Children, Education, and Technologies: Current Debates, Key Concerns, and Future Directions Around Data Privacy, Surveillance, and Datafication

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1 Background

Edtech products have diffused into educational systems globally, driven by education policy [1] as well as beliefs that they can help achieve some of the United Nations Sustainable Development Goals (SDGs), including Goal 4 (Quality Education) and Goal 10 (Reduced Inequalities) [2]. At the same time, the current design and implementation of digital technologies presents complex contradictions in justly achieving the SDGs [3].

For instance, the absence of transparency regarding data collection processes and decision-making concerning students undermines the ability of teachers to fully understand how they can effectively collaborate with edtech platforms. This lack of clarity inhibits the use of their professional insights, consequently hindering the enhancement of teacher qualifications through the integration of edtech, thus contradicting Goal 4.C [3]. The lack of transparency raises ethical concerns, such as fostering a surveillance culture [4]. It also conflicts with Goal 16, which aims to establish peace, justice, and strong institutions, as it can undermine privacy and trust within educational systems [5]. Moreover, this constant collection (and over-collection) of data uses high computing resources, whose environmental impacts challenge Goal 13 (Climate Action), given that the ICT sector, including edtech, is projected to contribute 14% of global greenhouse gas emissions by 2040 [6]. Therefore, current efforts aimed at greening education should include greening edtech [7].

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Importantly, while edtech advances digital infrastructure (Goal 9), neglecting data privacy contradicts Goal 9.1. Cloud-based solutions expose student data to cybersecurity risks, jeopardizing educational integrity. Profiting from education data undermines Goal 9.2, prioritizing economic gains over inclusivity and sustainability. Altogether, edtech's infusion has often been propelled by industry's aggressive marketing, promising technological revolution in education, and accelerated by the COVID-19 pandemic. Yet, despite the hype, technological adoption has been accompanied by a sense of disappointment and failure to impact education [8]. Educational institutions, specifically in Anglo-American contexts, increasingly depend on edtech, while datafication and surveillance are normalized.

Data-intensive edtech is used across the educational system—from providing lessons and content, to assessing students and practicing subjects, to managing schools and staff. Many K-12 schools across the United States, for instance spend financial resources on monitoring applications such as Gaggle and GoGuardian, whose functionalities comprise activity and time logging, 24/7 notifications, home calls/wellness checks, and remote control. This digitization, especially in K-12 education, has led to growing concerns of learning environments that convert learners' social actions into quantifiable data, a process known as "datafication." While datafication has been seen to support decision-making by adapting and personalizing the learning experience [9], it has also raised significant concerns for children's well-being.

2 Current State

2.1 The Nature and Impact of Datafication

First, datafication can be understood as the quantification of social processes that espouses a reductionist view of education-related phenomena. This trend is driven by a view of numbers as objective, true, accurate, and subsequently superior to other forms of knowledge, which some describe as a mythology of data [10]. That is, numbers strip context from what they represent and underpin the problematic "turn to decontextualized data as truth,' [11] because numbers produce an "abstracted tunnel vision" that only reveals a fragment of reality and its complexity [12]. The behavior management platform ClassDojo is an example of decontextualization as it reduces student behavior to a numerical score [13], removing any social context.

Second, datafication can involve inferring, predicting, and controlling human behavior in ways that risk undermining individual agency, privacy, and basic human rights [14]. In the United States, the Family Educational Rights and Privacy Act of 1974 (FERPA) provides legal guidance for protecting student privacy enforcing that student data can be shared with third parties only as long as there is an educational reason for disclosure such as providing critical services. Yet, loopholes for data exploitation remain [15]. Conversely, the Children's Internet Protection Act (CIPA) aimed to address concerns about children accessing obscene or harmful content on the Internet, enabling schools to use monitoring software applications to keep track of students' online behavior.

Third, datafication leads to the collection of vast amounts of personal and sensitive data, which can be used to identify individuals and track and control behaviors that are not conducive to learning. While data privacy laws continue to adapt and address the challenges of datafication, edtech remains plagued by data misuse [16], cybersecurity risks, weak scrutiny, and no clear standards in the sector [17].

Fourth, datafication has led to risks of bias, perpetuating, or amplifying existing inequalities. The algorithm used by the Office of Qualifications and Examinations Regulation in the United Kingdom was meant to forecast national exam results, yet it produced biased outcomes, negatively impacting students' learning progression and confidence [18].

In many American K-12 schools today, platforms like iReady are used to assess students' reading and mathematics proficiency, which determines their subsequent placement in middle

and high school. However, there exists a lack of transparency or clarity regarding the methodology employed by the platform to conduct these assessments, including sufficient details on the process of data collection [19]. Consequently, the conclusions drawn may lack validity and reliability. This is particularly important in light of evidence indicating that students using the iReady platform instructional resources either scored lower [20] or exhibited no discernible improvement [20] in reading proficiency compared to their peers who were not instructed through the iReady program. Moreover, globally, digital divides continue to widen. Since underserved children still lack digital resources, less data is available about them, which leads to samples that disproportionately represent White, Educated, Industrialized, Rich, and Democratic (WEIRD) populations. Using such biased samples could further impact children's education negatively [21].

Finally, datafication has also intensified the debate surrounding the risks of harm through surveillance, or "dataveillance" [22] and diminishing personal freedoms and rights. The digital monitoring system E-HallPass, which was recently introduced into 1000 U.S. schools to track students movement outside the classroom (including visits to the bathroom), exemplifies the concerns with such technologies [23]. Such real-time surveillance of students can lead to unjustified control of their behavior [13]. Schools and local authorities may end up using surveillance data as evidence in disciplinary investigations and harm children and young people when the same surveillance systems are used even outside school hours [24]. Such practices are transcending schools' role beyond academic environments to ones of sanction and punishment.

Knowing that there is constant digital surveillance can create a sense of unease and even paranoia among individuals—be those students or teachers. This can lead to self-censorship (chilling effects) where both students and teachers refrain from expressing themselves freely or exploring controversial topics for fear of repercussions. The normalization of surveillance and datafication is now extending beyond the classroom, which can potentially impact students' willingness to question authority or engage in activities that may be deemed unconventional.

Many digital surveillance systems are also dependent on algorithms to analyze data and make inferences and decisions about individuals. These algorithms often inherit biases present in the data on which they are trained. As such, digital surveillance systems can often target certain groups of individuals based on shared characteristics of race, ethnicity, socioeconomic status, and others, which can lead to increased scrutiny and surveillance of minoritized individuals, perpetuating inequalities, and exacerbating bias and other social injustices. In short, the implications of dataveillance in education are concerning because they can discriminate against specific individuals, create anxiety among students as well as teachers who are equally subject to dataveillance, and erode overall trust not only between students and teachers but also students' trust in the whole educational system [25].

2.2 Current Safeguards Against Datafication

Indeed, with increased datafication, it is important to consider the nature of safeguards for student data. Thus far, we have hinted at the need to elevate privacy by design—that is, incorporating privacy protections directly into the design of technologies. However, privacy protection can also be viewed from a digital literacy perspective: the knowledge and skills to responsibly evaluate, create, collect, and share information in digital environments. Digital literacy has been previously linked to online resilience and well-being, and "three times as many young people [aged 11 to 16 years across the UK] with high critical digital literacy scores have high mental wellbeing." [26]

Teachers enact and resist the logics of dataveillance [27], while also recognizing the inherent limitations of the data such technologies generate. That said, the implications of datafication are often remote for teachers and school district leaders immersed in the day-to-day

responsibilities of education [27]. For teachers, the more immediate concerns surrounding technology relate to children's (in)appropriate device use [27]; for districts, the concerns are basic data protection and security procedures [28]. While teachers express interest in incorporating digital literacy into their lessons, neither teachers nor district administrators receive much training in digital privacy or security [28].

Although researchers highlight the value of diversity in digital literacy conversations, inappropriate critical digital literacy strategies, often based on Global North (GN) realities, are implemented in Global South (GS) (a sociopolitical term referring to newly developed or developing nations with a colonial past) voices) contexts [29]. Given the distinct experiences in GS contexts, these strategies may not necessarily be effective within GS environments. Moreover, in the GS, the diverse ways of constructing concepts like "digital" and "literacy" (e.g., Latin-American and Caribbean literacies) are mostly excluded from conversations on curricular reforms [30]. Investing in context-specific digital literacy is important across the GS because, as these economies' internet connectivity expands, they often host infrastructures that are not resilient to cyberattacks, which require digital literacy and cybersecurity knowledge, especially regarding unregulated edtech [31].

3 Future Research

Future research should focus on the larger sociolegal and ethical implications of datafication and surveillance. Laws and policies pave the way for creating more transparency about who has access and what kind of student data is collected. However, research enquiry should delve on the long-term use of data. Research can focus on whether the obsessive drive for digital opportunities in education does not eliminate nondigital opportunities, too.

There is a gap in literature on teacher perceptions and experiences with advancing algorithmic systems and the growing datafication model. Questions can focus on how teachers perceive and experience datafication and surveillance. This includes questions about how these practices affect their sense of autonomy and professionalism, their relationships with students and parents.

Scholarship can be built around the impact of automating decision-making on teaching and learning itself. Answers are needed around how these practices affect student motivation, engagement, and achievement. Diagnostic platforms such as Naviance, iReady, and Thrively are capable of automating decision-making with the risk of automating inequalities, too. Only longitudinal research can identify the true impact of such systems on children's future opportunities.

Research, policy, and investment focus should be directed toward technological solutions that address the digital divide and learning barriers that persist worldwide. However, such efforts should be cautious about how investment and funding can expand the current educational inequalities.

4 Recommendations

4.1 For Educators

- *Evidence-based practice:* To fully leverage the power of technologies in learning, teachers should adapt evidence-based practice for effective use of edtech [32]. Put otherwise, educators need to make instructional decisions that integrate good evidence for which technology works, for what purpose, and for whom. Evaluating empirical research to align technology with appropriate pedagogical approaches can lead to greater learning outcomes [33].
- *Professional development:* Educational processes depend highly on teachers' skills and performance. Even though technologies can support pedagogy, teaching is influenced by teachers' attitudes, routines, visions, and competencies in novel methodologies and, equally in technologies [34]. Digitally competent teachers can be perceived by students and educational institutions as competent and

capable facilitators overall [35]. Using technologies is challenging for teachers, especially as products evolve fast and new edtech are being offered all the time. Teachers are expected to show willingness to engage in ongoing professional development and keep pace with the fast-changing technologies. In the absence of such competencies and professional development, teachers are less likely to use edtech [36]. Take, for instance, how Chat GPT and similar large language models have changed the demands on teachers' skills, not only in terms of whether this is indeed a tool that is beneficial for teaching and learning but also in terms of detecting and understanding how to respond, from pedagogical and ethical aspects, when students use LLMs for their homework and assignments.

- The digitization of education is changing the demands on teachers' skills, abilities, and competencies, and the interplay between the different competencies is becoming more critical. Research shows that teachers' perceived competencies by students and their educational institutions are critical to students' acceptance of technology [37]. Developing teacher competencies for digital learning should be strongly supported. The goal should be to implement the complex interplay between pedagogy, content, and media skills as part of the curriculum for future teachers and their continued training.
- *Critical pedagogies:* Beyond professional development, we also call on educators to adopt critical pedagogies as a means of addressing the suite of concerns we have presented. Critical pedagogies offer an approach to teaching and learning that confronts injustices and power relations, prioritizes student interests, acknowledges the importance of context, and recognizes the inherent political nature of education [38]. Unlike common instrumental pedagogies, Saltman [11] argues, critical pedagogies foster an engagement with the politics of edtech and datafication while reasserting education's contribution toward creating more democratic and just societies. In both educators and students, it cultivates dispositions and thinking that encourage "an examination of the values, assumptions, and ideologies that undergird claims to truth" within technologies and data and enables them to be understood "in terms of broader structural and systematic patterns, history, and context." [11]

- Within critical pedagogies, learning is grounded in the process of deliberation, debate, dissent, and investigation that can be used to explore the relationships between technology and data, and the interests, authority, and social positions of those involved in their production, function, and use. This subsequently allows "students to theorize the technology [and data] they utilize" [11] in socially relevant ways, while simultaneously subjecting them and the knowledge they produce and represent to scrutiny. The adoption of critical pedagogies offers a way to resist the harmful impacts of datafication.

4.2 For Parents

- *Active mediation:* Parents should be supported to take a more active role in mediating children's engagement with digital learning and the increasing datafication and surveillance in education. Parents are often a significant influence on their children's lives; therefore, an opportunity exists for them to exercise such influence in digital learning. To do this, parents can adopt a mediator role that fosters strong positive relationships with their children involves explaining and discussing digital technologies and their content and provides guidance in proper use of technologies and data, which research has shown to be increasingly important to children's engagement with online environments [39].
- *Data literacy:* Such a role requires parents to possess data literacy, which is becoming a critical quality for navigating today's data saturated education environment (specifically in Anglo-American contexts). This means that it is important for parents to be sufficiently

informed or be supported to become informed about digital technologies and data, including how they work and the social, cultural, and economic forces operating through them [40]. This would enable parents to, for example, help children discern the different ways data is created about them through technologies, such as through information they voluntarily provide, or when it is extracted from them without their knowledge [40]. In this way, digital literacy can be viewed as a meta-competence necessary to assess the interrelationships, social consequences, and the impact of digitization. It also enables people to act more self-determinedly.

4.3 For Policymakers

- *Enhanced regulation:* More needs to be done to regulate and scrutinize the businesses developing and selling edtech products [41]. There are numerous frameworks, toolkits, and policies providing privacy by design guidelines and good practices; however, oversight and enforcement should be the next step [42]. This holds particular significance because privacy-enhancing can vary greatly among individuals, including developers, across different contexts [43].
- *Children's best interests:* Policymakers should put the spotlight on the edtech industry and demand that they prioritize children's best interests. This is harder said than done: whose best interests, according to what, how these might change over time, why edtech should be the main solution to achieve these best interests, and so on, are questions that cannot be answered in a straightforward manner. Additionally, the debate over what constitutes "best interests" can be both endless and distracting from other crucial tasks. For instance, meaningful education and efforts are essential to address more pressing issues related to the safeguarding and well-being of children. This is particularly important as both safeguarding and well-being are increasingly impacted by the digitization of education and children's lives to begin with. In practical terms though, "best interests" should entail emphasizing contextual and historical educational norms and structures, identifying collective and individual needs first, and then identifying how edtech may facilitate and address these. Indeed, educational technologies may benefit specific individuals. For example, children absent due to illness can catch up on their learning at home through the support of approved and vetted technologies. Edtech could also fit well within specific contexts, such as, when children work collectively on a project. The key point, however, is that we must avoid allowing the digital environment to become the sole and default method of learning and teaching.
- *Common standards:* Policymakers should recognize that education stakeholders demand that the edtech industry adhere to commonly agreed standards, protocols, and rules, along with a robust mechanism to enforce these is also implemented, if trust in advancing technologies is to be built. There are many frameworks and mediators coming to the fore offering stamps of approval. A parallel can be drawn with the emergence of environmental, social, and governance auditing (ESG) frameworks in response to climate change, where companies use standards to demonstrate their positive impact on the environment, relationships with employees and communities and effective governance structures [47]. The expectation is that companies disclosing their performance on ESG criteria will receive a "higher value," benefiting both "their bottom line and shareholders." [48] Consequently, the demand for corporate ESG frameworks and financial ESG investing metrics has surged more recently. The consulting industry, as Mazzucato and Collington point out, is a major provider of ESG frameworks and related services, promoting their adoption en masse. Similarly, in education, we see an overwhelming number of frameworks, standards, and industry-led associations and alliances offering vetting programs, "evidence-based" assessments of edtechs,

evaluations of "what works," and certifications sorting out the "good quality" edtech products. The list is too long to fit here (read a full chapter on this here [60]); however, some are worth paying attention to as they also can be seen as demarcating market share, which demonstrates more the commercial value created than says much about what technologies are safe and meaningful to use. For instance, the World Bank's SABER-ICT Framework [51] aids policymakers in designing and evaluating edtech policies, while the UNESCO ICT [49] Competency Framework for Teachers, in collaboration with Microsoft, CISCO, Intel, and ISTE, supports reforms in teacher training and professional development. The PISA ICT Framework assesses the integration of digital technologies in education, and other frameworks like the *Technological, Pedagogical, and Content Knowledge* (TPAC) [56], the T3 Framework (elevating the influence of edtech into "transnational, transformational, and transcendental" domains) [59], and the International Society for Technology in Education's ISTE Standards for Educators [52] provide additional guidance. Organizations like 1Edtech (former IMS Global [61]) also offer standards and certification for edtech products (TrustEd Apps [62]). 1Edtech not only certifies edtech products but also schools, encouraging them to then "Seek out suppliers with the IMS Data Privacy Seal," which reflects the aggressive market expansion and the creation of lock-ins. These entities drive market-focused activities—from training teachers to use edtech products to forming affiliations where teachers promote rather than critique these products. They also make high-level commitments with schools and districts, providing training and technical support, which develops top-down approaches where teachers have no choice but to submit to using technologies they may not want to. This also illustrates the lucrative business of digitization, with educational programs and events like trade shows and the glamorous ASU + GSV Summit reinforcing edtech's prominence. All these standards, training, and searches for "evidence" often come at a cost for schools and districts. There are numerous more standards, including those for quality online teaching, technology integration matrices, e-assessment quality assurance, age-appropriate design standards, the ISTE *edtech Product Evaluation Guide for Teachers* [52] and its *Five Pillars for edtech Procurement* [63], and the edtech Digital Promise framework among many others. There are various legal frameworks like the EU's General Data Protection Regulation, the new EU AI, data, and digital markets laws, among the growing plethora of data privacy laws in the United States, and an endless list of cybersecurity frameworks and standards. More are likely to emerge. How do edtech companies meet any of these? Is it even possible that all vendors meet such standards? And what are students and schools to understand of all this messy market while keeping focus on studies and healthy development? In a word, a common understanding must be made and one that addresses the industry, not one whose bill falls on schools.

- *Student privacy laws:* Current legal frameworks fail to adequately protect student privacy. Existing laws primarily focus on prohibiting educators from sharing information with third parties without parental consent [15]. They have not kept up with rapidly changing technology and, therefore, do not address potential issues that may arise even when well-meaning educators use technology to serve educational purposes [44]. Vendors are not held responsible to promises backed by little empirical evidence. Administrators may use predictive analytics in a deterministic manner that reinforces existing inequalities [45]. In addition, many edtech services track students' movements, online activity, and social media presence—both in and out of school [24]. This normalizes students to constant surveillance and risks stifling their intellectual growth and willingness to express unpopular ideas. Legislators and regulators must update student privacy laws to address today's technologies and concerns.

4.4 For edtech Providers

- *Child-centered design:* Risks of harm from datafication and surveillance in education create the urgency to reset the values that guide future design and development of edtech. This includes emphasizing child-centered designs, data responsibility, and evidence-based practices. Bridging the gap between research and industry is essential for ensuring child-centered designs of educational technologies and their adoption in formal educational settings or as complementary efforts for out-of-school engagement [46]. Cross-sectoral collaboration can facilitate edtech products that are underpinned by scientific knowledge (i.e., cognitive and learning sciences) to support future evidence-based products [32]. Hence, there is a necessity for closer collaboration between researchers and industry leaders. However, that also means that industry input should not be accepted by default as the superior or "only way" option for access to education. Design that is child-centered should also be socio-ethical and humanistic [41], (e.g., what are edtech products' impacts on individual and collective cultures and values?) to safeguard children's rights and privacy.
- *Internal capacities for compliance:* Value-driven edtech providers should consider hiring for roles such as data responsibility officer to establish internal policies for the collection, use, and sharing of children's personal data. Such roles can ensure compliance with local data protection laws and data practice accountability.

4.5 For Funders and Investors

- *Transparent assessment:* It is crucial for edtech providers to develop robust products that are grounded in scientific research and validated through rigorous testing. The industry has the responsibility to share their results transparently with key stakeholders, including funders and investors. This includes demonstrating their products' effectiveness, beyond mere compliance with data privacy regulations, but also their value to pedagogy and learning.
- *Responsible investment:* On the other hand, investors must also take responsibility for demanding results before investing in and launching edtech products. As investment has the power to shape the future of education and the lives of the next generation, investing in edtech start-ups that demonstrate effectiveness in improving learning outcomes and are grounded in scientific research can drive a positive impact on education. To build a strong evidence base surrounding new technology, it is essential for different stakeholders to collaborate and work toward child-centered and evidence-based designs. Venture capitalists should also establish investment frameworks that prioritize products that align with such principles.

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