The Pandemic and the Platformization of Education

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Overview

Technology in education is no magic fix. Many educators believe it has unleashed a Pandora's box of problems, affecting the education system at large, starting from the classroom. Instead of fostering critical thinking and creativity, technology often encourages passive content consumption, weakens teacher autonomy, and reduces both teachers' and students' control over learning. It also distorts curriculum, pedagogy, and assessment while straining teacher-student relationships and learning environments.

Moreover, EdTech can undermine institutional autonomy and weaken the education system's role in promoting progressive societal aims. The COVID-19 pandemic heightened the role of technology in all sectors, EdTech being the tragic outcome of this process in education. The crisis has deepened with the rise of artificial intelligence (AI) and opaque 'black box' algorithms that further erode teacher agency, atomize teaching-learning processes, and leave students and teachers vulnerable to surveillance, data harvesting, and manipulation.

However, this crisis is not inevitable—it is a function of its political and pedagogical design. This paper by Gurumurthy Kasinathan, published in the Southern African Review of Education Journal's special issue 'Researching, Teaching and Learning During Times of Crises: Experiences of the Global South', argues that for technology to truly serve the highest goals of education and teachers to exercise their agency towards a meaningful pedagogic design of EdTech, public ownership and control are imperative. If proprietary EdTech can be regulated and a public EdTech ecosystem (comprising public production, distribution, and appropriation of EdTech) seen as an integral part of the public provisioning of education, the crisis can be averted. Free and open digital tech movements have been independently working to enable such public ownership, and this needs to be mainstreamed into EdTech. The paper provides the example of Kerala, a state in South India, which has developed a public EdTech ecosystem over the last two decades, enabling it to avert the EdTech crisis, and ensuring that it was less affected during the pandemic.

Historical Perspective of Technology

As a complex activity, education has always used various technologies. Information and communications technologies (ICTs), a subset of technologies that deal with information processing and communication processes, impact education widely and deeply because they are key to teaching and learning. Every successive ICT has transformed educational processes and systems. The invention of language ICT made formal education possible. Language is so foundational to education that all concept learning can be seen as learning the language of the discipline (Postman, 2009). The invention of script allowed asynchronous learning through texts, transcending space and time constraints for education. Print technologies enabled mass schooling; radio and TV have enabled mass instruction (and successful propaganda) through broadcast.

The digitization of information has led to an information explosion and the access, creation, storage, and dissemination of data (in multiple formats—text, image, audio and video) has become cheaper and easier. This has created an 'information society'. Digital networks have made communication cheaper and easier, creating a 'network society' (Castells, 2010). 'Digital society' and 'digital economy' are now often used to signify society and economy.

Over this millennium, technology (tech) in education (EdTech)[1] has impacted the processes and structures of education; the brick-and-mortar education system is now seen as belonging to the obsolete industrial society paradigm (Gilbert, 2009). In this new information society paradigm, it is argued that learning need not be limited by space and time—it can happen anywhere and at any time, provided one has a digital device and connectivity. Where good teachers are unavailable or unwilling to go, tech can provide e-content directly to the learner, facilitate self-learning, and render the intermediary (teacher) unnecessary (Scherer, 2012). Learning resources and paths can be customized for each learner, enabling what is referred to as personalized learning. Tech can connect learners synchronously and asynchronously for peer learning and sharing. No wonder many tech enthusiasts, tech manufacturers, education administrators, and even teachers believe that EdTech is the biggest game changer in delivering quality education to all. Towards this, it is widely accepted that corporates must be allowed to provide EdTech services because only private sector innovation can produce tech for education. Education systems gravitate towards corporate entities like Alphabet and Microsoft for EdTech solutions. The education bureaucracy's exploration of EdTech usually begins by comparing the products of these and other corporations and then choosing what they consider most appropriate.

This paper argues that EdTech cannot replace the school or the teacher, but it can be appropriated to support progressive education. It can play a key role in teachers' continuing professional development (CPD), help prepare teachers for diverse contexts, and enable the development of professional learning communities for CPD. However, for this to happen, teachers need to exercise their agency and actively design EdTech and its appropriation ; to accomplish that, they need to become owners and stewards of tech instead of being passive users or consumers. Teachers have previously used ICT to mediate teaching, and EdTech needs to be no exception.

1 In this paper, tech refers to digital tech and EdTech refers to digital tech in education, unless otherwise specified or apparent from the context

Controlling Teachers Through ICT

Each successive ICT has had greater potential to control educational processes. The education bureaucracy used the textbook ICT to control teachers (Kumar, 1988). EdTech can be used to constrain teachers' curricular flexibility given that school management may control the use of digital devices in schools, the content used through these devices, and access their digital trail (through CCTV monitoring or digital footprints in applications [apps]). Teachers can be clearly instructed to use given content for teaching to ensure uniform (teacher-proof) content and pedagogy across classes and schools. Many school franchisees already exercise this level of control over teachers. Such detailed prescription and optimization of work behavior through algorithmic management can be seen in an advanced form in the retail and logistics sectors (Hirth & Rhein, 2021), and threatens the future of teaching. EdTech can be used to control teachers and students by prescribing what must be taught, surveilling what is taught, and recording for posterity what has been taught. Such control affects teacher and learner agency, and limits teachers' ability to be sensitive to local contexts.

The mainstream EdTech model provides curricular content to the student, bypassing the teacher. Most EdTech apps aspire to make their interface "intelligent" by allowing the apps to understand the learners' proclivities (treating these as a proxy for their learning needs) and provide content that hooks learners. Such personalized learning using artificial intelligence (AI) is seen as an improvement over the typical classroom where the teacher uses the same content and pedagogy for all students irrespective of their backgrounds and needs.

However, personalized learning increasingly substitutes the teacher with the functions and content of the apps, which can deskill teachers and dilute their agency, adversely affecting learner development possibilities. No AI can match the natural intelligence of a capable and caring teacher because AI is a misnomer—algorithms do not possess intelligence but do an extremely efficient job of processing our digitized past to make predictions. Hence, its ability to customize a response is likely inferior to that of a capable and caring teacher who interacts with their students.

> No technology today or in the foreseeable future can provide the tailored attention, encouragement, inspiration, or even the occasional scolding for students that dedicated adults can, and thus, attempts to use technology as a stand-in for capable instruction are bound to fail. (Toyama, 2011, para. 6)

A human's depth, variety, and consistency of authentic responses can never be equaled by algorithms.

Ownership Defines Control

Understanding 'free' as a construct

Vendors of proprietary digital tools and platforms constrain teachers' right to modify digital artefacts, freely share them with others, or use them for posterity. Although these are often available "free" of cost, they only permit usage but not ownership of the artefact, which continues to be owned by the licensor. Digital artefacts are often offered gratis because the vendor makes money by selling user data to advertisers or through freemium models (where a basic version is offered for free, but a version with advanced features has license fees). Such products and platforms deprive us of the freedoms that we usually exercise while using other educational technologies—the freedom to study, make, modify, and share resources, and deploy the tech for posterity. The tech sector has hugely impacted our understanding of the word 'free', replacing its powerful political connotation (free as in freedom, e.g. India became free on 15 August 1947), with its economic connotation (free as in gratis; Gmail is free, we do not pay for it). This shift is significant to education, whose aim includes making us free (Friere, 2000).

Given that curriculum and pedagogy are core processes of education, schools and teachers must have the autonomy to decide how to create, customize, share, and use curricular resources. Hence, EdTech, which learners and teachers can access without any constraint to creating, modifying, and sharing the tools (apps) and content are essential. The Free Software Foundation, a non-profit organization that globally supports the development of free software, explained that "free software is the software that grants the user the freedom to share, study, and modify it" (Garbade, 2020, para. 6). The term free should be used only for digital resources that provide us all these aforementioned freedoms; "free of cost" must be called gratis. Apps or content that are gratis but do not provide these freedoms are termed 'freeware'. They can be taken away at any time and their terms of use can be unilaterally modified by the provider. Users have no recourse in such instances, whereas copies of free software can be installed by users without any constraints and can continue to be used, studied, modified, and shared for posterity.

The use of proprietary tech also creates vendor lock-ins because only the provider can maintain or support its use. Applications can disappear because the vendors close shop or decide against making them available on the same terms. When a vendor decides that it is no longer profitable to support a version of proprietary software, teachers or schools cannot do anything to continue using it. Thus, teachers can never be sure how long any software will be available to them. For instance, Microsoft withdrew support from its Windows XP platform, which was being used on thousands of desktops that could not be upgraded to the later versions of the operating system. Such avoidable but planned obsolescence forces institutions to invest in new hardware (Thadani, 2014).

A textbook or a blackboard is always available for teaching. However, tech licensed to be used only as per the vendor's decision makes the world of software an uncertain one. The inability to maintain, repair, or revise proprietary software reduces teachers to mere consumers of EdTech. The loss of control can make it difficult for teachers to be serious users and rely on any digital app or platform.

The most significant difference between earlier ICTs used in education and contemporary EdTech is this ownership issue. While earlier ICTs could be owned by schools and teachers, and were usually so owned, allowing them to design their use based on their perceptions, perspectives, and priorities, mainstream EdTech is proprietary—the vendor (usually a for-profit company) decides its design and availability. It is prioritization that makes EdTech harmful, posing a crisis; teachers and schools must have agency in designing the use of EdTech.

Perhaps the most powerful (and not emphasized enough) feature of tech is that replication costs are nil. This is one important reason why proprietary tech companies become huge, and are extremely profitable. Creating a public tech ecosystem would allow the benefits of this nil-replication-cost feature to enrich the public education system rather than support private profit. This requires the adoption and promotion of free and open tech.

Free and open-source software

Recognizing the dangers of the proprietization of tech, various programs, movements, institutions, and networks have been developing free and open-source software (FOSS). Professor Richard Stallman (1983) initiated the free software movement in which thousands of software professionals collaborated globally to develop FOSS for universal use. Consequently, there are thousands of FOSS education apps. FOSS allows users to become full-fledged participants, giving them the freedom to not only use but also study, make copies for posterity, and modify and redistribute digital tools. Teachers can localize the software by translating its user interface into their languages. Thus, the enrichment of FOSS is not restricted to only its creator—anyone can contribute to its development and enhancement. This has practical significance, for instance, IT for Change (https://itforchange.net/), a Bengaluru-based organization where the author works has contributed to creating Kannada and Hindi language interfaces for many FOSS apps.

Free software is, in spirit, owned by all because it can be created, maintained, or enhanced by any entity. Therefore, it can be seen as software of, by, and for the public. The movement from being users to owners, designers, and stewards of tech can make tech just another pedagogical resource for teachers. This movement can assuage apprehensions that teachers, educators, and education systems have about control over EdTech. It is a prerequisite to the question: "How can EdTech be pedagogically relevant and useful?" FOSS EdTech can be freely shared at nearly nil cost, allowing universal availability. This means a rich cornucopia of free digital resources could be available for every school and every teacher—who can then decide which of these they will use.

Visualizing EdTech as a public resource also enables actors in education to freely articulate what tech is required to achieve the aims of education, instead of limiting it to what the market can provide profitably. Relevant tech aligning with education needs becomes the focus—not whether the tech will be profitable. Education is universally recognized as a fundamental right, so it cannot be a market good: access based on ability to pay. EdTech needs to be in line with the philosophy of universalization as a public service, producing and consuming publicly owned FOSS EdTech. FOSS EdTech may not necessarily be relevant or useful, and can be educationally useless or even harmful, in much the same way that proprietory EdTech can be useless or harmful.

However, FOSS EdTech provides the required autonomy and space for the teacher and the school to explore ways it can be used meaningfully for achieving educational aims, escaping hype peddled by commercial interests.

The Political and Pedagogical Aspects of EdTech Design and Deployment

Funding and ownership

The first political aspect of tech pertains to funding and ownership, which can be analyzed across the following spectrum:

1. Public or public-aided open tech (government-funded and publicly owned).
2. Private not-for-profit open tech (funded by private not-for-profits and publicly owned).
3. Commercial open tech (funded by private for-profit and publicly owned).
4. Proprietary tech (mostly funded and owned by private for-profits, but can also be used by public institutions, and also can be not-for-profit).

The first three open tech options provide for public ownership of tech, enabling the teachers or schools to design and deploy without constraints, and we can term them part of public EdTech. The fourth option is the proprietary model, which constrains the freedoms of schools and teachers. The third option, in which the public tech is provided through services that are commercially charged, still does not constrain teachers' agency in principle because the tech can be modified and distributed freely and there is no vendor lock-in.

Control

The second political aspect of tech is related to the level of user control over it. Here, we can have centralized or decentralized/distributed tech design. While desktop-based tech infrastructure allows for decentralized program design, cloud-based architecture supports centralized design. The centralized model is vulnerable to unbridled data collection from schools, teachers, and students.

Federated models that allow for the principle of subsidiarity in tech control (maximizing local control) are desirable, with minimal guidelines from the central hub for maintaining necessary coherence and alignment. For instance, the National Digital Education Architecture framework for EdTech, developed by the Indian Government recognizes the value of a federated architecture for the platforms proposed for development for education (Ministry of Education, 2022).

Educators view small schools as having greater potential for progressive education than large-scale, franchisee schools subject to strong central control. A highly centralized government school system leads to disempowerment of schools, teachers, and local communities and a local government. EdTech can promote such centralization. Federations of small schools can provide possibilities for collaboration (through tech). EdTech, which is in itself implemented in a decentralized and networked mode, would be in philosophical alignment with networks of small schools and support their effective functioning.

Pedagogical design

The pedagogical design of EdTech is concerned with using it to enhance or dilute teachers' and learners' agency, which in turn enriches or impoverishes the teaching–learning environment. To make tech pedagogically more relevant, we must:

1. Consider it as a vehicle for fostering teachers' and students' conversations, peer learning, and collaborations through digital networks, instead of a pipeline for one-way pushing of content, and
2. Allow teachers and students to create and re-create materials and share, instead of merely consuming what has been made elsewhere (for example, interpreting and evaluating ChatGPT instead of just getting answers from it).

Using the technological pedagogical content knowledge framework (Mishra & Koehler, 2006), we can say that when EdTech understanding is agentically used to enhance pedagogical and content knowledge, and vice versa, the resultant pedagogic design will be best suited to meet the educational aims of that context. Most educators and education administrators tend to ignore the element of ownership. For instance, a recent policy brief on Enhancing ICT Readiness of Schools in South Africa (van Greunen et al., 2021) discussed a maturity model for EdTech use in schools, covering a wide variety of aspects including digital competencies, integration in teaching–learning, culture, and management of EdTech resources, but was silent on ownership and control. Some may believe that the public EdTech model is not feasible. However, creating a public EdTech ecosystem is integral and even foundational to creating the ethos for a public education system to succeed.

The Platformization of Education

The foundation of the internet was laid through public investment in the USA. Indeed, a significant part of the research and development of modern technologies usually occurs through public funding. Yet, in the neo-liberal paradigm, the private sector uses the benefits of such innovations to privatize related services for their profit. For instance, ChatGPT was only developed by processing very large data sets that did not belong to its owners. A class-action lawsuit has been recently filed in the USA, alleging that the ChatGPT tool scraped data belonging to the public without their knowledge, let alone consent (Brittain, 2023). ChatGPT was originally developed by a not-for-profit entity, the OpenAI initiative. However, once its profit potential was established, Microsoft took direct control to drive its design and application for its profit.

It is taken for granted today that the not-for-profit sector (government and FOSS organizations and communities), or even the for-profit-free-and-open-source business entities, cannot produce tech for all; only the business sector can do it through a proprietary model of software production.

Under this model, the producer prevents the users from making copies of the software, using technological and legal means, even though replication at nil or marginal cost is one of the main advantages of tech. Technologically, the producer prevents replication by not releasing the source code, which can be replicated or even modified by users; only the object code, which cannot be modified, is released. Secondly, the producer releases the software under a restrictive license, legally preventing users from reading, modifying, or replicating the software. The user has only one freedom—to use the software. By preventing replication or modification, the producer forces each user to procure a separate license to use the software, enabling huge profits. For years, Bill Gates, the founder of Microsoft, was the richest person in the world thanks to the rental income from Microsoft Windows and Office proprietary software.

The tech sector has a much higher propensity to allow for monopolies or oligopolies due to the network effect (Stobierski, 2020). As the service acquires more users, it increases the value of the network, thereby attracting even more users. The widespread use of proprietary standards prevents interoperable competitive services. This perversely incentivizes businesses, particularly start-ups, to indulge in all kinds of (mal)practices to acquire enough users to try and become a monopoly or oligopoly. Eventually, the business becomes “the” platform in that space, which all have to use. A platform is a large tech business (Big Tech) providing services that connect producers and consumers and seeks, over time, to determine the terms of engagement with both, which, as a monopoly or even an oligopoly, it can. Instagram, X, Google Search, and Amazon e-commerce are all platforms that dictate the terms to the producers and consumers of their services.

The profitability and domination of tech corporations are due to their being legally allowed to proprietise and license the same digital artefact to many, and collect rent from each—whereas free sharing would benefit all because the marginal cost of production of digital artefacts is nil.

Alternate economic models (public investment, incentivizing private for-profit and not-for-profit sectors) for FOSS production could result in higher social welfare gains, especially in the public sector and public services domains. For instance, the Unified Payment Interface developed in India is a public platform (the term 'digital public good' is popular) that can be used to make a bank transfer or payment at no cost. The Indian Government has offered this platform to other countries.

A proprietary EdTech platform renders the teachers' suppliers or receivers of content, and not agentic participants in the educational process—just as the Uber taxi driver can only decide to accept an offer made by the platform while the fare, passenger, and even the route are dictated by Uber. The driver and the passenger have no independent relationship and only relate through Uber, which keeps detailed records on both and harvests the data to generate intelligence and profits. The teachers' and students' roles would resemble that of the driver and passenger using Uber as the EdTech platform matures. Given that the teacher–learner relationship has a profound role in learning, platformization will impoverish education.

In asynchronous learning programs, where teachers and learners are not interacting, students learn by interacting with digital resources and activities. Once the platform acquires sufficient content, the teachers' role as content suppliers will reduce. In a rote-learning-based education system, the provision and delivery of content tends to be a major activity in teaching, and EdTech platforms will easily take over that role. Teachers who mainly transmit content as teaching will find their jobs in peril

In synchronous learning programs where teachers and students interact directly, once the platform onboards a large number of teachers (similar to Uber onboarding a large number of drivers) for online interactions with students, the bargaining abilities of individual teachers will be reduced; the platform will then find it easier to dictate terms, making teachers vulnerable as gig workers. This online instruction model is susceptible to societal pressures of "cracking examinations." Hence, it will function as a coaching shop where possibilities of constructivist approaches to learning are negligible. In societies where education qualifications are seen primarily as a vehicle for employment and socio-economic mobility, the EdTech models will promote an environment where achievement in examinations is the main aim of education. These will increase competitive pressures on students.

EdTech platforms can also leverage parental insecurities (Dutta, 2015) about their ward's future, and persuade them that their incremental investment in online instruction can benefit their ward and enable socio-economic mobility. This is particularly possible given that digital offerings can be easily stratified—EdTech companies can create "just barely affordable" sachets of educational services for all strata. For instance, unscrupulous salespersons from BYJU'S, the Indian edupreneurial company, have exploited information asymmetries to make poor Indian parents subscribe to long-term educational products. The BYJU'S model also harms students; it can easily spread the infamy of the "suicide capital Kota"[2] across the country with the power of its digital reach (Kasinathan & Dasarathy, 2022).

2 Kota, a city in the state of Rajasthan, is famous for its coaching centers that prepare students to write competitive examinations for further studies and prized jobs. It is infamous for student suicides, caused by the extreme pressure imposed on them by the coaching centers and parents to achieve and pass the high-stakes exams.

As the platform becomes the default content source for students, teachers, and schools, it starts attracting more of them due to the network effect. Subsequently, public systems will feel pressure to contract platforms to provide students with content, pedagogy, and assessment services. Governments and education systems in the USA have signed contracts with Apple, Amazon, Google, and Microsoft to provide educational services to their schools (Cavanagh, 2017). In India, the Government of Andhra Pradesh signed an agreement in 2023 with BYJU'S to distribute their content in government schools. This will allow EdTech platforms to gain control over the education system through vendor lock-in. Given that content, pedagogy, and assessment are the core activities of schools, outsourcing these to external entities (for-profit proprietary product vendors) hollows out the system over time and makes it dependent on the vendor—a crisis for education.

Tech use tends to be sticky due to interface loyalties (users get accustomed to a particular interface and are unwilling to shift products because that would require them to invest effort to become acquainted with the new interface) apart from the network effect and proprietary software standards, which requires others to procure the same app. Hence, moving from one platform to another is not easy. To make matters worse, the more intensive a user's interaction with a platform, the more difficult it is to move to another platform. The younger the age at which one gets addicted, the more difficult it is to shake off the addiction (Vollmer et al., 2014). EdTech vendors will find these factors useful in trying to establish a monopoly.

The EdTech Crisis

Data and intelligence

A major problem inherent in the proprietary model is of tech drawing data from digital interactions for sale or misuse. The business platforms of Alphabet, Meta, Amazon, and Uber turn social interactions and economic transactions into free or paid services while collecting and monetizing their users' data (Sadowski, 2020) to facilitate the targeted delivery of customized advertisements to users. For instance, over 80% of Alphabet's (Google's parent company) revenue comes from online advertising (Graham & Elias, 2021).

The big data collected by platforms are processed through machine-generated algorithms to identify patterns and make predictions (AI). Such data harvesting is an essential element of corporations' efforts at profit maximization. However, because AI is based on a projection of the past, it tends to exacerbate biases; this has already been alerted in criminal justice, credit scoring, and facial recognition systems (Flynn, 2020). In addition, algorithms reflect their designers' and developers' biases in the rules they frame to guide the algorithms and in the data sets they process.

EdTech platforms are beginning to dominate education by offering gratis products or services, grabbing most of the market share, and harvesting user data. Data security and privacy concerns are aggravated in education because the data subjects are vulnerable children. Students, being minors, are incapable of giving consent, are more vulnerable to data theft, and suffer greater harm. Businesses will manipulate students' behavior for their commercial priorities.

Data collection cannot be prevented in proprietary EdTech because the source code is not open to scrutiny. Alphabet, which owns Google products, tracked user location even after it was turned off by users (eWeek, 2018). Its Chromebook devices spied on children, collecting far more information than necessary (Electronic Frontier Foundation, 2015).

Developing countries have no regulation, or inadequate regulation, of companies collecting data, hence their education systems are vulnerable to data harvesting. Their students are likely to become guinea pigs for EdTech, becoming training data at best (fine-tuning algorithms for personalized learning). EdTech relying on past data to predict future possibilities for students through data-driven models might lead to students from marginalized communities being driven towards vocational training for eventual poorly paid and insecure jobs because the model will likely suggest that—while their peers from dominant social classes are afforded the privilege of continuing with their mainstream education, which can offer better paying and more secure employment opportunities. Using AI for personalized assessment and learning will aggravate pre-existing social biases and will scientifically create an even more inequitable education system (Kasinathan, 2020).

Such AI-driven learning can take us back to BF Skinner's model of operant conditioning where a machine can direct the development of a human being. Skinner's model was discredited not only because it was proven wrong in its understanding of cognition, but also because, "it would seem, that enforced conditioning of a mind, however good the social intention, has to be evil" (Anthony Burgess as quoted by Watters, 2020, para. 35). Thus, AI-based personalized learning without teachers' active role is problematic on the grounds of cognition, educational philosophy, equity, and morality.

> Many data-driven, personalized education initiatives focus on learning rather than education, and on processes rather than on teachers and students. The [social] activity of learning is broken into quantifiable cognitive and pedagogical units, such as instruction, short quizzes, assignments, deliberation with other students, and tests. . . . The "learnification" model is predicated on the real-time, short-term process of learning rather than its long-term outcome, which is, in most schools, to provide an education. Education. . .involves simultaneous nourishing of intellectual, social, technical, and cognitive skills. (van Dijck & Poell, 2015, p. 2678)

The push towards individuation of learning and quantifying individual learning outcomes can affect collaborative learning possibilities focusing on holistic education through open-ended exploration and classroom collaboration. It can push content consumption (rote learning) education models. Learnification is now being hyped through AI-based personalized learning, which gathered pace due to the pandemic. BYJU'S for instance, sells its education services, claiming, "You don't even need school or teachers, where nobody gives any attention to your daughter. Our way is customized. For you" (The Ken, 2019, para. 23).

Tech in education and AI must be regulated and cautiously implemented, perhaps more as a pedagogical support tool for teachers than for direct student learning. A possible use could be analyzing error patterns and content possibilities for teachers, allowing them to determine its role. Here, personalized learning does not move in the direction of individualized learning but on humanized personalization, focusing on collaborative learning to promote equity (France, 2020).

Policy intervention

There have been calls for AI to be banned from certain domains because its potential harms could outweigh the gains. Platforms would increase the harms and risks from EdTech because they will have greater control over the core processes of curriculum, pedagogy, and assessments than earlier EdTech. The potential harms of technology, especially AI, are often known more clearly at a future date while its benefits are more visible immediately (Postman, 1998), so ex-ante regulation is necessary.

Because closed-source algorithms are black boxes, they hide their curricular and pedagogical assumptions. Hence, their alignment with curricular frameworks or accepted aims and educational processes cannot be validated. Algorithms used to process data must be publicly scrutinized (auditable AI) for the assumptions they make, the educational aims they serve, and the biases they hide. Hence, only open-source algorithms must be used in education and even these must be used only after considering the potential risks involved (Zimmermann et al., 2020).

Education policy is yet to wake up to this crisis. For instance, the Indian National Education Policy 2020 of the Government of India suggests that AI could process big data to develop personalized learning paths for students (Ministry of Human Resource Development, 2020). It naively recommends that data about students' assessment responses be analyzed to develop a machine-based understanding of the trajectory of conceptual errors, identifying solutions to address them, and creating learning paths. However, it does not mandate that algorithms must be open and audited.

Recognizing the need to prevent the proprietization of a public good like education, China has banned for-profit EdTech, mandated algorithms to be open, and restricted EdTech platforms' control over data collected from students, teachers, and schools (Koenig, 2021). These regulations are necessary to enable not-for-profit platforms that can provide spaces for teachers, students, parents, and other stakeholders to participate agentically within norms that evolve transparently and collaboratively. While regulating the private sector is an immediate necessity, it is essential to build critical media and digital literacy among teacher and student communities and the larger public to address the crisis of EdTech.

Pandemic Crisis and EdTech

The tech sector prospered during the pandemic (the pharmaceutical sector was the only other sector of the global economy that thrived then). EdTech boomed and its role became much more prominent due to school closures caused by lockdowns. Although educators warned that schools should be the last to close and the first to reopen, for the policymakers, it was the reverse—schools were closed first and were the last to open.

The medical evidence suggested that the COVID virus had the least impact on children therefore schools could have functioned. Schools for younger children, who were least vulnerable to the virus (Bhopal et al., 2021), tend to be small, and could have continued with the least risk, particularly as the socio-educational loss and harm were highest for them.

The continued long closures of schools revealed the low priority accorded to education by governments. At the peak of global school closures in April 2020, formal learning stopped completely or was severely interrupted for approximately 90% of the world's students in over 190 countries, from a few weeks to upwards of two years (UNESCO, 2022). EdTech was seen as the opportunity in the crisis—"it was understood as the go-to engine to drag schools out of the conveyor belt logic of industrialization and into the newer, networked logics of the 'information age,' the 'knowledge economy' and the 'Fourth Industrial Revolution'" (West, 2023, p. 53). The pandemic was believed to have provided a unique opportunity for teachers to catch the digital wave at an unprecedented speed (Education Emergency, 2020).

Unfortunately, because EdTech provisioning was mostly private, the boom provided stratified offerings. This meant sophisticated virtual classrooms with high connectivity and devices for the wealthy, coupled with well-resourced and supportive homes—with privileged children suffering less from school closures. On the other hand, SMS and WhatsApp-based asynchronous material sharing passed off as education for students from marginalized communities. Simply sharing material asynchronously without any synchronous support to students, and expecting them to follow instructions (mostly by copying the content to their notebooks or watching videos) implied impoverished learning possibilities for students (Mehmood, 2021). Providing materials appropriate for each learner, scaffolding interactions with students with these materials, and providing feedback on interactions are necessary for learning but were seldom part of the WhatsApp-the-files method.

Online education was ineffective because few students in government schools had the required digital devices and connectivity (West, 2023). Roughly half of the world's population lacked a functional internet connection in 2020 (International Telecommunication Union, 2020). Only 30% of Pakistani households were aware of remote learning opportunities, and fewer than half had the technology required (Mehmood, 2021). Only four % of African school-goers were using any form of EdTech at the height of the pandemic (Crawfurd, 2020). Studies in China, the United Kingdom, and Australia identified that even if students had connectivity, home environments in poor and rural families were not conducive to learning (Brown et al., 2020; Crew, 2021; Li et al., 2020). Furthermore, most teachers felt that their need to be trained in teaching and learning with EdTech was either insufficiently met or not met at all (Colclough, 2020).

The dominant form of EdTech focused on providing content to learners, bypassing teachers, instead of strengthening teachers' abilities to use it agentically. Indeed, there were cases where teachers were provided the content to pass on to students with a strict warning to not add to or modify the content (Batra et al., 2021). The assumption was that "good quality" content would compensate for the lack of classroom transactions.

Thus, it promoted a top-down content provision model for students. In its report about education during the pandemic, Human Rights Watch found most platforms directly violated or risked children's privacy and other children's rights for purposes unrelated to their education (Han, 2022).

The consequences of this naive faith in EdTech during school closures will probably have severe and long-term effects on the learning and development of children, especially those from marginalized sections of society. The impact on them is likely to be lifelong because once schools reopened, the attention to their learning recovery was not adequate because they were pushed into catching up with the grade level syllabus. For instance, in Karnataka, a state in India, the K10 public examination results in 2024 were poor, with just half the students passing (in contrast to the usual 90% pass results). The Minister of Education explained that the poor results were due to students being in the crucial middle school years when schools had closed for the academic year of 2020–21 during the pandemic (Deccan Herald, 2024). School closures dealt a devastating long-term blow, especially for children from marginalized communities and EdTech may have been an accessory to this crime (West, 2023).

It is possible that EdTech had a role in establishments seeing prolonged school closures as acceptable (UNESCO, 2022). Recognizing the danger of long school closures to the development needs of the children of marginalized groups, individuals and groups across the world pushed for opening schools and keeping them open. In India, educators and activists came together to establish the National Coalition on the Education Emergency (https://educationemergency.net/about-the-coalition/)[3], which advocated for keeping schools open and promoted using EdTech to support teachers rather than replace them. However, the global consensus on keeping schools closed was extremely strong, oblivious to children's developmental needs. Sweden was an exception; secondary school students had distance learning and younger students had in-person learning except during local outbreaks (European Centre for Disease Prevention and Control, 2023).

Public school education systems tend to be hierarchical, with high centralization of authority. Schools are seen as delivery instruments of the policymakers and bureaucrats. The teachers, by and large, consider themselves accountable to the administration rather than to the local community. Such an environment is amenable to using tech to strengthen centralized control over education processes (Kasinathan, 2018). Bureaucracies could implement their thinking that EdTech would make up for school closures.

The pandemic accelerated the move towards proprietary and centralized models of EdTech, which have further disempowered schools and deskilled teachers. The vital connection between the overall commercialization and privatization of education and proprietary EdTech is, however, yet to be seriously considered by most educators and policymakers.

3 Disclaimer: The author was one of the founders of the National Coalition on the Education Emergency.

For instance, the report of the United Nations special rapporteur on the right to education (impact of the coronavirus disease crisis on the right to education) said:

> The 'deployment of online distance learning' [emphasis added] . . . should be seen only as a temporary solution aimed at addressing a crisis. The digitization of education should never replace onsite schooling with teachers, and the 'massive arrival of private actors through digital technology' should be considered as a 'major danger for education systems' [emphasis added] and the right to education for all in the long term. (United Nations, 2020, p. 2)

In another report, Impact of the Digitalisation of Education on the Right to Education, the special rapporteur said that

> 'digitalization of education' [emphasis added] should be geared towards a better implementation of the right to education for all it is important to understand the 'profit-driven agenda of digital technology lobbyists and companies' [emphasis added]. (United Nations, 2022, p. 1)

Both reports identified private EdTech actors as dangers but failed to identify that publicly funded EdTech can be the solution. They did not see its public ownership of EdTech as indispensable to free, universal, quality public education.

Publicly owned, decentralized/distributed, cooperative, and collaborative models of EdTech production and consumption are possible. In fact, these would be critical components in the larger efforts to democratize education by empowering the school/teacher/community/local government component of the school system to negotiate with the powerful bureaucracy and the market. Public EdTech has been around for decades now and has demonstrated its potential to meet the needs of education systems. Policy support and public awareness are required for a transition to public EdTech in (and for) public education.

Public (and Community) EdTech: The Way Forward

To visualize a public and decentralized tech environment, we need to split tech into two constituents: the basic infrastructure (hardware), and the digital goods (software, content, and data). The hardware requires significant investment to enable access. In the context of education, such investment in digital public infrastructure should be considered an integral part of the physical and academic infrastructure provisioning of schools and budgeted for based on overall priorities. This should privilege the community's (shared) access to school digital labs over individual laptops for students to promote a communal ethos of EdTech use. The issue of producing digital goods is quite different. Digital goods—software, content, and data—are non-rivalrous. These can be created, modified, stored, and shared freely at negligible cost. Tech can itself support open and collaborative production, allowing for massive expansion in availability and universal access. Big Tech are controlling society and the economy through the provision of digital goods. Alphabet (Google), Microsoft, BYJU'S, or any other EdTech platform's power comes from its control over digital goods. Hardware, while foundational, is a relatively passive component.

Although a significant part of the expenditure would be on hardware; for digital goods, we need to (and can) establish collaborative and cooperative models.In the Web 2.0 paradigm, proprietary platforms significantly leverage the unpaid efforts of millions of individuals to develop digital goods. Google Maps, Google Translate, or ChatGPT have developed from user contributions. These efforts could instead be leveraged through projects that work with free and open licenses (such as Wikipedia) because the user-contributors would certainly prefer to share their work with the public instead of increasing a monopoly's profits.

Kerala, a public EdTech role model

The Kerala education department initiated a school-owned and teacher-led EdTech model in 2002—the FOSS-based IT@Schools program. IT@Schools was perhaps the only successful example from the ICT@Schools umbrella program of the Indian Government implemented in many states (Kasinathan, 2009). Kerala has continued with its tradition of public sector production of EdTech over the last two decades, with increasing maturity that reflects in greater functional coverage of EdTech in educational processes and maximizing school/teacher/student coverage to ensure inclusion.

The state has established the Kerala Infrastructure and Technology for Education (KITE) as a special-purpose vehicle within the public education system. KITE has set up state, district, and sub-district structures staffed by teachers who provide technological pedagogical content support to public schools. This includes hardware maintenance and upgrades (ensuring EdTech infrastructure uptime), student digital literacy (through the advanced Little Kites program, which Finland is keen to adopt [Financial Express, 2022]), special academic programs such as the E-Language Lab (ELL), teacher and student open educational resources repositories, student mentoring by teachers (Sahitham), CPD (through Moodle LMS), School MIS, and school websites (Kwet, 2023). These programs comprehensively cover the activities of the public education system and are designed, implemented, and managed by KITE. No private sector vendors provide any educational software or content services, avoiding vendor lock-in and data theft and harvesting by them.

Most government and government-aided schools in Kerala implemented the ELL program during 2022-23 (Regional Institute of English South India & IT for Change, 2022). Such a smooth implementation of a new EdTech program across 14,000 schools within a single academic year is a testimony to the maturity of the public EdTech model. Because ELL uses FOSS, it can be used by any institution, any public education system or government, and freely implemented in all their schools without any license fee, vendor lock-in, or data theft. Each can also freely enhance/contextualize ELL based on their own needs, including extending it to their own languages.

The content of the ELL program has been developed by the teachers in the Kerala public education system. They accessed existing open educational resources (OER) from the StoryWeaver portal (https://storyweaver.org.in/en/), which has thousands of stories for children, in numerous languages.

Teachers created audio-visual complementing content for each story selected for the program, in the KITE studio. These resources, consisting of reading aloud, enacting the stories, adding activities, assessments and so forth, are available for public access, on the KITE website. This model—of preparing teachers to use FOSS, access existing OER, and create/revise/contextualize new OER can be used by any public education system, to develop a rich learning environment that is multimodal (text, image, audio, video, animations), multi-level (for instance the same story can be made simpler or more complex, activities can be at varying levels of complexity), and multilingual (for catering to multilingual classrooms and for learning different languages; Kasinathan, 2021).

Universal provisioning of digital education during the pandemic

This maturity concerning the use of technology in education enabled Kerala to address the pandemic crisis inclusively. Like other states, Kerala was also subject to a nationwide lockdown from May 2020. KITE started broadcasting lessons (called, First Bell) through its Vikters TV channel a short while later, and supported teachers to conduct online classes. KITE identified families who did not have access to digital devices and launched a program for such families to get devices through donations, which addressed the device shortage (Anupama & Sreekala, 2020).

A special equity focus ensured that communities that were least provided for, such as migrants, were prioritized in resource allocation. Due to CPD programs, teachers were able to use digital and online education to reach students during school closures.

Of course, this is not to suggest that the online and digital education modes were an adequate replacement for in-person learning during the pandemic. There were challenges in Kerala as well because online education could not cover students in remote, hilly areas and in tribal habitations. Also, in-person learning benefits resulting from physical engagement and social interactions were not available. However, the public education system was able to design universal digital education programs while avoiding constraints and dangers from proprietary platform vendors.

A survey by UNICEF in six Indian states concluded that students fell behind in social skills, fitness, job prospects, and so forth, during the pandemic (UNICEF, 2021). More than two-thirds of parents stated that their wards' overall progress was significantly or somewhat behind. However, in Kerala, about 70% of parents believed that their wards' overall learning progress had been the same or better than it would have been in school, and more than 90% reported that students were speaking with their teachers (UNESCO & UNICEF, 2021). The public EdTech model of Kerala offers a compelling alternative to the mainstream vendor-driven, proprietary EdTech model.

Conclusion

The pandemic clearly showed that privatized and proprietary EdTech solutions will take us away from our aim of universal and inclusive education. Unlike proprietary EdTech, public EdTech can offer teachers and schools agency in designing its curricular integration. Hence, the question is not “Do we need technology?” or “Can we do without it?” but “How can we offer teachers the agency to design and deploy tech in ways that meet their students’ educational needs?”

When a school system supports teachers and helps in building their capabilities to engage with EdTech, exploring its use, designing its appropriation in a manner relevant to their contexts and needs, and avoids EdTech that the school or teacher cannot own, then it enables agentic possibilities for teachers to appropriate EdTech. Therefore, school systems should move to the public EdTech model in line with the ethos of education as a public good. Only such a model can work for equitable outcomes in education.

References

Anupama, R. A., & Sreekala, V. S. (2020). How the Kerala model of bringing classrooms home works. The Wire. https://thewire.in/education/kerala-covid-19-education

Batra, P., Baza, A., Ranjit, N., Kaur, H., Das, R., & Shanmugan, A. (2021). Impact of the COVID-19 pandemic on education, livelihoods, and health in India. Transforming Education for Sustainable Futures: Indian Institute for Transforming Settlements. https://doi.org/10.24943/icpelhi08.2021

Bhopal, S. S., Bagaria, J., Olabi, B., & Bhopal, R. (2021). Children and young people remain at low risk of COVID-19 mortality. The Lancet Child & Adolescent Health, 5(5), E12–E13. https://doi.org/10.1016/S2352-4642(21)00066-3

Brittain, B. (2023). Open AI, Microsoft hit with new US consumer privacy class action. Reuters.https://www.reuters.com/legal/litigation/openai-microsoft-hit-with-new-us-consumer-privacy-class-ac tion-2023-09-06/

Brown, N., Te Riele, K., Shelley, B., & Woodroffe, J. (2020). Learning at home during COVID-19: Effects on vulnerable young Australians (Independent Rapid Response Report). University of Tasmania, Peter Underwood Centre for Educational Attainment. https://www.utas.edu.au/ data/assets/pdf_file/0008/1324268/Learning-at-home-during-COVID-19-u pdated.pdf

Castells, M. (2010). The information age: Economy, society, and culture: Vol. 1: The rise of the network society (2nd ed.). Wiley-Blackwell.

Cavanagh, S. (2017). Amazon, Apple, Google, and Microsoft battle for K-12 market. Market Brief. https://marketbrief.edweek.org/sales-marketing/amazon-apple-google-and-microsoft-battle-for-k-12- market-and-loyalties-of-educators/2017/05

Colclough, C. (2020). Teaching with tech: The role of education unions in shaping the future. Education International. https://issuu.com/educationinternational/docs/2020_ei_research_teachingwithtech_eng

Crawfurd, L. (2020). Why the COVID crisis is not EdTech's moment in Africa. Center for Global Development. https://www.cgdev.org/blog/why-covid-crisis-not-edtechs-moment-africa

Crew, M. (2021). Literature review on the impact of COVID-19 on families. The National Literacy Trust. https://cdn.literacytrust.org.uk/media/documents/Updated_COVID-19_Literature_Review.pdf

Deccan Herald. (2024). Angry CM pulls up officials for granting grace marks for SSLC exams. https://www.deccanherald.com/india/karnataka/angry-cm-pulls-up-officials-for-granting-grace-marks-for-sslc-exams-3027834

Dutta, N. (2015). 13 Traits "sharmaji ka beta" has that you don't. Storypick. https://www.storypick.com/sharma-jr-is-better-than-you/ Education Emergency. (2022). Right digitalisation in education? Summary note with suggestions for action. https://educationemergency.net/2022/05/right-digitalization-in-education-summary-note-with-suggest ions-for-action/

Electronic Frontier Foundation. (2015). Google deceptively tracks students' internet browsing, EFF says in FTC complaint. https://www.eff.org/press/releases/google-deceptively-tracks-students-internet-browsing-eff-says-co mplaint-federal-trade

European Centre for Disease Prevention and Control. (2023). The Swedish advice-making process for distance learning in schools, November 2020-April 2021. https://www.ecdc.europa.eu/sites/default/files/documents/covid-19-swedish-advice-making-process-s chools-2020-2021.pdf

eWeek. (2018). Google location tracking continues even after turned off, probe finds. https://www.eweek.com/cloud/google-location-tracking-continues-even-after-turned-off-probe-finds

Financial Express. (2022). Finland partners with Kerala govt to replicate little KITEs model. https://www.financialexpress.com/jobs-career/education-kite-it-kerala-finland-education-mode-helsin ki-2703658/

Flynn, S. (2020). 13 Cities where police are banned from using facial recognition tech. Innovation & Tech Today. https://innotechtoday.com/13-cities-where-police-are-banned-from-using-facial-recognition-tech/

France, P. E. (2020). Three tips for personalizing in a pandemic. Make Teaching Sustainable. https://maketeachingsustainable.org/blog/2020/07/06/three-tips-for-personalizing-in-a-pandemic

Friere, P. (2000). Pedagogy of the oppressed. Bloomsbury.

Garbade, M. (2020). Free software vs open source vs freeware: What's the difference? DZone. https://dzone.com/articles/free-software-vs-open-source-vs-freeware-whats-the

Gilbert, R. M. (2009). Distance education: Is the classroom becoming obsolete? UNI ScholarWorks. https://scholarworks.uni.edu/grp/758/

Graham, M., & Elias, J. (2021). How Google's $150 billion advertising business works. CNBC. https://www.cnbc.com/2021/05/18/how-does-google-make-money-advertising-business-breakdown-. html

Han, H. J. (2022). How dare they peep into my private life? Human Rights Watch. https://www.hrw.org/report/2022/05/25/how-dare-they-peep-my-private-life/childrens-rights-violatio ns-governments

Hirth, J., & Rhein, M. (2021). Algorithmic assembly lines: Digitalization and resistance in the retail sector. Longreads. https://longreads.tni.org/algorithmic-assembly-lines-digitalization-and-resistance-in-the-retail-sector

International Telecommunication Union. (2020). Measuring digital development: Facts and figures. https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2020.pdf

Kasinathan, G. (2009). ICTs in education: Outsourced versus integrated approach (Policy brief). IT for Change. https://itforchange.net/index.php/policy-brief-%E2%80%93-icts-education-outsourced-versus-integra ted-approach

Kasinathan, G. (2018). Exploring teacher agency: ICT programmme design in school education. Voices of Teachers and Teacher Educators, VII(I), 121–128. https://ncert.nic.in/pdf/publication/journalsandperiodicals/vtte/vtte_aug_2018.pdf

Kasinathan, G. (2020). Making AI work in Indian education. Artificial Intelligence in India, 6. https://dx.doi.org/10.2139/ssrn.3873187

Kasinathan, G. (2021). National Education Policy 2020: Imagining digital technologies as a resource to achieve educational aims. Voices of Teachers and Teacher Educators, X(II), 20–28. https://ncert.nic.in/pdf/publication/journalsandperiodicals/vtte/Dec_Issue-2021.pdf

Kasinathan, G., & Dasarathy, A. (2022). The EdTech Leviathan. Economic and Political Weekly, 57(1), 36–40. https://www.epw.in/journal/2022/1

Koenig, R. (2021). Online tutoring in China was booming. Then came a dramatic shift in regulations. EdSurge. https://www.edsurge.com/news/2021-07-26-online-tutoring-in-china-was-booming-then-came-a-dra matic-shift-in-regulations

Kumar, K. (1988). Origins of India's "textbook culture." Comparative Education Review, 32(4), 452-463. https://www.jstor.org/stable/1188251

Kwet, M. (2023). Flying the KITE high against digital colonialism: FOSS in the era of EdTech. Bot Populi. https://botpopuli.net/flying-the-kite-high-against-digital-colonialism-foss-in-the-era-of-edtech/

Li, G., Zhang, X., Liu, D., Hao, X., Hu, D., Lee, O., Rilling, C., Ma, Y., Abbey, C., Fairlie, R., Loyalka, P., & Rozelle, S. (2020). Education and EdTech during COVID-19: Evidence from a large-scale survey during school closures in China. Rural Education Action program. https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/education_and_edtech_during_covid-19-fina l-08032020.pdf

Mehmood, F. (2021). COVID-19: Bridging the digital divide in education. Centre for Human Rights. https://cfhr.com.pk/wp-content/uploads/2022/01/Covid-19-Bridging-the-Digital-Divide-in-Education- CFHR-Report-2022.pdf

Ministry of Education. (2022). National digital education architecture: NDEAR ecosystem policy. https://www.ndear.gov.in/images/pdf/NDEAR-Ecosystem%20Policy-Version.pdf

Ministry of Human Resource Development. (2020). National education policy 2020. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English.pdf

Mishra, P., & Koehler, M. J. (2006) Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017-1054. https://psycnet.apa.org/doi/10.1111/j.1467-9620.2006.00684.x

Postman, N. (1998). Five things we need to know about technological change. https://web.cs.ucdavis.edu/~rogaway/classes/188/materials/postman.pdf

Postman, N. (2009). Teaching as a subversive activity: A no-holds-barred assault on outdated teaching methods-with dramatic and practical proposals on how education can be made relevant to today's world. Random House.

Regional Institute of English South India & IT for Change. (2022). Impact study: KITE e-language lab: Endline study report. https://kite.kerala.gov.in/KITE/KITEELL.pdf.
Sadowski, J. (2020). The internet of landlords: Digital platforms and new mechanisms of rentier capitalism.Antipode, 52(2), 562-580. https://doi.org/10.1111/anti.12595

Scherer, M. (2012). Perspectives: The teacher-proof myth. Association for Supervision and Curriculum Development. https://www.ascd.org/el/articles/the-teacher-proof-myth

Stallman, R. (1983). Initial announcement. GNU Project. https://www.gnu.org/gnu/initial-announcement.html

Stobierski, T. (2020). What are network effects? Harvard Business School Online. https://online.hbs.edu/blog/post/what-are-network-effects

Thadani, R. (2014). Is the end of Windows XP support putting ATMs at risk? Quick Heal Blog. https://blogs.quickheal.com/is-the-end-of-windows-xp-support-putting-atms-at-risk/

The Ken. (2019). BYJU'S and the art of the deal: Inside a one hour pitch. https://the-ken.com/blog/byjus-and-the-art-of-the-deal/

Toyama, K. (2011). There are no technology shortcuts to good education. Educational Technology Debate. https://edutechdebate.org/ict-in-schools/there-are-no-technology-shortcuts-to-good-education/

UNESCO. (2022). COVID-19 recovery. Education: From school closure to recovery. Monitoring of school closures. https://en.unesco.org/covid19/educationresponse

UNESCO & UNICEF. (2021). India Case study situation analysis on the effects of and responses to COVID-19 on the education sector in Asia. https://www.unicef.org/rosa/media/16511/file/India_Case_Study.pdf

UNICEF. (2021). Rapid assessment of learning during school closures in the context of COVID. https://www.unicef.org/india/media/6121/file/Report

United Nations. (2020). Right to education: Report of the Special Rapporteur on the right to education. https://www.ohchr.org/en/documents/thematic-reports/ahrc4439-right-education-impact-coronavirus- disease-crisis-right

United Nations. (2022). Impact of the digitalisation of education on the right to education. https://www.ohchr.org/en/documents/thematic-reports/ahrc5032-impact-digitalization-education-right-education

Van Dijck, J., & Poell, T. (2015). Higher education in a networked world: European responses to US MOOCs. International Journal of Communication, 9(1), 2674–2692. https://www.researchgate.net/publication/281029492_Higher_Education_in_a_Networked_World_European_Responses_to_US_MOOCs

Van Greunen, D., Kativu, K., Veldsman, A., & Botha, J. (2021). Enhancing ICT readiness of schools in South Africa. Republic of South Africa. https://www.dst.gov.za/images/Policy_Brief_June_2021.pdf

Vollmer, C., Randler, C., Horzum, M. B., & Ayas, T. (2014). Computer game addiction in adolescents and its relationship to chronotype and personality. SAGE Open, 4(1). https://doi.org/10.1177/2158244013518054

Watters, A. (2020). The Ed-Tech imaginary. Hack Education. http://hackeducation.com/2020/06/21/imaginary

West, M. (2023). An ed-tech tragedy? Educational technologies and school closures in the time of COVID-19. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000386701

Zimmermann, A., Di Rosa, E., & Kim, H. (2020). Technology can't fix algorithmic injustice. Boston Review. https://www.bostonreview.net/articles/annette-zimmermann-algorithmic-political