement of crises in multiple global systems in ways that significantly degrade humanity's prospects"(p. 2). A crisis is understood as "a sudden (non-linear) event or series of events that significantly harms, in a relatively short period of time, the well-being of a large number of people" (Ibid). The 'poly' element of the term recognizes that there might be separate crises in different domains or systems, but that the interactions between these can give rise to more complex or severe effects, thereby constituting a larger, more global crisis: "the conjoined harms of multiple crises are different from, and generally worse than, the harms each crisis would produce in isolation, were their host systems not deeply interconnected".



The above diagram from Lawrence et al (2024, p. 3) represents eight global systems – a 'plausible scheme by which to disaggregate a messy reality for the purpose of polycrisis analysis'. Each of these categories represent systems that could be analysed separately and which each have their own dimensions of resilience or vulnerability. But because each of these systems now has an unprecedented level of integration with others - a feature and consequence of both globalisation and digitalisation - interdependence and hyperconnectivity become a dimension of risk in and of itself.

Not all risks or benefits are equal

An important working assumption in this paper is that social systems are fundamentally dependent on natural (ecological and energetic) systems, such that critical thresholds in natural systems are of prime importance. Erald Kolasi (2025, p. 17) refers to this as the 'physics of

capitalism': the recognition that energy and a healthy ecosphere "sets the broader constraints in which human societies and civilisations can successfully operate". Kolasi defines these constraints primarily in terms of the dependence of global economic systems on high flows of cheap and high-density energy (most of which comes (still) from climate-damaging fossil fuels) and a dependence on healthy, functioning ecosystems. He argues that we have increasing evidence that we are entering a dangerous "bionomic disruption that threatens not just the viability of our economic systems, but large portions of the planet's biological fabric" (Kolasi, 2025, p. 30). Hence, it is not merely the 'synchronisation' of various trends that matters in polycrisis research – many social, political and ecological risks becoming "critical at the same time or in quick succession"(Lawrence et al., 2024, p. 6) –, but the fact that foundational systems are at risk. Some risks are existential and, as such, might change how we view current trends vis-à-vis digitalisation.

2. Methodology

The broad aim of this paper is to make more visible the 'entanglements' of digitalization, education and other trends in relation to wider trends associated with the polycrisis, developing and substantiating some of the premises outlined above. By its very nature, the polycrisis is complex (many interacting trends and variables) which is difficult to capture solely in narrative (linear) form. An approach was needed that would both help generate analysis and support explanation of complex dynamics, within the possible scope of this paper. For this reason, the analysis that follows was developed using two forms of diagramming – System Mapping (or Network Analysis) and Causal Loop Diagramming (CLD) – both techniques linked to systems thinking.

Causal Loop Diagramming is used in a number of fields which involve the study of complex issues and where a more systemic or holistic analysis can be helpful (Baugh Littlejohns, Hill, & Neudorf, 2021; de Kraker, 2017; Gallo, 2013) Causal loop diagrams provide a visual representation of either theoretical or empirically based hypotheses about causal relationships and dynamics in complex systems (Uleman et al., 2024). In essence, they attempt to tell stories about causality (what is influencing what) and about feedback loops (what is causing something to getter better or worse, stronger or weaker, more or less significant). A core assumption in systems thinking is that causal relationships are non-linear and can have unpredictable effects; CLDs aim to show how and in what ways.

Causal Loop Diagramming can be qualitative or quantitative, or based on mixed methods (Uleman et al., 2024). It can be an individual or participatory practice - e.g. stakeholders developing and evaluating CLDs together as a form of participatory knowledge generation (Rajah & Kopainsky, 2024). CLDs can be used for different purposes – as an alternative approach to literature review, to identify or evaluate policy or practice interventions (Baugh Littlejohns et al., 2021). In all approaches, though, the process is as important as the outcome. The creation of a CLD involves a systematic and highly iterative process to organise knowledge to both reflect and test hypotheses about causal relationships. Diagrams should be understood as experimental tools whose utility lies in being not a literal or complete representation of a system but a means to highlight and generate discussion around important, perhaps unrecognised, dynamics.

Systems Maps or Network Analyses provide a more static analysis of elements in a given system – such as the education system – and how they are connected. The purpose here is really to define who and what is part of a system, often as first step before analysing system dynamics in CLDs.

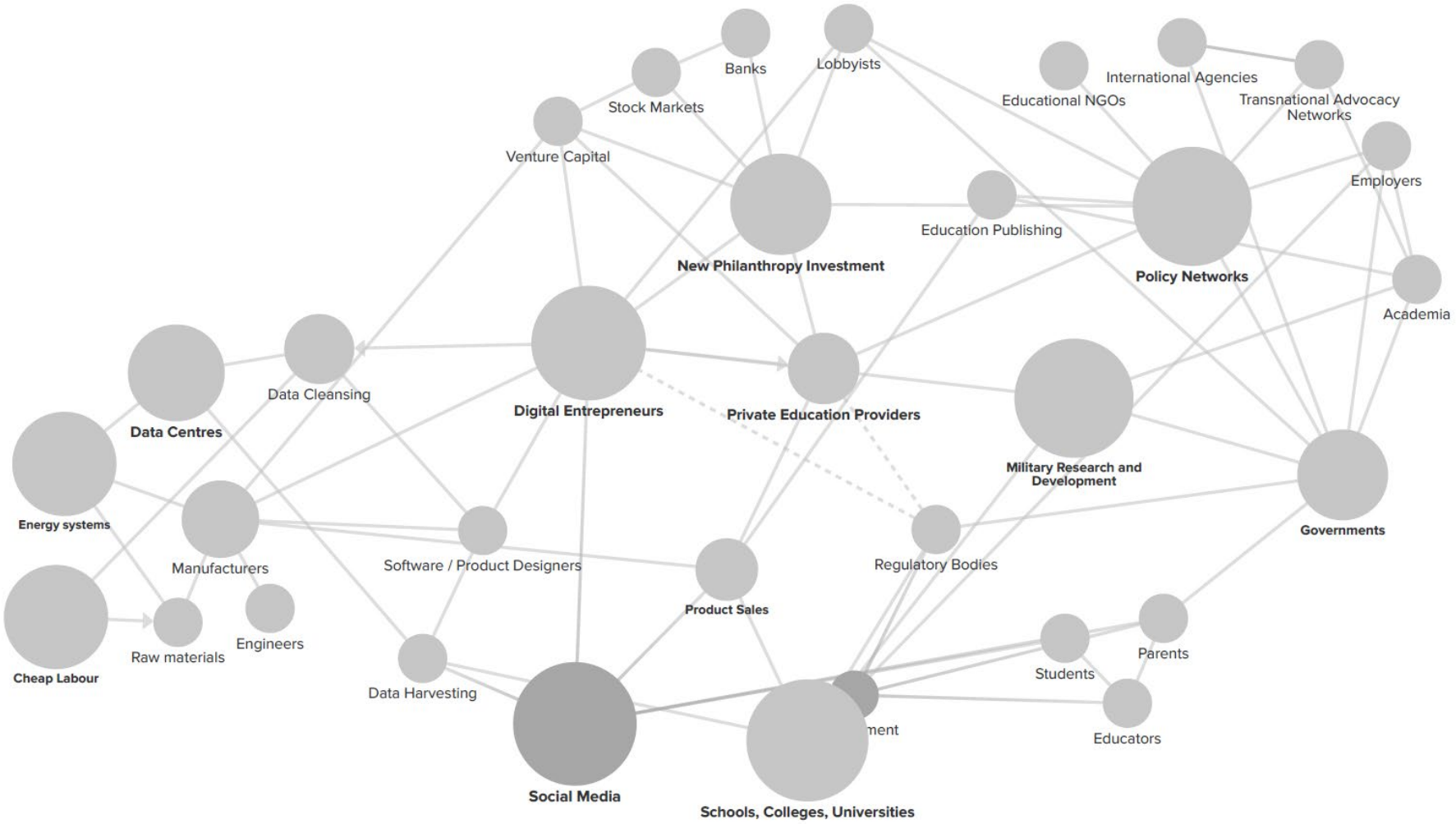
The two maps presented below were created gradually and in dialogue with my writing and research process: development and substantiation of the claims made in and through the diagram involved both my existing knowledge and more intentional searches on relevant themes linked to the paper. The development of the diagrams informed my writing; writing sometimes led to modifications to the diagram.

The key steps in the mapping process were:

1. Gathering and reading relevant research
2. Creating and refining an overall System/Network Map of the core elements and actors in the system responsible for the development and promotion digital education technology and media (Section 3)
3. Creating and refining a causal loop diagram (using Kumu software) to develop claims about trends and dynamics within this system (Section 4)
4. Developing a narrative explanation of the above, supported by appropriate sources of information or evidence (Section 4)
5. Developing commentary and conclusions in relation to the overall purpose and questions in the paper (Section 5)

There are obviously limitations with this method. The CLD in this paper represents a conceptual hypothesis about the relationship between education, digitalisation and elements of the polycrisis. It is purposefully high-level and focused on underlying trends or patterns rather than specific cases. There is not space in the paper to provide details or illustrations to support all the points. The analysis is qualitative and theoretical. There is no attempt at quantitative justification or triangulation. Again, as stated above, these visualisations are best understood as exploratory and a starting point for discussion.

3. The System of Global Education and Educational Technology



The claims represented in this system/network map draw on some linked bodies of work about the changing landscape of education internationally, particularly in relation to linked drivers of privatization and digitalization. The work of Stephen J. Ball is a core reference point, especially his book *Global Education Inc* (2012) alongside some more recent work (Stephen J. Ball, 2017, 2018). It is particularly relevant and useful because it is based on a method of ethnographic network analysis: his aim is to identify the complex assemblage of actors involved in educational policy and reform internationally, and to understand how the flow of policies, financial interests and technology is facilitated by both the form and activities of these networks (Stephen J. Ball, 2023). The analysis below also draws on related work on 'intermediaries' in education – including financial actors and technology entrepreneurs (Davies, Eynon, & Komljenovic, 2022; Hartong, 2024; Hartong, Geiss, & Röhl, 2024; Ortegón, Williamson, & Decuypere, 2024), 'platformisation of education'(Decuypere, Grimaldi, & Landri, 2021; Nichols & Dixon-Román, 2024), and a wider critical literature on educational technology (Macgilchrist, 2018; Openo, 2024; Selwyn, 2023; Selwyn & Facer, 2021; Selwyn, Hillman, Bergviken Rensfeldt, & Perrotta, 2021).

The network map aims to capture what this research literature tells us about the thoroughly global nature of contemporary education policy and practice, about the (surprising) diversity of actors and interests converging in international policy networks, and about the agendas and practices that are driving change. Education policy and governance networks include a variety of actors, including educational policy institutes, international publishing conglomerates, academics, educational specialists, employers, governments, transnational advocacy networks (TANS), as well digital technology companies, private education providers and 'new philanthropy' organisations keen to sponsor educational reform initiatives (e.g. the Clinton Global Initiative and the Bill and Melinda Gates Foundation). We also see the presence of banks, venture capital and 'portfolio' corporations like Serco or Mott McDonald. There is a clear sense that education is no longer the preserve of nation-states and public sector policy. As Ball writes, "traditional line and demarcations between public and private, market and state, are being breached in all this and are no longer useful as free-standing descriptors" (Stephen J Ball, 2012, p. 71).

What binds such disparate interests together? In Ball's analysis it is a belief in what he calls 'the neoliberal curriculum of reform': "the public sector learning to confront its purported inadequacies, learning lessons from the methods and values of the private sector, and learning to reform itself" (2012, p. 30). The word 'purported' is significant here, reflecting the view that, as Ball puts it, policy problems are as often as not 'constructed' rather than merely 'identified'. Clearly, "to the extent that the public sector can be represented as 'broken', then there is more 'fixing' to do (2012, p. 114). Reforms are opportunities to "create new business opportunities and open up new markets" (Stephen J. Ball, 2017, 2018). Similarly, Davies et al write that investors "operationalize specific ideas about what is wrong with education, how it should be disrupted or fixed, and what future education should materialize"(Davies et al., 2022).

Of particular relevance in this paper, digital technologies – and the 'intermediaries' (Joecks, 2024) associated with them – are probably the most significant drivers of the substantial changes taking place in education. There is obviously a long history of educational technology associated with computing and digitalization, but a number of trends and events have converged to accelerate what some are calling a 'revolution' in education: the Covid pandemic, which forced a rapid adaptation to remote teaching; datafication, which promotes the collection of student and teacher data for a variety of educational and commercial purposes (Decuypere et al., 2021), and the acceleration of AI-technology. The latter has been enabled, in part, by both the wealth and the data that has been captured through the embedding of educational technology in

schools and universities. At the same time, global education is seen as a primary site for future profits – a market estimated to be worth $6.5 trillion according to Nicols and Dixon-Romain (2024, p. 319). As they note, this explains the interest of some of the largest technology companies (Microsoft, Apple, Facebook) both for investment and philanthropic spending (see below). As Davies et al write, "ed tech investors are not only financial actors; they are also political actors, using their financial power to influence what they think should be happening both within and after school".

Digitalisation takes many forms in education. It can range from electronic payment systems (in private education initiatives) and digital administrative systems to platforms for learner analytics, content management systems, as well as curricula materials and digital teaching tools. In line with points made earlier about the postdigital condition, the cultural role of technology and the ecological, additive nature of socio-technological development, digitalization in education should not be understood as a purely technical change. These are not neutral tools but, on the contrary, "connective artefacts constitutive of, as well as constituted by, active socio-technical assemblages that are in the process of significantly transforming the educational sector" (Decuypere et al., 2021, p. 2). The form, purpose and experience of education is changing. For example, recent studies on the platformisation of education discuss how digital platforms – "a programmable digital architecture designed to organize interaction between users" (Van Djuick and Poell, 2018 cited in: Decuypere et al., 2021, p. 3) change how learners and teachers interact, their expectations of how, where and when learning happens – they "at once envision and create different social possibilities … enact different sorts of user identities and they generate and require new forms of professional expertise and professionality".

This process of change could be seen as natural, benign and beneficial. However, a consistent theme in the literature reviewed for this paper is that this is a highly political process, that it is significantly focused on the commodification of education (Hartong, 2024), and that it reflects a "particular imagined future about what technology-mediated education ought to look like – one that forecloses alternative imaginaries for how school systems might relate to or use technology" (Nichols & Dixon-Román, 2024, p. 320). For some researchers there is a clear disconnect between the seductive rhetoric of personalization, empowerment, inclusion and opportunity - as well as the promises of more efficient and effective methods of teaching – and both the realities of ed technology in practice and the (increasingly obvious) commercial agendas of ed tech promoters (See for example: Selwyn & Facer, 2021; Watters, 2021). In his book *Access is Capture,* Roderic N. Crooks (2024) provides a detailed account of the ways in which 'access to technology' is presented as a solution to endemic problems of racial inequality in resource-poor and struggling US schools, legitimizing significant investments of public resources into computers and software. But rather than improving educational outcomes and living up to the promises made on its behalf, the new technology was either ignored, abused (by students) or mainly used for purposes of student surveillance, datafication and performance management by the schools in his study. It provided both a distraction and a means to justify existing divisions and outcomes – not only leaving the underlying structural causes of disadvantage untouched but generating profits for the various companies selling hardware, software and the data it collected.

The promotion of digital ed tech is not only commercial or government actors. It is often also supported by activist and social justice-oriented organisations – highlighted as Transnational Advocacy Networks (TANs) in the diagram. According to Ball, TANs exist "to promote principled causes, ideas and values", operating "within a paradigm of progressive policy solutions, vulnerable constituencies and community empowerment related to human rights and

environmental issues" (2012, p. 12). Logically, this would seem to be in tension with a programme of neoliberal privatization which, arguably, might be seen as responsible for some of the problems – poverty, social marginalization, unemployment – that the TANs exist to challenge. The rise of 'New Philanthropy' and 'solutionism' is probably key to understanding. New philanthropy describes a shift from traditional approaches to charitable giving towards an 'investment' based model – a type of 'social capitalism' in which profit is seen as both a desirable and legitimate part of philanthropic work; profit as a 'force for good' (Stephen J Ball, 2012, p. 66). The role of TANS in policy networks is to highlight areas of social need and potential investment, providing knowledge and expertise as well as advocating for 'solutions'. Essentially, their involvement in these wider assemblages helps to legitimize the rhetorical claims made about the social benefits of initiatives or investments. As with the example in Crooks' work mentioned above, claims about a lack of access to technology as a core dimension or indicator of social exclusion – the so-called 'digital divide' - can be very powerful and persuasive in themselves, but are more so if supported by independent and credible actors with genuine interest in progressive social goals.

Even if the progressive rhetoric is justified – if profit-led investments in education are beneficial (to be discussed further below) - the flows of finance and profits from both privatization and digitalization are important to understand. At least some of the 'new philanthropy' is based on wealth generated in the computing and software industries, raising questions about the agenda and beneficiaries of 'investments' in educational reform. In other words, there is a degree of (questionable) circularity to the financing of ed tech, with funds flowing into and out of education via the same connected actors, and sometimes in the form of 'philanthropy'. As Ball makes clear, this story is not unique to education: "education is just one manifestation of a global reworking of the economic, social, moral and political foundations of public service provision and the development of new kinds of political responses to social disadvantage" (2012, p. 15).

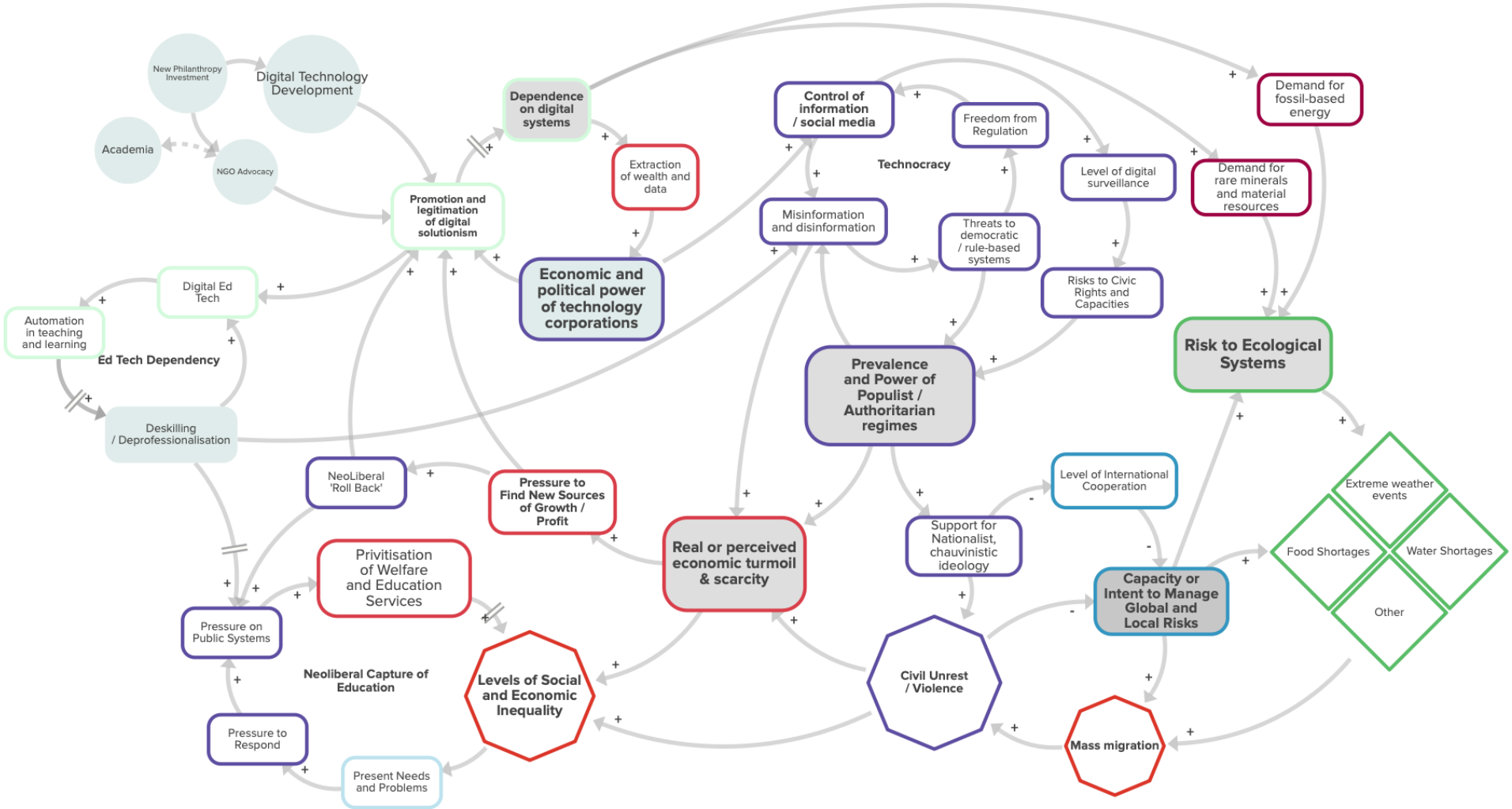
The map above includes one additional set of actors or stakeholders – those associated with the design, development and manufacture of digital technology, the energy systems which power digital technology, and – as described powerfully by Karen Hao - with the work of data cleaning that has supported the development of Large Language Models/AI (Hao, 2025). Much of this is invisible to end users, but it is an important dimension of ethical questions that have been raised about digitalisation. As I will explain in more detail below, this is particularly important in the context of the polycrisis.

Before moving on, the role of the military in global education is not given explicit attention in Ball's work but is important to mention here. It is considered by Audrey Watters in her valuable history of efforts to automate education through '*Teaching Machines'* (Watters, 2021) , and in Douglas Noble's (1991) early study '*The Classroom Arsenal: military research, information technology and public education*'. Noble opens his book saying "recent technological excursions in the classroom reflect not so much the use of technology in the service of education as the usurpation of education in the service of technology" (1991, p. 1). It is an interesting and provocative reordering of perspectives on the education-technology relationship. It is not the 'real and pressing' needs of education that are at stake here, but those of both technological development and financial return: "education itself is now conceived, ideally, as a tool, a sophisticated supply system of human cognitive resources, in the service of a computerized, technology-driven economy" (Noble, 1991, p. 1). The specific contribution of his book is to make more visible the decades-long history and 'formidable' (yet least recognized) influence of military research and development as 'a pivotal catalyst in the historical linkage between education and technology'. As he writes, "although it has not been widely understood, military research in 'human

engineering' has been the prime incubator, catalyst, sponsor of educational technology throughout this [the 20th] century – from the classification and selection tests of WWI, to the programme instruction and teaching machines of the 1960s, to the most significant, computer-based 'intelligent' tutoring systems of today" (1991, p. 2). At the time of his writing, military agencies had provided three quarters of funding for educational technology research in the preceding three decades and played a significant role in accelerating the spread of computing technology in schools. Perhaps the most important point that Noble makes, linking with the discussion above, is that this is not some simple conspiracy, but arises through 'a convergence of efforts and motives', including genuine, well-intentioned efforts by educationalists and others to improve education and 'policy-makers responding to public outrage of educational failure', and a wider culture that believes (has been encouraged to believe) in technological solutions to social problems (1991, p. 3). At the same time, echoing Franklin and Jasanof, Noble questions the 'neutrality' of digitalization: they are not 'merely inert tools' but 'the embodiment of particular perspectives and contexts' and histories of those with the power to determine technological development (1991, p. 4).

In summary, there is growing evidence of significant changes in education around the world, with a growing number of 'intermediaries' who are actively reshaping policy and practice. This complex assemblage of actors, financial mechanisms, technologies and practices are linked by a strong ideological drive to further commodify and 'deinstitutionalise' educational provision. Digitalisation, and especially AI, makes it more possible to change the forms of both education and educational governance. Whilst this process is often framed in benevolent terms – making education more accessible and agile, more personalized, and less subject to bureaucratic control – it is also a route to new forms of standardization and monopolization by large corporations. Citizens and states will potentially cede significant control not just over what and how students learn, but also over the data that education systems generate. This, arguably, is the emerging landscape of postdigital education. It raises very significant questions about ethics and power in relation to education specifically, but these questions take on further significance in the context of the polycrisis. This is the focus of the next section.

4. Causal Loop Diagram: Digitalisation, Education and the Polycrisis



Reading the Causal Loop Diagram

The causal loop diagram three main elements: boxes represent trends or conditions, octagons represent crises, arrows represent the direction and nature of causal influence. In addition, plus signs (+) next to the arrows indicate when influence amplifies the existing trend (positive feedback). Minus signs indicate counter trends (negative feedback). Double lines indicate time delays – the fact that influence is not always immediate. Crises can be understood both as outcomes of trends and also triggers (i.e. the crisis feeds back into and often amplifies existing dynamics in a system).

The colours indicate different types of causal elements: Red labels economic trends/interests. Dark blue labels political trends/dynamics. Light blue labels international governance and security. Green labels environmental trends/impacts. Light green labels technological development. (Given the overlap between some of these areas, it is an indicative schema.)

The map consists of a number of self-contained causal loops which are linked together. These are labelled to indicate the key theme or story the loop represents and can be read independently. explanation below attempts to draw out the connections between these separate dynamics, reflecting the systemic intent of polycrisis research. Larger sized boxes and crises indicate the elements or factors that are deemed of the greatest significance.

i.

The left-hand side of the diagram mainly reflects what has been discussed above: a process through which public services – including education – are increasingly privatized and digitalized, and where this process is legitimized as a necessary response both to known social needs (including economic inequality) and to 'broken' or 'failing' education systems. An accelerated and deeper form of digitalization is under way with AI, creating significant change within education. As discussed in the introduction vis-à-vis the Brookings report, this might bring benefits for learners and teachers, but it also presents risks in terms of new forms of digital dependence, surveillance, and negative impacts on 'foundational development'. The political risk in this process is associated with opportunities to capture economic resources and data (which can both be monetized and used to train AI) via educational reform.

The digitalization loop suggests a simple reinforcing pattern: as technology companies capture more wealth and data, their ability to influence policy in and outside of education also grows, further advancing the scope for privatization and wealth/data capture (Fraser, Beckel, Keesing, Minkin, & Sunderland, 2025; Kirkwood, 2025). This loop connects back to dynamics shown in the loop titled 'neoliberal capture of education'. The hypothesis here is that failures of privatization and digitalization, which are well documented in the research by Crooks, Ball and others cited above, nevertheless generate continuous political pressure for solutions to intractable social problems, including (under the conditions of late Capitalism) through further privatization and/or digitalisation. As AI is increasingly touted as the solution to myriad shortcomings in education (and welfare) systems, this positions education as a key site of unfolding social and political change.

One additional potential consequence of the 'big tech' takeover of education is shown in the loop labelled 'Ed Tech Dependency'. This is based on emerging evidence about forms of student and teacher deskilling through routine use or overuse of AI. For students, this can occur through 'cognitive offloading' and a lack of the effort that is required for lasting learning to take place. For teachers, dependence on AI for tasks like class preparation or marking could result in declining

individual skills and might facilitate more structural changes to professional work. Whilst there is, as yet, no reliable longitudinal evidence on these issues (Trabelsi, 2025; Williamson, 2025), there is analogous evidence from wider work on the impact of digital technology on young people's social, emotional and cognitive development that validate concerns about a similar, possibly higher dependence on AI. This matters not just at an individual level, but also socially – including for the quality and viability of civic life and democratic participation. This provides a point of connection with the more political implications of digitalization explored on the right-hand side of the diagram below, especially the capacity and willingness of citizens to critically assess information about social and environmental issues.

ii.

The rest of the diagram hypothesizes some entanglements between the growing power of technology corporations, the technologies they have created (including ed tech) and wider dimensions of the polycrisis, especially those introduced above: the growing influence of populism and extreme nationalism, the weakening of democratic/rule-based governance nationally (in some countries) and internationally (in terms of global cooperation), and the accelerating ecological crisis (Albert, 2024; Caesar et al., 2024; Sogaard Jorgensen et al., 2024).

For example, the increased energy demand[2] and environmental degradation associated with the manufacture and operation of digital technology (shown as demand for rare minerals and materials) amplifies risk to ecological systems. The impacts of environmental change are known to disproportionately affect more vulnerable populations, especially in areas where drought, floods, land degradation and other extreme weather events are more prevalent (Markelius, Wright, Kuiper, Delille, & Kuo, 2024; Schlosberg, 2012). Thus, a failure to effectively manage environmental risk becomes causally associated with specific crises – such as increases in the scale and speed of mass migration and the social-political dimensions of population movement.

That risk is further exacerbated by the changing nature of national and international governance, noted on the diagram as the capacity and intent to effectively manage environmental and other risks. That capacity and intent is currently under threat from different countries and for different reasons (Tisdall, 2025), but 'big tech' is playing a key role. Technology companies are providing financial and political support to more populist/authoritarian regimes, in part to minimise state and international regulation of their business.[3] This contributes to a weakening of democratic, rule-based governance at both national and international scales (labelled 'technocracy' on the diagram). Amongst the potential consequences for international cooperation on different aspects of the polycrisis, this will impede efforts to regulate the causes of environmental degradation.

Democratic governance is impacted by digital technologies in other ways too. For example, social media facilitates the spread of disinformation and misinformation about environmental risks, often in line with populist agendas to prevent action on climate change and related issues.(Elbeyi et al., 2025). This is now referred to as an issue of 'epistemic security' – the ability of states or other actors to maintain 'healthy and robust information chains' (Seger, Perry, &

[2] The IEA estimate that "a typical AI-focused data centre consumes as much electricity as 100,000 households, the largest ones under construction today will consume 20 times as much"(Spencer & Singh, 2025)

[3] For example, Silicon Valley companies lobbied hard – though unsuccessfully in this instance – for a 10-year ban on any state regulation of AI in the US. The original proposed legislation read "no State or political subdivision thereof may enforce any law or regulation regulating artificial intelligence models, artificial intelligence systems, or automated decision systems during the 10-year period beginning on the date of the enactment of this Act." (Merchant, 2025b)

Hancock, 2025). Digital dependence and the fact that tech companies own most of the infrastructure through which information flows affords these companies unprecedented influence: "Tech companies make unilateral decisions about how information flows in the networks they own. When they do, they shape the information available to citizens and officials, influencing their views and choices. This means that tech companies may affect democratic discourses and systems profoundly. In some cases, companies' decisions appear to have been made directly by their owners and may have been made with political motives" (Hancock, 2025).[4]

The causal loop diagram shows other feedback mechanisms, including how the dynamics described above are both influenced by and exert influence on economic turmoil and social (in)equality. For example, the push for an AI economy will involve efforts to automate more and more areas of work. In education specifically, and as indicated earlier, digital technology not only promises to transform existing institutions, but to radically 'deinstitutionalise' education, including the 'unbundling' of traditional roles (through automating and separating different areas of teachers' work)(Selwyn & Facer, 2021). Whilst some predict that automation might increase jobs in the long-term, there will be significant and disruptive impacts on (un)employment, economic stability and inequality) in the short-term. As shown by Lawrence et al (2024), economic turmoil and scarcity, whether real or perceived, is linked to political changes in society when grievances form or are encouraged.

Technocratic/authoritarian regimes are further enabled by the surveillance capabilities of deeply embedded digital technology. This has become more obvious via the current alignment between key tech entrepreneurs and right-wing movements in the US (Merchant, 2025a) and abroad (Golumbia, 2025), and through the evidence of the political (unpeaceful) uses to which AI is being put: the dismantling of US state institutions is premised on AI-based automation; AI technologies are supporting programmes of deportation and political surveillance; they are being deployed in sites of warfare, including in the war in Gaza. Writing about the successful passage of Donald Trump's 'Big Beautiful Bill' in July 2025 and the vast state funding that it allocates to surveillance technology, Jai Dulani says: "This bill makes one thing crystal clear: corporate-state collusion is accelerating, threatening to fully convert the US into an authoritarian state. Tech oligarchs are seizing unprecedented control over the economy and government. As the House now votes on one of the biggest investments in state surveillance ever, it is also considering one of the biggest wealth transfers to billionaires in US history."(Dullani, 2025) This is an important dimension of the dynamics shown on the diagram: there is always a possibility for dissent or resistance to developing trends, and therefore for different possible futures. Yet, the increasing dependence on digital devices, the power this grants to tech corporations and entrepreneurs, and the power that the technology itself affords for different forms of social control may significantly limit the possibility of effective resistance.[5]

---

[4] In similar terms, Fraser et al write: "What sets Big Tech apart from other corporate giants is not just its money or scale. It is that these companies control the spaces where public discourse unfolds. They dictate what information we see, what goes viral, and whose voices are amplified or buried. They do not just influence the debate — they are its architects."(Fraser et al., 2025)

[5] Von Knebel argues that the conditions that facilitated the emergence of liberal democracy in the 20th century are disappearing, threatening the compromise between capital and labour that has chracterised welfare and rule-based societies: "A rise in inequality and the disappearance of a middle class as a stabilizing force could severely undermine the support of tech billionaires for democracy. Growing costs of redistribution that come alongside rising inequality, paired with a reduced need for human labor, could mean that elites see the democratic process as a relic that is simply not needed anymore. This could be exacerbated by a vicious cycle with self-reinforcing feedback loops: As societies become more unequal,

Concern about this technocratic potential is derived partly from analyses of the 'sociotechnical imaginaries' (Jasanoff, 2015) of digital/AI technology - including the stated worldview of its leading proponents. This can perhaps be summarized in the term 'cyberlibertarianism' or 'technolibertarianism'. According to David Golumbia (2025, p. 37), "at its narrowest core cyberlibertarism is a commitment to the belief that digital technology is or should be beyond the oversight of democratic governments – meaning democratic political sovereignty". This in itself can provide a justification and explanation for attacks on the perceived 'illegitimacy' and 'violence' of the modern state. However, there is a deeper and somewhat complex relationship with (extreme) right wing politics which goes beyond simple libertarian demands for freedom. Golumbia argues that "there are 'natural' affinities between digital technology and the foundations of political reaction, especially with conviction that might makes right: that the dominant salient political factor in the world is how much power a person or group can accrue to itself, and that any action is licensed in the pursuit of that power and its maintenance once achieved" (2025, p. 913). AI is a means for an unprecedented accumulation of power, so it is significant that key figures in AI industries openly subscribe to philosophical positions have alt-right, techno-fascist resonances and which propose the superiority not just of technology to humans, but of the elite responsible for developing it. Ideas, not just money and structural power, are a critical influence on system dynamics.

5. Discussion and Conclusion

A Causal Loop Diagram can generate plausible hypotheses about existing and emerging dynamics in interacting systems. The diagram in this paper draws on recent and credible research about observable trends and risks. However, there are clearly many other trends and dynamics not shown here. This has two implications: the maps are not comprehensive, and they are arguably too one-sided; they pay insufficient attention to counter-trends and dynamics. For example, it could be argued that AI technology might enable very rapid advances in 'green technology' that would not otherwise be possible, and therefore that the problem of climate change might become more manageable. If this was possible, then the predicted social and political upheavals might not materialize in the same way.

There are undoubtedly many details, uncertainties and contingencies that have not been discussed in detail here. However, the main purpose of the preceding analysis is to show why discussion about education and (post)digitalization (including AI) as mechanisms for potentially 'progressive' or peaceful social change needs to be informed by polycrisis research. The paper has tried to show some of the different ways in which education and digitalization are 'entangled' with some of the main social, ecological and political drivers of the polycrisis. As such, whatever potential benefits might be associated with educational initiatives or with applications of digital educational technology, a systemic, holistic analysis of the broader interests, power dynamics and potential harms that flow in and through the system of global education is essential. An individual teacher might well find valid uses for AI in their own classroom, but it is the aggregate of such decisions that will be decisive. If or when AI (or other educational technology) is adopted on a massive scale and across the whole education lifecycle, then it is necessary to consider the environmental impacts, the implications of AI and automation for the form and nature of educational work, the power technology companies acquire through the (stealth) privatization

---

the cost of redistribution rises, and efforts to block such measures will become more aggressive. This, in turn, will increase inequality, further raising the cost of redistribution and the cost of tolerating democracy"

and deinstitutionalization of education systems, and how that power might be exercised more widely, including in ways that exacerbates structural, cultural and direct forms of violence.

The particular risk for progressive/peace educators, arguably, is of a naïve co-option by actors whose interests may be far from peaceful. As discussed above, a powerful rhetoric accompanies many educational reform initiatives and digital ed technologies. These are frequently described in terms that will appeal to progressive-minded educators – improving accessibility, addressing disadvantage, promoting more inclusive pedagogies, and addressing other known limitations of mass education systems. Because there are indeed real challenges in education systems, it is understandable that technological or other solutions to pressing needs and challenges in the present will command interest and investment. Yet, analysis of the actors, interests and ideologies that are driving and benefiting (most) from educational reform/digitalization suggests, at a minimum, a need for caution. That caution should also take account of the fact that the evidence about the longitudinal influence of recent digital/AI technologies in education is limited and the evidence that does exist indicates greater risks than benefits.

Education in the postdigital condition is, on these terms, not a simple site for or agent of progressive change. It is not independent of, unaffected by or implicated in wider socio-ecological and political trends. Indeed, the analysis above suggests that progressive potential of education might be weakened through the twin processes of privatization and digitalization. It also suggests that, under the evolving conditions of the polycrisis, what we have thought of as both peace and education for peace might need rethinking, including whether and how they might be more clearly 'disentangled' from compromised systems.

This paper has attempted to visualize the system associated with digitalization in and beyond education and, using causal loop mapping, to generate hypotheses about linkages between these trends and the polycrisis. One contribution of the paper is to literally make visible the range of actors, interests and causal factors that are driving changes both within education and beyond it. Seeing this complexity represented diagrammatically can, arguably, support understanding in a different way.

A second related contribution is to orient discussions about the possibility or conditions for ethical adoption of digital educational technology and media, particularly for progressive or peace educators. Maps help us to see where we are and where we are heading. The causal loop map focused attention on the conditions shaping the production and adoption of digital technology in education, but also showed how this process is entangled with political, economic and environmental trends and unfolding crises. Some of these – like the climate crisis – are existential in nature. Unless there is a change in course, we are heading towards a much less peaceful world.

Causal loop maps can also help us identify possible points of intervention – where extant trends might be slowed, halted or reversed through intentional action. If we recognize, for example, that increased dependence on digital technology or media in schools not only has harmful impacts on 'foundational development' at learner level (amongst other things) but also enables or accelerates transfers of public funds and data into private hands (which in turn has political ramifications), then the definition or calculation of risks vs benefits of digital/AI adoption potentially changes. A different calculation of risks and benefits can lead to different choices by educators or policy makers.

These considerations seem particularly acute but also difficult for progressive educators. A concern to do good and make a difference through education, especially within education systems that are far from perfect, can encourage a pragmatic or utilitarian stance towards technology – a 'whatever works' solutionist mindset. This is a real and meaningful dilemma in many forms of peace work – when the pressure to respond to present needs and injustices involves actions that either fail to challenge systemic, structural causes of harm or contribute to their reproduction. It is understandable that educators may be attracted to the promises made on behalf of digital educational tools and media vis-à-vis inclusion, efficiency or enhanced learning. But, returning to Franklin's opening quote, a focus on 'manifestations' – on the symptoms of unpeaceful systems – can detract from efforts to recognize and address their root causes, the deeper patterns and logics that explain the persistence of inequality, poverty and polarization. There are no easy answers, but we can start by recognizing how and in what ways our choices and actions are related to those root causes. This paper is a contribution to that endeavour.

References

Albert, M. J. (2024). *Navigating the Polycrisis: Mapping the Futures of Capitalism and the Earth*.

Ball, S. J. (2012). *Global Education Inc: New Policy Networks and the Neo-Liberal Imaginary*. London: Routledge.

Ball, S. J. (2017). Corporate Elites and the reform of public education. *Educational Review, 70*(3), 383-384. doi:10.1080/00131911.2017.1375808

Ball, S. J. (2018). Commericalising education: profiting from reform! *Journal of Education Policy, 33*(5), 587-589. doi:10.1080/02680939.2018.1467599

Ball, S. J. (2023). Education policy network analysis: The state of the art. *International Journal of Educational Research, 117*. doi:10.1016/j.ijer.2022.102096

Baugh Littlejohns, L., Hill, C., & Neudorf, C. (2021). Diverse Approaches to Creating and Using Causal Loop Diagrams in Public Health Research: Recommendations From a Scoping Review. *Public Health Rev, 42*, 1604352. doi:10.3389/phrs.2021.1604352

Burns, M., Winthrop, R., Luther, N., Venetis, E., & Karim, R. (2026). *A New Direction for Students in an AI World: Prosper, Prepare, Protect*. Retrieved from Washington, DC:

Cadwalladr, C. (2025). It is a coup. Retrieved from https://broligarchy.substack.com/p/it-is-a-coup

Caesar, L., Sakschewski, B., Andersen, L. S., Beringer, T., Braun, J., Dennis, D., . . . Rockström, J. (2024). *Planetary Health Check Report* Retrieved from Potsdam, Germany:

Carvalho, L., & Oliveira, G. (2025). Alternative Futures in the Postdigital Classrooms of the Global South. *Postdigital Science and Education*. doi:10.1007/s42438-025-00555-y

Cramer, F. (2014). What is post-digital. *A Peer-Reviewed Journal, 3*(1).

Crooks, R. N. (2024). *Access is Capture: How EdTech Reproduces Racial Inequality*. Oakland: University of California Press.

Davies, H., Eynon, R., & Komljenovic, J. (2022). Investigating the financial power brokers behind EdTech. In S. Livingstone & K. Pothong (Eds.), *Education Data Futures: Critical, Regulatory and Practical Reflections* (pp. 80-92). Retrieved from https://educationdatafutures.5rightsfoundation.com/essays/competing-interests-in-education-data/investigation-financial-power-brokers-edtech

de Kraker, J. (2017). Social learning for resilience in social–ecological systems. *Current Opinion in Environmental Sustainability, 28*, 100-107. doi:10.1016/j.cosust.2017.09.002

Decuypere, M., Grimaldi, E., & Landri, P. (2021). Introduction: Critical studies of digital education platforms. *Critical Studies in Education, 62*(1), 1-16. doi:10.1080/17508487.2020.1866050

Dullani, J. (2025). How Trump's Budget Bill Sells Out The Future to Big Tech. *Tech Policy Press*. Retrieved from https://www.techpolicy.press/how-trumps-budget-bill-sells-out-the-future-to-big-tech/?utm_source=substack&utm_medium=email

Elbeyi, E., Bruhn Jensen, K., Aronczyk, M., Asuka, J., Ceylan, G., Cook, J., . . . Valenzuela, S. (2025). *Information Integrity about Climate Science: A Systematic Review*. Retrieved from Zurich, Switzerland: https://cdn.prod.website-files.com/643ecb10be528d2c1da863cb/68541b1613026bbfd94181b9_SR2025.1%20-%20Information%20Integrity%20about%20Climate%20Science.pdf

Feenberg, A. (2019). Postdigital or Predigital? *Postdigital Science and Education, 1*(1), 8-9. doi:10.1007/s42438-018-0027-2

Franklin, U. (2014). *Ursula Franklin Speaks: Thoughts and Afterthoughts*. Montreal: Mcgill-Queen's University Press.

Fraser, A., Beckel, M., Keesing, L., Minkin, A., & Sunderland, I. (2025). The Tech Money Machine: How Silicon Valley Buys Power - and Shapes Reality. *Tech Policy Press*. Retrieved from https://www.techpolicy.press/the-tech-money-machine-how-silicon-valley-buys-power-and-shapes-reality/

Gallo, G. (2013). Conflict Theory, Complexity and Systems Approach. *Systems Research and Behavioral Science, 30*(2), 156-175. doi:10.1002/sres.2132

Golumbia, D. (2025). *Cyberlibertarianism: The Right-Wing Politics of Digital Technology*. London: University of Minnesota Press.

Hancock, J. (2025). Tech Oligarchy Imperils Democratic Information Flows. *Tech Policy Press*. Retrieved from https://www.techpolicy.press/tech-oligarchy-imperils-democratic-information-flows/

Hao, K. (2025). *Empire of AI: Inside the Reckless Race for Total Domination*. London: Penguin.

Hartong, S. (2024). Governance by intermediarization. Insights into the digital infrastructuring of education in Estonia. *Research in Education, 120*(1), 91-109. doi:10.1177/00345237241234613

Hartong, S., Geiss, M., & Röhl, T. (2024). Intermediaries and the digital transformation of schooling: An introduction. *Research in Education, 120*(1), 3-13. doi:10.1177/00345237241258700

Heck, C. (2024). Absolutizing Prevention: Big Data, AI, and 'the Future as a Threat'. *Berliner Gazette*. Retrieved from https://berlinergazette.de/absolutizing-prevention-big-data-ai-and-the-future-as-a-threat/

Jandrić, P., & McLaren, P. (2020). Critical intellectuals in postdigital times. *Policy Futures in Education, 19*(6), 626-639. doi:10.1177/1478210320964372

Jandrić, P., Ryberg, T., Knox, J., Lacković, N., Hayes, S., Suoranta, J., . . . Gibbons, A. (2018). Postdigital Dialogue. *Postdigital Science and Education, 1*(1), 163-189. doi:10.1007/s42438-018-0011-x

Jasanoff, S. (2015). Future Imperfect: Science, Technology, and the Imaginations of Modernity. In S. Jasanoff & S.-H. Kim (Eds.), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago: University of Chicago Press.

Joecks, L. (2024). Exploring the intermediary role of ed-tech consulting in Germany: In-between policy, pedagogy, and economics. *Research in Education, 120*(1), 14-34. doi:10.1177/00345237241242993

Kirkwood, M. (2025). The UK's AI Strategy Risks Entrenching the Power of Big Tech. *Tech Policy Press*. Retrieved from https://www.techpolicy.press/the-uks-ai-strategy-risks-entrenching-the-power-of-big-tech/

Knox, J. (2019). Postdigital as (Re)Turn to the Political. *Postdigital Science and Education, 1*(2), 280-282. doi:10.1007/s42438-019-00058-7

Kolasi, E. (2025). *The Physics of Capitalism: How a New Political Ecology Can Change the World*. New York: Monthly Review Press.

Lawrence, M., Homer-Dixon, T., Janzwood, S., Rockstöm, J., Renn, O., & Donges, J. F. (2024). Global polycrisis: the causal mechanisms of crisis entanglement. *Global Sustainability, 7*. doi:10.1017/sus.2024.1

Macgilchrist, F. (2018). Cruel optimism in edtech: when the digital data practices of educational technology providers inadvertently hinder educational equity. *Learning, Media and Technology, 44*(1), 77-86. doi:10.1080/17439884.2018.1556217

Markelius, A., Wright, C., Kuiper, J., Delille, N., & Kuo, Y.-T. (2024). The mechanisms of AI hype and its planetary and social costs. *AI and Ethics, 4*(3), 727-742. doi:10.1007/s43681-024-00461-2

Merchant, B. J. (2025a). The budget bill opens the floodgates for state surveillance tech and bad AI. Retrieved from https://www.bloodinthemachine.com/p/the-budget-bill-opens-the-floodgates

Merchant, B. J. (2025b). Don't forget what Silicon Valley tried to do. Retrieved from https://www.bloodinthemachine.com/p/dont-forget-what-silicon-valley-tried

Nichols, T. P., & Dixon-Román, E. (2024). Platform Governance and Education Policy: Power and Politics in Emerging Edtech Ecologies. *Educational Evaluation and Policy Analysis, 46*(2), 309-328. doi:10.3102/01623737231202469

Noble, D. (1991). *The Classroom Arsenal: Military Research, Information Technology and Public Education*. Oxford: Routledge.

Openo, J. (2024). The Right Relationship Between Teaching and Educational Technology: How Ursula Franklin's Technology as Practice Can Guide SoTL. *The Canadian Journal for the Scholarship of Teaching and Learning, 15*(1). doi:10.5206/cjsotlrcacea.2024.1.15640

Ortegón, C., Williamson, B., & Decuypere, M. (2024). Edtech brokers and evidence governance: knowledge intermediaries in the education technology market. *Globalisation, Societies and Education*, 1-12. doi:10.1080/14767724.2024.2439419

Rajah, J. K., & Kopainsky, B. (2024). A systematic method to integrate co-produced causal loop diagrams based on feedback stories. *System Dynamics Review, 41*(1). doi:10.1002/sdr.1794

Ricaurte, P. (2022). Ethics for the majority world: AI and the question of violence at scale. *Media, Culture & Society, 44*(4), 726-745. doi:10.1177/01634437221099612

Ruiz, N., Gallagher, M., & Najjuma, R. (2025). Postdigital Science and Education and The Majority World. *Postdigital Science and Education*. doi:10.1007/s42438-025-00545-0

Schlosberg, D. (2012). Climate Justice and Capabilities: A Framework for Adaptation Policy. *Ethics & International Affairs, 26*(04), 445-461. doi:10.1017/s0892679412000615

Seger, E., Perry, H., & Hancock, J. (2025). *Epistemic Security 2029: Fortifying the UK's Information Supply Chain to Tackle the Democractic Emergency*. Retrieved from London: https://demos.co.uk/wp-content/uploads/2025/02/Epistemic-Security-2029_accessible.pdf

Selwyn, N. (2023). Lessons to Be Learnt? Education, Techno-solutionism, and Sustainable Development. In *Technology and Sustainable Development* (pp. 71-83).

Selwyn, N., & Facer, K. (2021). *Digital Technology and the Futures of Education - towards non-stupid optimism*. Retrieved from

Selwyn, N., Hillman, T., Bergviken Rensfeldt, A., & Perrotta, C. (2021). Digital Technologies and the Automation of Education — Key Questions and Concerns. *Postdigital Science and Education, 5*(1), 15-24. doi:10.1007/s42438-021-00263-3

Sogaard Jorgensen, P., Jansen, R. E. V., Avila Ortega, D. I., Wang-Erlandsson, L., Donges, J. F., Osterblom, H., . . . Crepin, A. S. (2024). Evolution of the polycrisis: Anthropocene traps that challenge global sustainability. *Philos Trans R Soc Lond B Biol Sci, 379*(1893), 20220261. doi:10.1098/rstb.2022.0261

Spencer, T., & Singh, S. (2025). *Energy and AI*. Retrieved from https://iea.blob.core.windows.net/assets/34eac603-ecf1-464f-b813-2ecceb8f81c2/EnergyandAI.pdf

Tisdall, S. (2025, 6.7.2025). The UN is our best defence against a third world war. As Trump wields the axe, who will save it? *The Guardian*. Retrieved from https://www.theguardian.com/commentisfree/2025/jul/06/the-un-is-our-best-defence-against-a-third-world-war-as-trump-wields-the-axe-who-will-fight-to-save-it

Trabelsi, W. (2025). The Good, the Bad, and the Ugly Science of AI in Education. Retrieved from https://wesstrabelsi.substack.com/p/the-good-the-bad-and-the-ugly-science

Uleman, J. F., Luijten, M., Abdo, W. F., Vyrastekova, J., Gerhardus, A., Runge, J., . . . Verhagen, M. (2024). Triangulation for causal loop diagrams: constructing biopsychosocial models using group model building, literature review, and causal discovery. *npj Complexity, 1*(1). doi:10.1038/s44260-024-00017-9

Watters, A. (2021). *Teaching Machines: The History of Personalized Learning*. Cambridge, Massachusetts: The MIT Press.

Weich, A., & Macgilchrist, F. (Eds.). (2023). *Postdigital Participation in Education: How Contemporary Media Constellations Shape Participation*. Cham, Switzerland: Palgrave.

Williamson, B. (2025). Enumerating AI Effects in Education. Retrieved from https://codeactsineducation.wordpress.com/2025/05/28/enumerating-ai-effects-in-education/