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Digital technology and the futures of education – towards 'non-stupid' optimism

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Abstract

This paper develops a constructively critical perspective on the application of digital technologies in education – what is sometimes referred to as 'educational technology' and 'edtech', which encompasses the use of digital technologies to support teaching, learning and educational work. In particular, we reflect on what can be taken from the past 40 years of initiatives, interventions and policies that have aimed to mobilise digital technologies to change the day-to-day practices of education for students and teachers. This history (alongside recent experiences of pandemic remote schooling) points to the limitations of technology to transform long-standing patterns of educational opportunities and outcomes. Yet, as enthusiasms for the digitisation of education continue in light of emerging AI and virtual education technologies, the paper lays out some foundations for the development of 'non-stupid' optimism about educational technologies. We argue that this requires policy, tech industry and education actors to look beyond the charismatic allure of the 'techno-fix', and instead work toward forms of technology use that can support and sustain the longstanding and hard work of addressing the social and material obstacles to educational and social equalities. If we are concerned to create educational practices that work towards the common good and towards sustainable futures, then our first concern must be to attend to the causes of existing injustices, individualisation and unsustainability and to proceed from there. While digital technology can be an adjunct to this wider work, digital technology alone is not capable of creating sustainable educational futures.

Introduction

Digital technologies are an increasingly prominent feature of contemporary education provision and practice around the world, and are central to the popular imagination of futures of education. The educational significance of digital technologies has been amplified by the widespread take-up of digital education resources during the pandemic. As such, the hope that digital technologies might transform education along expansive and empowering lines is, once again, and despite their uneven history to date, being actively promoted.

In contrast, this paper makes a case for approaching the future potential of educational technology in more circumspect and, we would argue, more realistic ways. It proposes that discussions of education's futures need to move beyond the simplistic idea that digital technology can offer ready solutions to the long-standing problems that continue to blight education. Instead, this paper looks back to lessons that might be learnt from the past 40 years of educational technology (specifically, digital technologies used for teaching and learning and administration) and uses these to develop both signposts and warnings about how these technologies tend in practice to interact with the lived realities of schooling.[1] The paper therefore offers a historically informed counterpoint to the speculative ways in which education and technology is usually discussed by early adopters, advocates and especially vendors of digital 'solutions'.

The paper is based on our joint and separate work in the fields of Educational Technology and Educational Futures since the mid 1990s. One of us (Neil) has been researching and writing around the subject of digital technologies and education since 1995. He has worked in universities in England, Wales and Australia, and conducted numerous empirical research projects on technology use in primary and secondary schools, colleges, universities and informal adult learning. Neil's work on educational technology takes a deliberately critical approach – focusing on the actual experience and 'messy realities' of educational technology use in situ. He has described his approach as focusing on the 'state of the actual' rather than 'state of the art'. One of us (Keri) has

been working on educational futures since 1998 in universities in the UK and Sweden, and at Futurelab, where she led the UK's 'Beyond Current Horizons' foresight programme for education and technology. Keri's work is interdisciplinary, focused on ethnographies of formal and informal learning, as well as design-based, working in partnership with organisations such as the BBC and Microsoft to develop innovative prototypes. In recent years she has been working on the environmental and climate aspects of educational futures and the ethical issues of thinking about long term change in education. This shared 40 year history of empirical study and experimental design, forms the basis for the arguments we are making in this report.

We start with an overview of the main trends, themes and lessons that characterised the use of educational technology from the early 1980s through to the present, before discussing what can be learned from the uneven impacts and outcomes of the recent global pivot to digitally-supported 'remote learning' in the COVID-19 pandemic. We then outline a set of recurring themes that emerge from the past 40 years – the failure of edtech to deliver on its promises to improve learning, address inequalities, and reduce teacher workload, as well as highlighting the unintended wider consequences that emerge with its introduction. We foreground the reality that the impacts of education technology are highly context specific and associated with wider social, economic, political concerns.

We then discuss the ongoing allure of the technological 'fix' in education, and trace how this continues to inform the next generation of edtech promises being made about artificial intelligence, personalised learning and distance education today. We argue that an informed approach to these futures, drawing on the 40 year history of edtech research and practice, suggests four urgent questions to inform their development. We conclude by pointing towards new alliances that might be formed between educators, researchers, policy makers and others interested to create educational technologies that sustain the common good.

These conclusions are not reached in order to advocate for some sort of anti-technology stance. Rather, we hope that this perspective provides a basis for developing forms of education technology use that can *work for* rather than against education as an empowering, equalising force for transformed and sustainable futures. We propose, in other words, a new phase of what we call (after Erica McWilliam) 'non-stupid' optimism about the potential role of technologies in addressing longstanding educational challenges (McWilliam 2005).

Uneven impacts and outcomes – educational technology since the 1980s

Digital technologies have clearly grown to assume a significant presence in education since the 1980s when computers and rudimentary educational software was first introduced into classrooms in a small number of countries. In high-income countries today it is now difficult to imagine learning without laptops, Google and word-processing. Resources such as YouTube and Wikipedia are the first places that many students turn when wanting to discover information and learn new things, and the large majority of schools in these countries are now home to hundreds (if not thousands) of digital devices and display screens. Anything that can be digitized is stored online. Lessons are live-streamed, resources are downloadable, and communications routinely take place through apps and email.

At the same time, education in low-income and middle-income countries has seen increased use of 'm-learning' (mobile learning), e-readers and other digital resources that can support expanded opportunities for educational engagement in communities otherwise lacking reliable traditional educational provision (see Wagner 2018).

These shifts reflect the continuous development of more powerful and cheaper digital technologies, efforts to extend mobile internet access to rural and low income communities, coupled with the sustained efforts of policymakers around the world to develop national 'digital education' strategies over the past 40 years or so. While clear 'digital divides' and inequalities remain in terms of internet access and the ongoing cost of connectivity (ITU 2021), today's education provision is reliant on substantial amounts of digital technology.

That said, the past 40 years has shown that even the most extensively implemented educational technology innovations have mixed and inconsistent outcomes. Counter to the claims that have accompanied successive waves of 'Computer Assisted Instruction', 'Technology Enhanced Learning', virtual classrooms and networked learning, there have been few abrupt 'transformations' or 'revolutions' in terms of the basic tenets of education provision and practice. At best, these technologies have been part of a slow 'evolution' that has seen a loosening of some aspects of education (such as the times and places that education can be accessed), while many other fundamental structures and interests remain unchanged.

Perhaps the most distinct changes to education that digital technologies have been associated with during the past 40 years are ones that are rarely acknowledged in mainstream discussions of educational technology. First, and most notably, digital technologies have been a constituent part of the shift to increasingly standardised forms of education measurement, metricisation and international comparison of teachers' practice – standardisation that has been essential to the production of competitive relationships in education between students, teachers and countries (Facer 2012). Second, edtech' has grown rapidly into a multi-billion dollar industry – supported by extensive venture capital funding, and attracting the involvement of a wide range of companies and commercial interests from outside the traditional education sector (see Williamson & Hogan 2020). All told, it could be argued that the initial hopes of educational technology innovators – often allied to aspirations for more student-led, personalised, democratic educational practices - have rarely transpired on a widescale and/or sustained basis, and have instead been co-opted to drive increasing narrowing of curriculum and practice, and the increased corporate influence over public education provision (Facer 2018).

The 'mixed outcome' of educational technologies thesis that we are proposing here is clearly illustrated by three historical examples that many people still consider to be educational technology success stories. Take, for instance, Seymour Papert's much celebrated LOGO programming language – described by its inventor as destined to 'blow up the school' (Papert 1984). Throughout the 1980s Logo was promoted as a tool to reimagine the ways that children could learn through thinking and solving problems. However, this technology proved an awkward fit with school curricula, with questions soon raised over its claims to stimulate learning and support inclusivity (see Pea 1987, Emihovic & Miller 1988, Ames 2018).

Twenty years later, MIT's audacious 'One Laptop Per Child' initiative oversaw the distribution of millions of notebook computers to low income communities across South America and Africa. This involved the development of a robust small laptop and educational software designed for use by children in middle and low-income countries. Hailed at the time as "open[ing] the world to children in the poorest countries" the eventual impact of OLPC was limited by a range of factors – from its lack of sensitivity to local contexts through to poor maintainability of devices. Tellingly, despite initial promises of creative and active learning, these devices often ended up being used for the passive consumption of online content and games (Ames 2019).

This cycle of 'hype, hope, and disappointment' continued with the rise of 'massive open online courses' (MOOCs) during the early 2010s, promising democratised access to high-quality higher education. These mass participation courses could be taken by tens of thousands of learners around the world for little or no cost. While attracting large numbers of initial participants, completion rates were soon being reported as nearing 5% and of most benefit to those with high levels of prior education (Rohs & Ganz 2015). Concerns over the limited

'broadcast' nature of teaching also contributed to this initial wave of highly accessible, mass participation MOOCs fading from prominence.

It would be unfair, however, to judge these innovations as having 'failed'. While they might not have realised their initial expectations, all these technologies are associated with subsequent developments and longer-term shifts – many of which were not necessarily anticipated at the time. For example, Logo led to a succession of widely-used introductory programming applications – not least the successful Scratch, as well as fostering the 'constructivist' learning principles that underpin Maker technologies, Microbit and Minecraft. Elsewhere, the OLPC initiative led to the wider production and take-up of low-cost 'netbook' computers in the 2000s, accelerated the development of language-free interfaces, and established educational technology as a policy priority in many low and middle-income countries. Similarly, MOOCs continue to be a popular form of education provision – especially in terms of paid-for work-related courses and university-level provision from the likes of Udemy, EdX, Coursera and Outlier. While diverging considerably from their initial mass inclusive philosophy, MOOCs arguably popularised the idea of online learning in university and workplace sectors.

In their own ways, then, the spirit of Logo, OLPC and MOOCs lives on in subsequent education technologies. These were not worthless interventions, but neither were they as effective and transformatory as was widely claimed at the time. Notably, their promise to overcome profound social and economic inequalities through technology access and provision alone, remains unfulfilled. Similar stories can be told of the many other less-sophisticated and less-celebrated educational technologies that have come and gone since the 1980s.

One of the main lessons that can be taken from the 40 year history of these various technological developments is that education change and improvement is iterative, inconsistent, and rarely predictable.

Uneven impacts and outcomes – recent lessons from COVID-19 remote schooling

The inconsistent and uneven outcomes of technology-based education has been brought sharply into focus by ongoing responses to the COVID-19 pandemic as countries attempt to enact forms of 'remote schooling' where children and young people can maintain some continuity of educational engagement away from their usual face-to-face classrooms. This abrupt rupture in education provision has highlighted both the capabilities *and* limitations of digital education. For instance, in countries from Europe to India emergency forms of 'temporary distance education' (Welner 2020) have been enacted – making use of families' own digital devices, along with schools' learning platforms and various other educational apps and software. These official provisions have been bolstered by innovative informal uses of digital technology, as individual teachers and families have improvised with popular social media platforms to ensure the continuation of schooling throughout successive lockdown periods (Selwyn 2020, Bubb & Jones 2020).

Yet, these school shutdowns have also foregrounded the continued problem of unequal access to digital devices and online connectivity both within and between countries. Indeed, many middle-income and low-income countries have opted to rely on non-digital strategies to ensure a continuity of education across their populations of children and young people. As the UN's 'SDG Goals 2020' report highlighted a few months into the pandemic, "remote learning remains out-of-reach for at least 500 million students". Indeed, subsequent UNICEF Innocenti (2020) survey data from 127 countries during the first wave of school shutdowns of 2020 found television to be the most-used medium of education provision (75%), supported by radio (58%) and take-

home resource packages such as books and worksheets (48%). This offers a timely reminder of the broad scope of 'pre-digital' educational technology – with educational radio stemming back to the 1920s and the establishment of 'Schools of the Air' (Cuban 1986). At the same time, it is important to note that even these analogue technologies did little during the pandemic to disrupt existing patterns of educational exclusion, with UNESCO (2020: 16) reporting that:

> While 55% of low-income countries opted for online distance learning in primary and secondary education, only 12% of households in least developed countries have internet access at home. Even low-technology approaches cannot ensure learning continuity. Among the poorest 20% of households, just 7% owned a radio in Ethiopia and none owned a television. Overall, about 40% of low- and lower-middle-income countries have not supported learners at risk of exclusion.

Similarly, many high-income countries have also found themselves having to rely on supplementary non-digital approaches to support repeated periods of school lockdowns – for example, turning to television broadcasts of educational materials to ensure population-wide access to remote schooling. This reflects the persistence in even the most well-resourced countries of enduring 'digital divides' that leave many low income families lacking the basic access to devices and internet connectivity required to access digital learning materials at home and, where such access exists, lacking the personal ownership as well as quiet space and time needed to create supportive learning environments.

The COVID pandemic also highlighted 'second order' inequalities in the nature and form of education that can be enacted through primarily digital channels. Concerns have been raised about the quality of teaching and learning that has been possible through online remote education, alongside pronounced 'learning loss' amongst low-income and other disadvantaged groups, coupled with the considerable psychosocial demands of sustained online study (Engzell *et al*. 2020, Kuhfeld *et al*. 2020). In short, while digital technologies have played a key role in sustaining basic forms of education in many high income countries during the COVID-19 pandemic, this has proved to have been a decidedly limited form of schooling.

What we know about technology and education – recurring themes from the past 40 years

So, while many parts of the world now boast education systems that are replete with devices and multi-billion dollar edtech industries, there are a number of recurring conclusions to be drawn from the past 40 years' history of technology in education.

i) Digital technology alone does not transform education

The headline trend that is often overlooked is the lack of substantial change – or, more accurately, the persistence of fundamental structures, and inequalities that have characterised mass education provision (for better and worse) since the mid-twentieth century. For example, despite talk of 'computers blowing up the school' and mass-scale 'open' learning, the main institutional structures of education have remained relatively intact over the past 40 years – even amid the substantial disruption of the pandemic. Schools, colleges and universities continue to be dominant providers of compulsory and post-compulsory education, and long-established face-to-face classroom routines continue. Education at all levels continues to be shaped by matters

of curriculum, assessment and work-related skills. Despite the increasing visibility of digital devices and online systems, the essence of traditional education forms remain intact.

This 'business as usual' scenario fuels the accusation by some proponents of edtech that schools and universities are out-dated and 'broken' – relics of industrial-era societies. Yet this 'inertia' that appears to persist within many areas of education is both more complicated and may indeed be more rational, than this argument suggests. Indeed, it may derive from at least some of the following interlocking observations that emerge when we examine the history of educational technology to date.

ii) Digital technology does not improve learning

While there are many theoretical explanations of possible learning benefits arising from digital technology use, there is little robust evidence that technology use leads to sustained 'improvements' in learning independent of teacher and other contextual effects. Instead, most researchers agree that pinpointing discernible 'cause-and-effect' relationships between technology use and learning gains is difficult, if not impossible. In short, learning is an imprecise process that is subject to a variety of influences. It is therefore not possible to say that X technology leads to Y learning gains without taking a lot of other factors into account.

Indeed, those researchers who have attempted to pinpoint causal effects of technology use on learning tend to reach inconclusive findings. On one hand, a number of large-scale studies conclude that technology use is sometimes associated with modest improvements in learning performance (e.g. Chauchan 2017). On the other hand, a number of 'meta-analyses' find no difference, or even negative relationships (e.g. Kulik and Fletcher 2016; Clark *et al.* 2016; Setren *et al.* 2019). As a review of meta-analyses between from the 1990s and 2000s concluded: 'the correlational and experimental evidence does not offer a convincing case for the general impact of digital technology on learning' (Higgins *et al.* 2012: 3).

iii) Digital technology does not fix inequalities

Educational technologies are often heralded as addressing and reducing social inequalities. Sometimes these expectations are hugely ambitious – such as the OLPC claim to bring high-quality education to the world's poorest communities. Often these expectations aim to address long-standing inequalities in terms of people's ability to access education opportunities – as reflected in the hopes that MOOCs could offer access to university-level tuition regardless of individual circumstance or location. Other instances aim to 'level-up' educational outcomes – such as learning gains, exam scores, or progression into employment.

While well-intentioned, research tends to find a recurring tendency for these technological interventions to benefit most those who are already engaged and advantaged (Tewathia *et al.* 2020, Eynon & Malmberg 2021). In other words, while digital technologies might increase opportunities for individuals who are well-resourced, motivated and already-educated, such benefits tend to be experienced unevenly across wider populations. This has clearly been the case in terms of the divergent ways that digital technologies have supported 'remote learning' during COVID school shutdowns amongst different socio-economic groups (Greenhow *et al*. 2021, Robinson *et al.* 2020). In this sense, regardless of technical sophistication or apparent ubiquity of adoption, technology use in education remains subject to and often reproductive of a range of persistent and pernicious inequalities.

iv) Digital technology does not alleviate teachers' work

Another common claim is that technology can support education professionals – allowing teachers to achieve more in less time, and freeing them up from tasks that are repetitive, time-consuming and otherwise unappealing, and allowing them to concentrate on high-level teaching. The promise here is one of effectiveness and efficiency – with digital technologies doing much of the 'heavy lifting' of teachers' work. In reality, there is growing empirical evidence that digital technologies tend to augment and exacerbate teachers' workloads – extending working hours into what might previously be considered 'leisure time', and intensifying the amounts of work expected to be done (Selwyn *et al*. 2017, Pollock & Hauseman 2018). Seemingly 'automated' and 'data-driven' processes actually require considerable amounts of behind-the-scenes work from teachers in order to ensure the continued functioning of systems, as well as the production of data and other inputs (Selwyn 2021, Grant 2017 & forthcoming). In short, digital technologies are often a source of longer working hours, role expansion, increased non-teaching and administrative duties, and increased accountability – adding to the increased demands now being placed on teachers (Fitzgerald *et al*. 2019)

Alongside increased volumes of work, are concerns over the diminished nature of teachers' work. A key trend over the past 40 years have been the use of technology to support the disaggregation of teachers' work into smaller discrete tasks (Apple & Junck 1992, Gallagher 2019) – what has recently been referred to as 'unbundling'. In theory, the unbundling of teachers' work means that tasks can be shared between different people and/or automated through technology. While this breaking-up of work might appear beneficial, it hastens a deprofessionalization of teaching - fragmenting jobs into disconnected work processes that require little conceptual ability. All told, the role of digital technology in diminishing teachers' professional autonomy and expertise remains a key concern.

v) Digital technology use often results in broad consequences that stretch beyond matters of 'learning'

These previously described issues highlight the fact that the outcomes of technology use in education are certainly not consistent. Furthermore, any intended 'learning' outcomes of technology use will be accompanied by other consequences and side-effects – many of which are largely unacknowledged in discussions of technology and education. This is certainly the case in terms of trends for technology use to widen inequalities between already-advantaged individuals and those from more vulnerable backgrounds, or technology increasing teachers' workloads and diminishing their professional expertise.

Often these accompanying outcomes can be subtle. Take, for example, recent trends in online teaching to narrow educational content and teaching styles to fit the technologies being used – such as the trend for YouTube-friendly eight-minute video lectures or online quizzes. At the same time, the increased use of digital technology is often also linked to other issues far beyond immediate concerns of the individual student or classroom – such as the data protection implications of student data being sold to third parties. Indeed, the intentions of software vendors and system providers are often driven by non-educational concerns related to commercial profit-driven imperatives or technological-efficiencies. All told, even when it seems clear what educational technology use is supposed to achieve, it is important to pay attention to other consequences that also result (Krutka *et al*. 2021, Tawfik *et al.* 2016).

vi) Any 'impacts' are context specific and tied with socio-technical factors

Above all, these previously highlighted issues reflect the underpinning point that educational changes associated with digital technologies are not essential properties of the technology *per se*. While this observation holds true of technology use in any aspect of society, it remains especially relevant to discussions of technology use in

educational contexts. Many of the 'outcomes' and 'effects' of technologies in education are influenced heavily by the local contexts and cultures that these technologies are used in. In this sense, any outcomes of digital technology use in education are certainly not consistent, and there is no 'one-size-fits-all' way that technology should be used in education.

Alternately, as described earlier, sophisticated educational technology interventions such as OLPC have ultimately fallen short in terms of their lack of contextual appropriateness and 'fit' with local cultures. For example, as studies by the likes of Morgan Ames (2019) and Christo Sims (2017) have shown, edtech innovators and developers can often be led by cultural assumptions that fit more closely with North American 'tech culture' than the local social and cultural conditions in which their products are being used. Sims contends that, as a result, edtech interventions can often mis-construe (and often under-estimate) the education 'problems' that they have identified because they approach education through a technical mind-set - leading to a 'tunnel vision' where attention is only paid to aspects of education that fit with the tools that are being developed and the personal educational experiences of those that are developing them. As such, it is important not to treat digital technology as somehow separate from the social, economic, political, cultural and historical conditions that it is developed, produced and used within. Instead, digital technology use in education needs to be understood along 'sociotechnical' lines. As Thomas Hughes (1983: 1) put it, this is the idea that "technological affairs contain a rich texture of technical matters, scientific laws, economic principles, political forces, and social concerns".

In summary, what the last 40 years has taught us is *that hoping that technology alone will address education's fundamental challenges is as unrealistic as it is inefficient*. Continuing this approach is likely to result in technical 'solutions' that produce only uneven results – often dealing only with the surface manifestations of a problem rather than its roots. In short, it makes no sense to assume that future social issues surrounding education are easily 'fixable' via technology. This is not to argue that digital technology has no place in how we imagine education futures. On the contrary, digital technology can play an important supporting role in education improvement. And indeed, technologies and their social uptake will change the conditions within which education is operating and potentially some of the capabilities that students might develop. Nevertheless, it needs to be reiterated that we now have the evidence that technology itself is rarely the primary (or leading) part of any educational improvement.

Resisting the allure of the technological 'fix' to educational problems

Despite these lessons from the past 40 years, the appeal of digital technologies as a simple solution to long term educational challenges remains strong. And indeed, with each new technology there remains the hope that 'this time' the tools will be different and so the promises will be realised. There is, in other words, an enduring attraction for educationalists and policymakers of the 'technical fix' - i.e. attempts to use the 'power' of digital technology in order to solve problems that are non-technological in nature (Robins and Webster 1989). This desire goes deep: in many industrialised regions a cultural faith in technology as a corrective to societal issues stems back to the development of nuclear power, space technology and other innovations of the Cold War period (Johnson 2018). More recently, the development of online technologies has prompted a pernicious 'technological solutionism' – where digital technology alone is seen as capable of managing and solving long-standing societal problems in innovative ways (Morozov 2013). Recently, Meredith Broussard (2019) extended this logic into what she described as a prevailing 'technological chauvinism' – where digital technology is assumed to be a default response to any problem.

Attention to, and understanding of, this desire for the technical fix is particularly important at the present moment as education is beginning to encounter a new wave of what Morgan Ames (2019) calls 'charismatic technology' – technologies that promise impressive technical progress allied to far reaching social progress. In particular, emerging AI and virtual education technologies are the latest in the long line of technologies to raise hopes that seemingly entrenched problems might perhaps be overcome with the judicious application of appropriate technologies. At the same time, given the establishment of device-based learning as a 'new normal' for many countries during the pandemic, policymakers and leaders are perhaps feeling obliged to continue to view education along such technology-centred lines.

This continued willingness to turn to technology as a ready way of overcoming educational problems is understandable; after all, the alternative, a recognition of the profound educational, economic and social challenges both within and between countries, a recognition of the importance of investment in high quality teaching and schools, a grappling with the issues of epistemic inequalities and historical injustices, seems daunting compared with the promises of edtech entrepreneurs. However, *it is no longer acceptable to turn to education technology naïvely and without recognition of the mixed outcomes of the past.* As our previous instances of technology use in education suggest (from Logo to COVID remote schooling) a 'technology-first' mindset is not a helpful way to address the question of how digital technologies might usefully play a part in establishing more equitable, responsive and sustainable forms of education.

In other words, while the promise of large-scale technological change will undoubtedly persist – particularly amongst policymakers and education leaders under pressure to be seen to 'do something', and fearful of appearing out-of-touch or perhaps anti-innovation – those concerned with creating plausible and ethical scenarios of the futures of education must resist the allure of the 'technical fix'. This is particularly the case as we examine the next generation of edtech promises.

New enthusiasms: the next generation of edtech promises

The 2020s are so far proving to be characterised by continued talk of digital technologies as "ready-made, top down solutions" (Teräs et al 2020). For example, prominent calls are being made to treat COVID remote schooling as a 'tipping point' after which the continued post-pandemic expansion of online learning will provide "unprecedented opportunity to transform education across whole systems" (Fullan *et al*. 2020: 2). Similarly, enthusiasm is growing for the application of AI technology to education. As Microsoft's Dan Ayoub (2020: n.p) speculates:

> AI is a major influence on the state of education today, and the implications are huge. AI has the potential to transform how our education system operates, heighten the competitiveness of institutions, and empower teachers and learners of all abilities

These enthusiasms are predicated around three distinct forms of emerging educational technologies.

First we are seeing the emergence of a raft of post-COVID forms of *technology-based reconfigurations of face-to-face schooling*. Alongside the continued adoption of 'learning management systems' to facilitate the sharing of resources and group communication, are growing institutional enthusiasms for 'blended', 'hybrid' and 'hyflex' approaches that involve teaching to be hosted (at least partially) online. Also of note are online social learning platforms (such as Noon Academy), where young people can study together outside of school and be assessed against each other. The shift to remote learning is often associated with the complete relocation of education

provision to for-profit platforms – as illustrated by online tutoring platforms catering for additional after-school tuition such as GSX and OutSchool. That said, as students around the world gradually return to face-to-face schooling, interest is growing in the potential of mainstream shifts over to combined classroom and online provision.

Second, is the continued rise of *personalised (or more accurately individualised) learning systems* designed to direct individual students' engagement with online learning resources through the use of sophisticated data-driven analytics to guide student decision-making. Here, each student is claimed to benefit from the vast quantities of data being analysed – reckoned by some vendors to give these systems the capability to know more about any individual's learning than a 'real-life' teacher could ever hope.

Third, is a range of *other forms of AI-driven technology* – mostly designed to support automated decision making for institutions, teachers and students. This includes system-wide 'automated education governance' based on AI-driven modelling (Gulson and Witzenberger 2020), and institution-specific use of AI-driven recruitment, procurement and predictive 'business analytics' (Yates and Chamberlin 2017). Alongside these institutional forms of AI, a number of other AI-driven technologies are also now available to take on tasks that previously would have been carried out by teachers. This includes live facial and neurological detection systems to monitor students' attention levels and emotional states, as well as AI-based 'language stylometrics' and automated essay assessment – so called 'robo-grading'.

Advocates for these technologies promise:

- **Education efficiencies.** These are technologies that promise to lead to cost-efficiencies, time-saving and speeding-up of education processes, and a general avoidance of institutional inertia. Automated technologies promise to achieve greater efficiencies by reducing (or removing) the number of 'humans in the loop'

- **'Precision' education:** These are technologies that promise to tailor educational interventions around an individual's personal needs and characteristics which are often gleaned from personal data. This precision also offers a basis for prediction – foreseeing likely development and progress, and altering actions accordingly.

- **Differentiation of learning:** These are technologies that promise to support varied forms of learning that best fit an individual's needs. This is one of the key aspects of 'personalised learning' technologies – i.e. the notion that individuals are best placed to alter and 'self-regulate' their own learning in light of feedback from machines.

- **Enhanced 'insight' and 'knowing':** These are technologies that promise to offer insights into otherwise unseen and unknowable aspects of education. 'Always-on' monitoring and comprehensive data collection raise the prospect of being able to know everything – what Andrejevic (2020) describes as a logic of 'framelessness'.

- **Seamless eradication of inequalities:** These are technologies that are presented as a means (through efficiencies) to 'level the playing field' for all children, overcoming barriers of distance, of lack of professional teachers and of access to resources.

As with previous 'waves' of edtech innovation, these charismatic appeals are being accompanied by a predictable increase in commercial activity and claims for transformative impacts. More immediately, the pandemic pivot to online teaching has mobilised and extended the commercial marketplace for digital education provision – what Williamson and Hogan (2020, p.1) describe as "positioning educational technology as an integral component of education globally, bringing private sector and commercial organisations into the centre of essential educational services".

Elsewhere, it has been estimated that the global market for AI products in education is set to expand from $1.1 billion in 2019 to $25.7 billion by 2030. At the same time, developers and vendors of AI systems are already claiming impressive learning gains, as adaptive learning software begins to be taken up across school systems. The implementation of the Century AI platform in over 700 Belgian schools, for example, has also been accompanied by claims to boost learning levels by 30% and reduce weekly teacher work by six hours. In China, Squirrel AI (2021) claim its intelligent learning adaptive system boosts student learning levels in poor rural communities beyond the average performance of more advantaged groups after one month of use. While no independent research is available to verify such claims, such promises are understandably appealing to educators and parents alike.

In turn, these agendas have begun to be taken up by policymakers facing various challenges to improve and reform education systems. We are seeing increased national and supranational interest in AI and education, in particular in China (Yang, 2019; Hao, 2019). In light of the pandemic, we are seeing similar commitments to continuing online education provision. For example, in some areas of India it is anticipated that significant proportions of students will continue with online schooling even after the (re)commencement of face-to-face schooling (Indian Express 2021). In the state of New York, a taskforce "to develop a blueprint to reimagine education in the new normal" was established a few months into the pandemic to initiate a permanent switch-over to sophisticated 'remote learning' across the state education system. As Governor Andrew Cuomo put it:

> The old model of everybody goes and sits in a classroom and the teacher is in front of that classroom, and teaches that class, and you do that all across the city, all across the state, all these buildings, all these physical classrooms … why, with all the technology you have? … It's hard to change the status quo. But you get moments in history where people say, 'OK I'm ready. I'm ready for change. I get it'. I think this is one of those moments (Cuomo 2020)

Digital technology and education futures – key questions and challenges

In assessing the potential role and impact of this next wave of educational technology, the non-naïve educational policy maker, mindful of the mixed outcomes of previous interventions, might therefore ask a range of important, but often overlooked, questions:

- How might these emerging technologies interact with the existing social contexts of education?
- What assumptions about learning and teaching processes drive these technologies, and what forms of learning will therefore be valued or ignored? What evidence is there to support their impact on learning?

- What non-educational consequences might result from these technologies – especially in terms of inequalities, impact on teachers' work, or other ways of altering the character and conditions of education?

In short, the experienced policy maker in this area will ask: what is missing from celebratory accounts of emerging technologies and education futures? They may also and quite reasonably, proceed from the assumption that the proposed forms of digital education might not be conducive to fulfilling the goal, for example, of creating an educational system that 'can contribute to the common good of humanity'.

Indeed, there are (at least) three longstanding issues familiar from earlier generations of edtech, alongside one new emerging challenge, that require consideration as the judicious policymaker examines potential trajectories for the new educational technologies in development. All of these threaten to impede the achievement of the SDG4 goal to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'.

1. The exacerbation of social inequalities

First and foremost, it seems sensible for any discussion of the next generation of educational technology to anticipate the continuation of various forms of digital divide and digital inequality given the existing and continuing social and economic inequalities into which such tools will be introduced. In these conditions, the emerging forms of educational technology just outlined look set to continue to advantage those who are already relatively well-resourced, well-educated and otherwise advantaged. Even as basic levels of digital technology use increase across populations, significant disparities remain in terms of the individuals, households and communities that are sufficiently 'connected'. For example, significant variations persist in terms of what is practically achievable with poor-quality devices, limited connectivity, and other constraints on how people are actually able to engage with technology. In this sense, there is little reason to expect emerging forms of AI-driven education and digitally-based provision to overcome pre-existing inequalities and disadvantage. Instead, moving education over to data-driven and individualised digital forms runs the risk of advantaging those who were already advantaged. While digital education might *increase* the education participation of these already privileged classes, it does not usually result in a *widening* of education participation to others who were previously not engaged, much less equipping low income groups to systematically and substantively address existing educational inequalities.

In addition, there are new concerns distinctive to this new generation of tools. For example, enthusiasm for educational AI are tempered by the ways in which AI and algorithmic systems exacerbate discriminatory decision-making in favour of those social groups most represented in the systems' datasets (Noble 2018, Eubanks 2017). It is also increasingly argued that the emphasis placed on categorisation and labelling within AI systems renders some individuals (who do not fit easily into norms) '*hypervisible*' to education systems oriented towards sorting and discipline. Conversely, the same individuals are rendered *invisible* to education systems oriented towards reward and progression – what Mary Madden (2019) describes as a 'double-down effect' that marginalised groups can experience in datafied systems. All told, the chances of already disadvantaged groups being mis-represented within AI-driven education are high. The increased presence of AI in education, then, not only risks intensifying existing inequalities in education but introducing new ways to (dis)advantage some groups of students and teachers over others.

This raises a challenge: *how can we reimagine forms of technology use in education that are explicitly designed to address issues of equity, diversity and overcoming disadvantage?*

2. Threats to education as a global commons

One of the dominant logics implicit in the emerging forms of digital education just outlined is the reorganisation of education around the needs, interests and circumstances of individuals rather than groups, classes or communities.

The logic of individualised learning works well for some individuals – i.e. those who are already well-educated, well-resourced, and without constraining life circumstances – what Tressie McMillan Cottom (2016) terms 'the roaming autodidacts'. The logic of individualising learning also fits with currently fashionable ideas of 'self-directed', 'self-organised' and 'self-regulated' learning. The promise of drawing on technology to provide bespoke educational opportunities that fit the needs and circumstances of different individuals is understandably appealing. However, these modes of engagement run the risk of exacerbating inequalities (as previously described), as well as undermining both the educational and social gains of education understood as a collective, communal endeavour. Learning is fundamentally not an individual activity - it requires encounters with others, engagement with difference and challenging ideas, and the development of the capacity to learn in and as part of a society. The significant and now well-documented 'learning losses' and social impairments arising from the closure of schools during the pandemic, provide a robust case for the limits of individualised learning.

Indeed, the idea of recasting educational engagement as a digitally-enabled individualised pursuit is to accept a particular set of conditions that shape learning along narrow lines – what might be described as a 'cyber-libertarianism' (Dahlberg 2017) based around individual freedoms and the notion of education as a private good that is only of personal benefit. Reorienting education around the individualised forms of digital systems, platforms and applications that we currently have is to accept a set of values and conditions that are likely to bump up against other ambitions and values for rethinking education as a form of genuinely 'public' education that is community-based, communally-experienced and of collective benefit.

Clearly, there are tensions here in terms of the overwhelming commercial production of digital hardware and private ownership of digital infrastructure – the core platforms, data centres and other foundational assets and services that constitute digital technologies. There are also tensions in terms of the dominant forms of 'digital capitalism' and 'data economy' that have recently come to the fore. Nevertheless, promising publicly-shared democratic alternatives exist – such as movements focused on platform cooperatives, knowledge commons models, data trusts and similar (Scholz 2019, Glass 2018).

This raises a challenge: *how can we reimagine forms of technology engagement in education that are founded upon values of collectivity, community and conviviality?*

3. Eradicating the professional expert teacher

The next generation of educational technologies oriented towards individualised encounters with 'intelligent' and 'responsive' information systems reproduces a long-standing trope in visions of future education – namely, the potential of creating technology-driven education that does away with the need for the oversight of expert professional teachers. While few people anticipate these technologies doing away with the need for human supervision altogether, there is a growing feeling that highly-trained, well-salaried professional teachers might no longer be required to oversee these processes. Instead, AI-driven classroom technology could well usher in an era of deprofessionalisation – where 'teachers' assume the role of technology steward and assistant. Emerging forms of AI-driven technology certainly imply a considerable challenge to traditional notions of what a 'teacher' is. The rate of technological development over the past thirty years or so, means that the notion of the

professional expert teacher leading a classroom is no longer beyond reproach (see Edwards & Cheok 2018, Selwyn 2019).

Indeed, there is no doubt that in countries and situations where professional teachers are few and far between these appeals are alluring. Equally in situations where evidence remains of systematic bias and inequalities in teacher judgement, the appeal of a 'neutral' digital education system offers some attractions. Such future visions, however, mistake the relatively limited forms of decision-making offered by 'artificial' intelligence's analysis of digital inputs with the multidimensional and holistic knowledge and relationships offered by human encounters. They also mistakenly assume that the tools being proposed are indeed neutral rather than the products of specific (always partial) human design decisions. And finally, they ignore the evidence that teachers are essential to any learning gains or impacts that technologies might offer. To look to these tools to displace teachers, then, risks underpinning a strategy of human-focused education for the well-resourced and machine-supported learning for the rest, and a replacement of absent teachers and human (accountable) flaws with the invisible judgements of algorithms.

This is not to suggest that the role of the teacher will remain the same, however. The potential for the rapid analysis of large amounts of digital information, for building on that information with useful feedback, of course offers useful resources for both students and teachers. It is to suggest, however that the pursuit of technology-first education at the expense of professional expert educators is the wrong one.

This raises a challenge: *how can we reimagine forms of technology use in education that are explicitly designed to work alongside and enhance the resources available to professional teachers rather than seeking to deprofessionalise and displace them?*

4. Issues of un-sustainability and environmental costs

Finally, a new question needs to be asked today about the relationship between edtech and the broader sustainability goals which global educational futures need to consider. As education reorients around not only care for the individual, but for their role in a fragile biosphere, the environmental impacts of educational technologies now require urgent and renewed attention.

Some educational technologies promote the possible environmental benefits of expanded digital technology use – for example, lowering emissions of students otherwise travelling to classes (Versteijlen *et al*. 2017) as well as reducing on-campus power consumption (Caird *et al*. 2015). At present, however, ambitions for the massively increased global use of online, data-driven and AI technologies in education are dependent on unsustainable levels of energy and natural resource consumption. This includes the "dirty material origins and processes" of digital hardware production (Miller 2015), the vast energy requirements of data-processing and data storage, and the growing problem of e-waste associated with the increased use of digital devices and screen-based education. It is reckoned that training a typical machine learning model emits the equivalent of around 300,000 kg of carbon dioxide - comparable to the lifetime carbon emissions of five cars (Strubell *et al*. 2019). All told, digital education is founded on a technology industry that has an 'explosive' footprint in terms of global greenhouse gas emissions – a trend that is set to increase in an 'alarming' manner over the next few decades (Belkhir and Elmeligi 2018). There is then, the very real prospect that future forms of remote, individualised and automated education might be curtailed by: (i) awareness of their increasing role in the ongoing depletion of natural resources, and (ii) attention to the unsustainable energy demands arising from the production and consumption of digital resources.

These issues raise a fundamental challenge: *how can new approaches be developed that prioritise essential rather than profligate educational uses of technology, and how might these be achieved in more environmentally sustainable ways?*

Conclusion: towards non-stupid optimism for educational technologies

In this paper we have laid some foundations for the development of 'non-stupid' optimism about educational technologies. Theses foundations imply first, a recognition of what we have learned from the past, namely:

1. That digital technologies alone do not transform education
2. That digital technologies do not improve learning
3. That digital technologies do not fix inequalities
4. That digital technologies do not alleviate teachers work
5. That there are unintended consequences of digital technology use in education that are impossible to predict and that stretch far beyond matters of learning; and
6. That any 'impacts' are context specific and tied with socio-technical factors

These limitations notwithstanding, we have also recognised that there is a persistent and charismatic allure to the introduction of technology in education, one that promises that we can overcome longstanding problems with the application of a 'techno-fix'. This allure encourages us to pursue the dream of a hyper efficient technological future rather than committing to the longstanding and hard work of addressing the social and material obstacles to educational and social equalities.

If we are concerned to create educational practices that work towards the common good and towards sustainable futures, then, our first concern must be to attend to the causes of existing injustices, individualisation and unsustainability and to proceed from there.

In this initiative, however, there is no doubt that new tools may offer some assistance. They may open up different ways of doing and thinking, working and learning. The future is, of course, not the past. Understanding the potential of emerging technologies to play a role in building sustainable futures, however, requires addressing our thinking and our experimentation to the four challenges we have outlined:

- *Directing technology use in education towards recognising and addressing issues of equity, diversity and overcoming disadvantage, as well as the potential for these tools to themselves produce and reproduce such disadvantage*
- *Supporting the development of technologies that are organised around the recognition of the role of collectivity, community and conviviality both as an essential feature of education and as a core component of educational purpose*
- *Envisaging the end-users of educational technologies not as the isolated lone student, but as professional teachers and students using these tools to complement rather than replace their other ways of knowing*
- *Assessing precisely when and where edtech – and its material and carbon costs – are essential to education (and where not) and ensuring the lightest environmental footprint possible of such educational uses.*

Just as the past 40 years have seen the development of a robust body of research in the field of educational technology, so too has the study of scientific and technological innovation progressed. A critical feature of these studies is their insight that the envisaged 'end-user' of the tools fundamentally shapes the design of new technologies. At present, the educational imagination for edtech is premised around the charismatic allure of efficiency, precision, individualisation and the search for the total knowledge of the child, irrespective of the environmental and educational costs of such an approach.

Our analysis of the history of digital technologies in education is that this imagination, focused on the disembodied learner, separated from her communities and from the existing material conditions of her education, at best, will produce mixed outcomes. At worst, it can cause significant intensification of educational inequalities. A new approach is required - one that operates with a different imagination that foregrounds and envisages students and teachers as working in highly divergent, socially and contextually situated learning spaces, and where the tools will have their value precisely in their mobilisation and practice, not despite them.

This approach foregrounds the fact that any educational technology is only one, necessarily flawed and highly unpredictable, resource in the much wider range of strategies that are open both to teachers and to educational policymakers seeking to create sustainable educational futures. In short, recognising that education is a highly situated, contextual, human and unpredictable endeavour provides a much more secure basis for educational decision-making than the fantasy of futures of universal digital efficiencies, transformations, and disruptions.

Notes

[1] This paper focuses on the application of digital technologies in education – what is sometimes referred to as 'educational technology' and 'edtech', which encompasses the use of digital technologies to support teaching, learning and educational work. Of course, the growing impact of digital technology across society also has broader implications for education. For example, new technologies will necessarily interact with other social, economic and environmental developments to change the conditions in which education is conducted. New technologies will also raise profound economic, political and technical questions that may demand new educational goals, and they will offer new ethical challenges, from data privacy and surveillance to the capacity for human autonomy. These wider questions are addressed elsewhere in other background papers and materials prepared for UNESCO's Futures of Education initiative.

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