Datafication Meets Platformization: Materializing Data Processes in Teaching and Learning

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Abstract　　*In this contribution to the *Platform Studies in Education symposium, Luci Pangrazio, Amy Stornaiuolo, T. Philip Nichols, Antero Garcia, and Thomas M. Philip explore how digital platforms can be used to build knowledge and understanding of datafication processes among teachers and students. The essay responds to the turn toward data-driven teaching and learning in education and argues that digital data is not only generated through national-, state-, and classroom-level assessments but also produced through the platform technologies that increasingly support all kinds of school operations. While much has been written about the promise of such technologies for schools, less is known about the role digital platforms play in constituting this data and how the platforms can be critically engaged to build knowledge and understanding of datafication processes in classrooms. Exploring these dynamics through three vignettes that investigate platforms as an interface for teaching and learning about data, the essay focuses on the ways three interrelated properties of datafication—reduction, abstraction, and individualization—can be made visibe for analysis, critique, and resistance in schools.*

In recent years, educational institutions have turned sharply toward amassing digital data. Data is collected at all scales (the individual, classroom, school, region, state, international) and about all activities (teaching, learning, governance) to drive decision-making processes for all stakeholders (students, parents, teachers, administrators, policy makers). Collection occurs both overtly, through the documentation of performance, behavior, and population details, and subtly, through automated technologies for instruction, management, and discipline (Selwyn, 2015). The volume of information being gathered, and its growing role in underwriting the everyday operation of schools, has been termed "the datafication of education" (Jarke & Breiter, 2019; Williamson, 2017), and it has led scholars to suggest that data now functions as a critical "infrastructure" for global education in the twenty-first century (Anagnostopolous, Rutledge, & Jacobsen, 2013; Gulson & Sellar, 2019).

Increasingly, the interplay of this data infrastructure with school systems is mediated by platforms—digital spaces for facilitating social and economic exchange (Gillespie, 2010). The term *platform* is commonly associated with apps and services that support generalized networked activity (e.g., web search, e-commerce, social networking) or specialized practices (e.g., video conferencing, collaborative authoring, adaptive assessment). Schools now rely on platforms to carry out a range of teaching and administrative tasks. In the classroom, this has led to what Means (2018) calls "platform learning," or learning that incorporates the "operating capabilities and logics of digital platforms" (p. 326). As a consequence, teachers' work is increasingly mediated by platforms. The most significant platform is typically the learning management system (LMS), which channels the bulk of a school's daily teaching activities. The LMS is often *the* defining

technology in any school and is used for a whole host of activities, including delivering content, circulating classroom assignments, interacting with colleagues and students, keeping records, making reports, and generally dispensing with administrative and bureaucratic duties. Platforms are the principal point of contact through which educational stakeholders and the data infrastructures that drive contemporary schooling encounter one another.

Significantly, in facilitating these encounters, platforms are not neutral go-betweens; they play a significant role in shaping how data collection and usage occur. Research across disciplines demonstrates that the technical and economic features of platforms leave imprints on both the data processes they modulate (Helmond, 2015) and the social practices of their users (Gillespie, 2018), a phenomenon known as "platformization" (Poell, Nieborg, & van Dijck, 2019). In education, platformization is evident in the tendency for platforms to shape instructional and learning practices. For instance, they often coax teacher and student behaviors to make them legible, as data, to their own software systems, such as when educators require students to compose in Google Documents so that the work can be more easily logged and tracked in Google Classroom (Perrotta, Gulson, Williamson, & Witzenberger, 2020). Platformization is also evinced in the growing influence of platform technologies in transnational educational governance. The Organisation for Economic Co-operation and Development's (OECD) PISA4U platform, for example, centralizes "data-driven" insights about instructional effectiveness and channels them into professional learning programs that are used across countries (Lewis, 2020). Reckoning with datafication in education, then, increasingly demands concurrent attention to its entanglements with platformization and the impacts that derive from their relations.

In this article we examine this relationship between datafication and platformization and, specifically, the potential that attention to platforms offers for education research and pedagogy in a world saturated with digital data. We argue that platforms, as intermediaries between users and wider data infrastructures, offer a unit of analysis that helps clarify otherwise abstract processes of datafication. Examination of platforms can spotlight the mechanisms by which complex realities are rendered calculable and the resulting dataflows are put to work in service of competing educational demands, such as those of educational authorities and administrators and of parents and students. In this way, critical analysis of platforms not only makes such processes visible for reflection, critique, and instruction but also opens possibilities for resisting, subverting, or intervening in modes of datafication that work against the promise of equitable public education.

We consider these potentials through three examples of educational interventions that used platform analyses to ground data and datafication as an object of inquiry and contestation to show what it might look like to think critically about platformization in an educational setting. In each vignette we illustrate different facets of datafication in classroom practice: individualization, reduction, and abstraction. Together, these examples demonstrate the potential of using critical analysis of platforms as a lens for countering the effects of datafication at the interactional level of classrooms. We conclude by discussing the possibilities and challenges of these responses and the need to augment them with other forms of collective action at broader institutional and policy scales.

Datafication Meets Platformization in Education

The underlying imperative of datafication—to amass, analyze, and operationalize data as a means of optimizing social systems and practices—is not new. In education, we find antecedents for datafication in long-standing efforts to develop large-scale assessments that trace performance and growth across national boundaries: the United Nations Educational, Scientific and Cultural Organization's (UNESCO) formation of the International Association for the Evaluation of Educational Achievement (IEA) in the 1950s; the inauguration of the National Assessment of Educational Progress (NAEP) in the 1960s; the IEA's introduction of regular assessment cycles for math and science in 1995 and for reading in 2001; and the creation of the OECD's Programme for International Student Assessment (PISA) in 2000 (Kirsch, Lennon, von Davier, Gonzalez, & Yamamoto, 2013). In the US, such experiments have been the backdrop for multiple waves of standards-based reform and accountability measures that have, similarly, functioned to "datafy" education and drive "evidence-based" decision-making: Goals 2000 in the 1990s, No Child Left Behind in 2001, the Teacher Incentive Fund in 2006, and the Race to the Top in 2009 (Nichols, Edgerton, & Desimone, 2021). Such initiatives tethered federal and state support to the formation of data systems, which incentivized the production of data, the creation of centralized databases, and the embedding of data experts and technologies across countries, districts, schools, and classrooms (Hartong, 2016). The groundwork for data to emerge as an infrastructure of global education (Anagnostopoulos et al., 2013) has been in place far longer than the connective technologies commonly associated with datafication have been in use.

The emergence of such technologies has amplified and accelerated this imperative. Advances in mobile and networked media have increased the speed and volume at which data can be collected, analyzed, and circulated and broadened the scope of activities that can be subjected to parsing as data (Mayer-Schoenberger & Cukier, 2013). In education, the subfield of learning analytics, for instance, has worked to harvest data from students' online activities (e.g., clicks, swipes, pauses, searches) to extract insights for personalized instruction, classroom management, and school governance (Perrotta & Williamson, 2018; Scott & Nichols, 2017). Likewise, developments in geolocation, facial recognition, and sentiment analysis technologies have birthed flourishing industries for monitoring students' biological, social, and emotional conditions in granular, even invasive, detail—like bracelets to measure time on task or aggression detectors to predict and preempt school violence (Hope, 2016; Lupton & Williamson, 2017). While examples like these veer toward the dystopic, they are part of a larger trend toward "dataveillance" (van Dijck, 2014), which connective technologies have made durable fixtures in even the most banal aspects of schooling. Tech companies capture data generated from a whole host of students' everyday activities, including swiping in with a student ID card, logging onto a school-issued laptop, or collaborating with classmates on a shared document. Once captured, these companies can aggregate and mine this data for pedagogical, administrative, or commercial insights—or sell it to third parties to do so.

Crucially, it is platform technologies that facilitate the production, mining, and application of such data. Generating attendance data as a student swipes an ID card, for instance, requires an intermediary platform to translate an embodied action (swiping) into a data point that can be

incorporated into individual, class, or school attendance profiles. In a datafied education system, such acts of translation occur continuously and across multiple scales. To illustrate, Kerssens and van Dijck (2021) delineate two types of platforms that have become commonplace in classrooms: digital learning platforms (DLPs), geared toward instruction, skill-building, and collaboration; and learning management systems, used for administrative purposes. When a student uses a DLP—say, to take an adaptive reading-fluency assessment—their responses are not only converted into data related to reading ability but also translated into a larger LMS data set for measuring and monitoring individual-, classroom-, and school-level growth over time. If they are using a school-issued computer, taking this assessment also produces metadata—data about the data they are generating (e.g., time-on-task, app usage, search history)—which is integrated into a school- and district-level LMS for monitoring device security and student behavior. We can go further. The data and metadata that platforms help generate is filtered back not only to schools and districts but to the platforms themselves. An adaptive assessment platform, after all, is only able to "adapt" to students by comparing their responses to an existing dataset scraped from previously recorded inputs, or "training data" (Dixon-Román, Nichols, & Nyame-Mensah, 2020). As such, platform providers are perpetually reincorporating data generated by users back into their products to refine their datasets, improve their features, and ultimately boost their market value. What all of this demonstrates is, first, that datafication is a multivalent process, one that renders activities at one scale legible for use at near and distant others, and, second, that platforms have emerged as key intermediaries for shaping and sustaining such relations.

For this reason, platforms offer a powerful entry point for making sense of data, datafication, and the inflections of each on equitable teaching and learning. As the primary point of contact through which educational stakeholders and wider data infrastructures interface with one another, platforms can help concretize otherwise abstract data processes by locating them in particular socio-technical and political-economic relations. It is for this reason that Edwards (2021) theorizes platforms as "second-order infrastructures": they are built on top of "first-order" infrastructures like datafication, and are conditioning and being conditioned by these substrates; yet they are also discernible in ways that their underlying layers are not, allowing them to make visible facets of their first-order architectures for analysis, instruction, and intervention. Of course, we do not suggest that attention to platforms ought to obviate more explicit studies of data and datafication; our own work takes seriously these subjects as critical areas of inquiry (Garcia & Nichols, 2021; Nichols, LeBlanc, & Slomp, 2021; Pangrazio & Selwyn, 2019; Philip, Olivares-Pasillas, & Rocha, 2016; Stornaiuolo, 2020). Rather, we contend that platforms, as second-order infrastructures of datafication, offer a perspective for seeing these topics anew, as they are mediated by and materialized through connective technologies in and across education systems.

Materializing Datafication Through Platform Studies

To attend to the relationship between platforms and datafication in education, it is helpful to highlight their key properties, as well as the ways these interoperate. Here we focus on three features of datafication—reduction, abstraction, and individualization—and how these are mediated by the interests and imperatives that animate platform technologies. While we discuss

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these as three separate features of datafication, in reality they are interdependent, with each feature relying on the others.

Reduction

The first feature of datafication is the *reduction* of complex phenomena into a form amenable for sharing, comparison, or storage. While encoding data in this way has many advantages—for example, the compression of a large amount of information and its efficient transmission between parties—doing so always involves a process of trimming away unnecessary details to make it comport with available systems of classification. Though the term can carry a negative connotation, such "reductions" are not, by themselves, sinister. With no vantage point from which we can grasp the totality of an object of study, reduction is vital to any process of producing and ordering knowledge (Bowker & Star, 2000).

This becomes problematic, however, when reductions are mistaken for the totalities from which they are culled. In schools, for instance, attendance and test performance data are often used as proxies for "learning" (Selwyn, Pangrazio, & Cumbo, 2021a). Over time and with repetition, such reductions can become reified, nudging teachers and students toward behaviors that accord with this one sense of "learning" at the expense of others. For example, multiple-choice tests may be prioritized by teachers over written responses because the outcome can be more easily quantified. This is another way of saying that the "structural objectivity" often ascribed to datafication, particularly in a time of computer-assisted collection and analysis (Daston & Galison, 2007), is shot through with human judgments: what will be included or omitted, how it will be simplified

and analyzed, how the results will be represented and shared. As Eubanks (2017) argues, choices about what goes into these variables "reflect the priorities and preoccupations of their creators" (p. 143). Reducing complex social activities to computable forms, then, can be a fraught and political process.

Abstraction

A second feature of datafication is that it relies on *abstraction* to draw out patterns within and across these reductions. *Abstraction* refers to the process of removing information from its original context so that it can be aggregated and processed. There is no limit to the data that can be abstracted from digitally mediated activity; this includes not only the data that users volunteer to share but also the metadata that can be scraped from their usage and the analytic data that can be inferred from sifting such flows through probability-based algorithms (Abrams, 2014). Social media platforms, for example, provide a continual stream of personal data that can be mined by sentiment analysis to "abstract" the emotional response individuals have toward a particular topic or brand (Kennedy, 2012). Once in a datafied form, this information can be collated and processed to make inferences about individuals—who they are, what they are likely to do, and so on.

Because these inferences are based on reductions, they are not always accurate. As data is removed or abstracted from its original context, any information that might help make sense of this data is also removed. Instead the priority is on finding patterns and correlations. Data scientists might find a correlation between data and particular variables that does not appear relevant, but which

enables the creation of a proxy, when data "stands in" for another variable. For example, a postal code might be used as a proxy for race; however, it is clearly a weak connection that does not always hold. Problems arise when proxies are taken as ground truths in data science (Crawford, 2021; Noble, 2018). The stakes of such inaccuracies are amplified when a logic of abstraction curates user experiences. By extracting data from the contexts that produce it, abstraction tends to reflect the dominant norms and values of white, capitalist heteropatriarchy (Benjamin, 2019). This is particularly problematic in educational datafication, since many of the issues that schools face have origins in structural inequalities that are not captured by, or considered in, data about student learning or teacher effectiveness. Even more, because the processes that produce these omissions and biases are black-boxed and hidden beneath the screen, they are beyond the scrutiny of most users. This makes it difficult for educators to understand the ways data is being defined, constructed, collected, shared, and commodified, much less intervene. Like reduction, abstraction is not just a technical process but an ideological one.

Individualization

Finally, a third feature of datafication is *individualization,* or the differentiating of the individual from the group. Broadly, individualization has been a guiding principle of the late modern era, when the erosion of public institutions and other collective forms of life has given way to the centering of the individual as the locus of choice about, and responsibility for, social and economic conditions (Brown, 2015). The advent of mobile and connective media has amplified this tendency, introducing new tool sets for monitoring and acting on individuals. Not only is access to most digital platforms individually negotiated, but "users" must learn how to navigate

particular features in order to participate. In this way, digital platforms act as "pedagogic devices," schooling users into particular norms and behaviors (Sefton-Green, 2021).

The collection and processing of personal data is key to this, as it not only guides and rewards digital participation but also reinforces the primacy of the individual. As Lupton (2020) explains, personal data refers to *any* "digitised information generated by entanglements of people with digital devices, apps, sensors and online platforms" (p. 4). Personal data can be drawn from a wide range of software and hardware sources and can take a variety of modes, including numbers, characters, symbols, images, electromagnetic waves, sensor information, and sounds. Once processed, this data is used to "personalize" digital content so that the platform can better meet the interests and needs of the individual user. Typically, this involves the creation of categories that are used to define target audiences and markets. However, these categories are not always accurate or appropriate and may not align with individual experience. Personalization can also make it difficult to collectively reflect on or critique content, since not everyone will have experienced the same content or interaction. For example, with a controversial advertisement in the newspaper, all readers are exposed to it and therefore have an opportunity to act together to have it removed; but the same cannot be said of online advertising because advertisements are personalized to individuals.

Datafication as a Platform Process

There are two points worth highlighting about these features of datafication. First, while we present them here as three distinct properties, in reality they are mutually constitutive. Each is

dependent on and sustained by the others. For example, the process of personalizing advertisements on a social network, or delivering adaptive feedback to a student using a digital learning platform, involves the recursive work of all three features: targeting individuals as nodes for data collection (individualization); isolating specific data points to be extracted (reduction); mining this data, in aggregate, for patterns (abstraction); and reintegrating the resulting inferences to shape subsequent user activities or experiences (individualization, again). It is the entanglement of these features, and the performativity of their relations, that distinguishes present-day datafication from its antecedents. Particular to education, for instance, large-scale assessments have long promised to deliver usable insights for improving policy, curriculum, and instruction. However, it is only in the last two decades that connective technologies for harvesting, analyzing, sharing, and storing data have been able to extend this logic from stand-alone tests into even the most mundane aspects of school and classroom life. In this way, while reduction, abstraction, and individualization have always been integral to data-driven education, it is their consolidation as constant, concurrent forces that is the hallmark of educational datafication.

Sececond, though it is common to talk about these features of datafication as "data processes," in an important sense they are also "platform processes." The technological shifts behind the proliferation of datafication in education are closely tied to the emergence of platforms as networked spaces for facilitating the collection and use of digital data (van Dijck, 2013). In this way, platforms offer a vantage point for studying the complex interplay of reduction, abstraction, and individualization in data-saturated schooling. As second-order infrastructures, platforms stand as a discernible point of translation between local classroom practices and their performative

entanglements with wider datafication processes. Importantly, in this role platforms are not neutral; they mediate the competing *interests and imperatives* of educational datafication.

By *interests* we mean the diverse, even contradictory purposes for which datafication is enacted and the conflicting values they serve. For instance, a third-party platform provider's reasons for amassing aggregate information about users is likely very different from that of the administrator who approves the use of this service or the teacher who implements it. As intermediaries in the datafication process, platforms are the terrain where these incongruities converge, and, as such, they provide a view of how they are negotiated in practice. By *imperatives* we refer to the role of data and platform systems in modulating or coaxing educational practice. For example, if the design of a platform asks teachers to document certain types of student behavior (to reduce data in a specific way), this encourages a particular platformized vision of classroom activity, which educators may adapt to or resist.

Platforms are spaces where data processes are materialized in classrooms and where classroom practices are materialized as data. And, importantly, they are also where mistranslations of either produce visible frictions. It is for this reason that attention to platforms provides a powerful object of analysis for understanding not only how datafication impacts equitable education but also where there might be generative possibilities for inquiry and intervention.

Platformization and Datafication in Practice: Possibilities for Intervention

To explore how platform analyses in education can open space for critical inquiry and intervention, we turn to three examples from our own research and practice. Each of the three vignettes illustrates how the intermediary nature of platforms concretized processes of datafication for educational stakeholders, making legible the properties of reduction, abstraction, and individualization and creating space to contest or counter the effects of datafication. While we recognize the mutually constitutive nature of these three properties of datafication in each vignette, we highlight each in turn to illustrate the specifics of how these properties of datafication can be materialized through platform analyses and thus negotiated in classroom practice. All three vignettes consider how platforms can serve as a starting point for grappling with educational datafication, making data processes visible and thus available as resources for stakeholders to move from critique to action.

Reduction in Practice: Relocating Data Practices to Center Youth Knowledges

In this vignette from a high school media makerspace, the teacher and students grappled with—and challenged—the reductive dimensions of datafication. Coming from a yearlong social design research study focused on data literacy (Gutiérrez & Jurow, 2016), this vignette centers on one educational intervention the teacher and Amy Stornaiuolo collaboratively designed to shift the location from which data was theorized, generated, and used—specifically, to center young people and their epistemic frameworks for making sense of the world around them. Such a topological shift (Gulson & Sellar, 2019) frames youth as agentive actors within broader networked infrastructures who produce, author, and interpret data from particular social and

cultural locations, pushing back against views of data as a neutral indicator of an objective reality and outside of young people's control (Acker & Bowler, 2018). We focus here on one project that youth created within that broader study to highlight how they engaged in critical platform analyses in ways that challenged the reductive dimensions of datafication.

The pedagogical intervention involved an eight-week sequence of activities that began with students generating personally meaningful research questions and then collecting, analyzing, and visualizing that data from their own lives. Students enrolled in a semester-long elective class in the media makerspace to fulfill an arts requirement. All of the participating students, identifying primarily as Black and/or Latinx, reflected the demographics of the urban district. This vignette focuses on the twenty-two students who examined the role of media in their daily lives by posing questions like: What is the effect of different social media sites on my mood each day? Who are the audiences visiting my e-commerce website, and what do they do there? How often do I play games each day, and how do I experience the different games? How often do I touch my phone each day and for what purpose? An important element of their process involved critical analyses of the media platforms they interacted with daily (e.g., gaming, e-commerce, social media sites) to consider— what data was already available via these platforms and how well the existing data addressed their questions. The students collected a week's worth of data from platforms like Nintendo, Instagram, and Wordpress to determine what kinds of data were collected in each and how it was made available and displayed to users.

Students' critical platform analyses made everyday processes of datafication visible to them in new ways. Students found that the data collected about them was reductive; it was not just partial in terms of what was collected and displayed, but it flattened their experiences to one-dimensional representations. While they could look at their Instagram dashboard to know how many people clicked on a story or check their gaming stats to know how many minutes they played, the data showed only a small fraction of students' lives and did not address some of the deeper inquiries they were making—What feelings motivated what kinds of posts? How did their time spent playing a game shift based on who they were playing with? How did audiences engage differently across kinds of content? These questions led students to consider what "counted" as data and who decided what would be collected, helping them develop new insights into how digital data abstracted and reduced the complexities of their activity depending on what was measured and measurable.

One benefit of such a critical interrogation of their platform practices was that students began to challenge narratives of platforms as neutral conductors of information and data as external realities that acted on them without their knowledge or consent. For example, the students questioned how processes of datafication were connected to the ways information was collected and represented not only on media platforms but also on school platforms, leading to a powerful conversation in class about how the school's attendance system similarly reduced their participation in school to a static metric. One student wondered why swiping a identification card at the school entrance after a certain time marked him as absent (even though he was present but late) and how that "data story" became a harmful narrative among teachers and administrators

(that he was chronically missing school). Other students chimed in and outlined further harmful ramifications, such as calls home by the office, the need to remember to ask a teacher to override the system, blocks on one's access to the online LMS, and a desire to skip school since they would be marked absent anyway. These competing imperatives were made visible by students' critical interrogation of how platforms mediated data processes and thus shaped educational practices in ways not necessarily intended or fully apparent.

While the critical inquiry into their practices with data was an important part of the intervention, the students found the act of collecting and visualizing their own data even more powerful. Essentially, students were engaged in critical writing with and about platforms, deciding how to display the data they collected to tell a story about themselves. This writing exercise involved students representing their findings in data art and then transferring it to a T-shirt that they wore (see image 1).
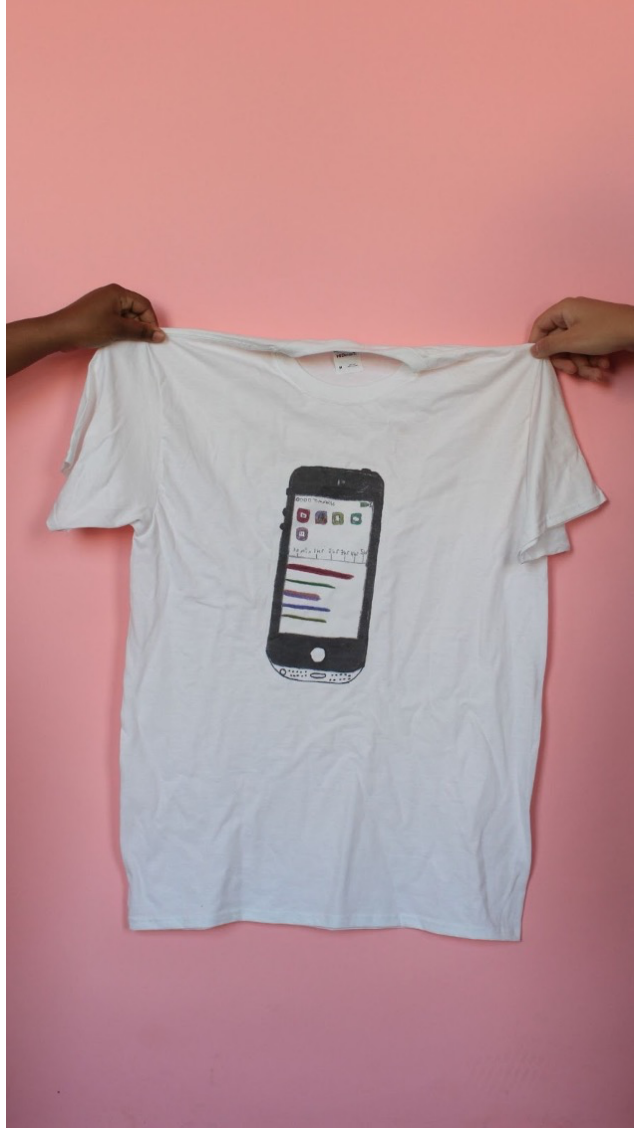
Image 1. *Example of t-shirt data art about smart phone use*

Through the process of collecting data about themselves, students reported that they felt more in control as they understood that "we can collect data . . . about what we care about." In designing their own measures of data collection, students reported seeing themselves as authors of their own data—and seeing data as representational and interpretive resources shaped by human infrastructure. As they began to design their own representations through data art, they grappled

with implications of data reduction, both what was afforded (e.g., relationships across time and space) and what was obscured (e.g., the texture and fullness of an experience).

In one data visualization, a young woman represented the ways she used social media platforms by drawing different colors and lines that corresponded to different actions she took on each platform and her mood while doing so (see image 2). She compared the data available across Facebook, Twitter, Instagram, and Snapchat, noting that each offered different windows into her activity with various kinds of analytic insights and displays. She traced her emotions as she posted in each site to learn about her motivations and how she felt after she posted. She found that the different platforms not only shaped what she did in the space but how she felt during and afterward (e.g., the boost of Instagram likes on photos was more satisfying than it was on Facebook).
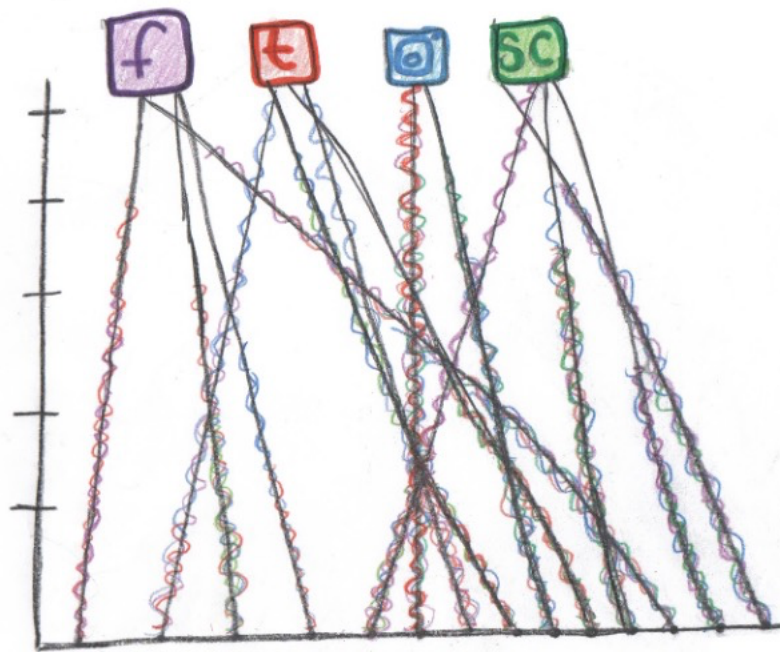
Figure 2. *Data visualization tracing one student's uses of different platforms*

The critical platform analyses involved in students' activities with data—from collecting to analyzing to visualizing data of personal relevance and concern—helped make visible often obscured dimensions of datafication in students' lives. The students grappled particularly with the implications of data reduction, not only the ways platforms flattened their experiences but in their decision-making around how to reduce and represent data for their own purposes. For example, some students used the reductive dimensions of datafication to obscure their findings on the T-shirts that would be publicly read by others without context. The student who drew image 2 deliberately left off key information that would help readers make sense of the graph, thus reducing the data to an abstract, artistic image that could not be read as data. This vignette demonstrates how students' platform analyses made visible datafication processes in their everyday lives, opening space not only for reflection but for critical action as they centered their particular lived social locations as a source of knowledge and used data's reductive capacities for their own purposes.

*Materialization in Practice: Countering Abstraction Through an Educational Chat App*

In its unprocessed state, digital data appears as strings of indecipherable numbers that few data experts can understand. However, when individuals encounter data, it is already in a representative form far removed from its original state. It appears more familiar as lexical, visual, or graphical information. While this makes it easier for the average person to interpret and act on data, it also means that platform architectures play a fundamental role in its creation and constitution. For example, platform architectures determine which data is collected and how it can be used and who should interpret it. They also determine how processed data is presented

back to users through analytics, dashboards, and metrics. The materialization of data through the platform is therefore integral to how everyday people understand, imagine, and act on data.

This second vignette explores ways of materializing data differently in order to expand how we think about data and to encourage a more critical disposition toward it. It is drawn from an international project (Pangrazio & Cardozo-Gaibisso, 2020; Pangrazio & Cardozo-Gaibisso, 2021) that aimed to build critical understandings of social media platforms among three hundred young people aged ten to twelve years in Australia and Uruguay.[1] The project focused on using the platform interface to develop understandings of how personal data is produced and processed as a consequence of use. Working with young people, this intervention aimed to "speak back" to the key features of datafication—namely, the abstraction of data from everyday social life as well as the individualized ways users encounter and interpret it. More specifically, this intervention sought to materialize geolocational data, which is one of the most common types of digital data generated through mobile devices because users are rarely privy to the level of detail and precision involved. First, geolocational data was visualized into a text that helped participants learn about data collection and processing. They then attended workshops to facilitate collective reflection and action with the aim of expanding and contesting current thinking about data. The first workshops focused on building understandings of data and social media platforms, while in later workshops researchers and teachers collaborated with students to come up with strategies and tactics to better manage and protect their data.

To begin the project, Luci Pangrazio worked with developers and primary school students in regional Australia to design an educational chat app called FriendSend. Researchers consulted students on the design and development of the app, concentrating on issues of the look and feel as well as what they thought was important in a chat app (e.g., group chat, sending videos). The overriding purpose of the app was to experiment with ways of materializing data so that children and young people might develop new and more critical perspectives and understandings of data. The app appears as a regular chat app, but it is able to collect and process the data generated through chat and present the insights to users via a dashboard on an associated web app. Using Google APIs, researchers processed the chat, image, and geolocation data to mimick the personal data profiling that takes place on most mainstream apps today—but without the commercial implications. Working closely with software developers, the researchers presented data to the young participants in a way that was both age appropriate and informative. This involved using colorful graphics, easy-to-read visualizations, and simple explanations of how their data had been processed.

While the app processed geolocation, text, and visual data, the materialization of geolocation data was most powerful in initiating critical understandings. Researchers presented geolocation data to participants via a map on the FriendSend dashboard that depicted where the students had been while using the app (see image 3). Using the Google Maps API, a red pin on the map indicated where geolocation data had been collected and a green pin showed where the student had taken a photograph.
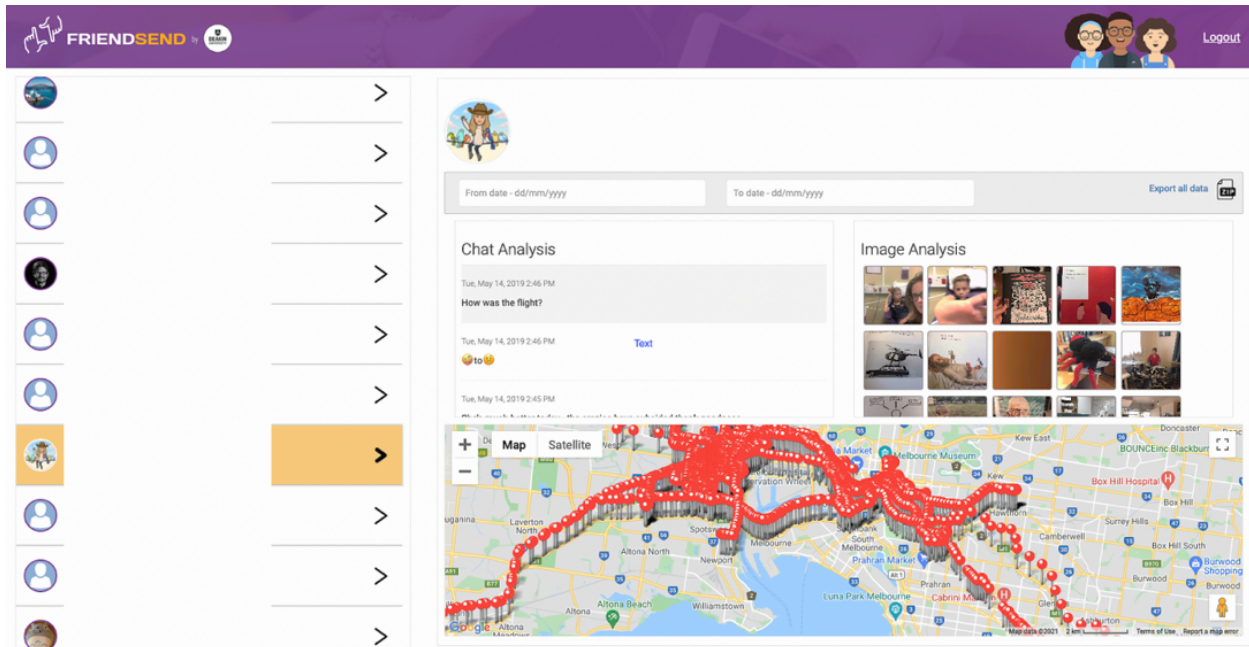
Image 3. *Screenshot of the app dashboard showing location data.*

The FriendSend web app helped participants see how their experiences were turned into data points for commercial data processing, which developed their understanding of how data was abstracted so they could appreciate the implications of data processing. Use of the app was supported by a series of workshops designed to help students develop understandings of digital data and to co-construct alternative ways of engaging with social media along more critical lines. The findings provided a range of insights into young people's data understandings and practices (Pangrazio & Cardozo-Gaibisso, 2021).

While the workshops discussed at length the rationale (and likely consequences) of permitting geolocational tracking through the chat app, students were consistently unnerved by this more direct representation of abstracted data. When students downloaded the FriendSend app, they were asked permission for the app to collect their geolocation data. Despite this, they were still

surprised by the accuracy and detail of the tracking. In the workshops, the researchers and teachers used these revelations to build understanding around datafication processes and to discuss how other apps and platforms also track geolocation data. As Mayer (2013) reasons, geolocation data can be especially revelatory; knowing where people go provides intimate and wide-ranging information about their professional, personal, and leisure lives. This seemed to resonate strongly with students and was manifest in their reflections on the program. For example, when asked what they had learned, one student noted "how many websites can actually see what you've been doing and . . . that even though you didn't let them, they kind of just did it anyway." Another student explained how personal data could be used by businesses: "It could track you to understand, 'Oh, you live there. Oh, here are some local businesses that we could get you into.'"

Materializing data through the web app revealed to students in real time how it was being generated by their use of the FriendSend app. This prompted a series of critical conversations and questions that enabled a clearer understanding of how platforms structure and process data and, consequently, expand their digital realities. Materializing data and data processing also helped the researchers and teachers break down the datafication process into its constituent parts (data generation, data processing, data implications) to reveal how these shaped student participation and behavior. The chat app and workshops also gave students the critical distance to reflect on their data practices and to question datafication processes. They enabled teachers to avoid didactic approaches which implied that there are "right" and "wrong" ways to use media and instead align their intervention with critical approaches that emphasized deeper thinking and reflection.

While this was not easy or straightforward work, (re)materializing data as a text for analysis essentially reversed the abstraction process, helping participants actually see the issues raised by platform architectures in more granular and detailed ways. Furthermore, exploring the processes of materialization enabled students, teachers, and researchers to examine *together* the "historical particularities, cultural specificities, and political consequences" of data (Dourish & Mazmanian, 2011, p. 4). Future educational projects need to investigate the dynamic interplay between the physical form of data and the nascent and evolving qualities it holds. Importantly, there needs to be greater attention to how the physical forms of data facilitate and create particular meanings, as well as to identifying the opportunities for individuals, particularly nonspecialists, to imagine and craft new meanings and interpretations.

Individualization in Practice: Analyzing Ideologies of Stand-Alone Classroom Platforms
Platforms, as a technology, afford and constrain pedagogical possibilities (Philip & Garcia, 2013, 2015). As they become integrated into the fabric of schools, they shape the pedagogical realities and imaginations of preservice teachers engaged in student teaching. This last vignette explores how these issues were taken up in the course "Technology, Computing, and Data in Classrooms" that is part of an MA and teacher credential program at the University of California, Berkeley. The reflections are from the Spring of 2021, a period characterized by the global pandemic and an abrupt transition in local K–12 schools from distance learning to modified in-person instruction.

With the return to modified in-person instruction, the uneven distribution and persistence of stand-alone platforms across lines of race and class were particularly glaring. Two platforms extensively used in the local schools where some of the preservice teachers were placed were i-Ready and NoRedInk. These schools enrolled the highest proportion of students of color and low-income and working-class students. As described on its website, i-Ready "delivers online lessons that provide tailored instruction and practice for each student to accelerate growth," "supports teachers with in-the-moment resources for remediation and reteaching," and "provides user-friendly dashboards and clear reports with actionable data" (Curriculum Associates, 2015). At the K–8 level, i-Ready's "adaptive diagnostic pinpoints students' needs down to the sub-skill level and generates a combination of online instruction for grades K–8 and downloadable teacher-led lessons that are unique to each student's diagnostic result." In 2016, i-Ready reported that it was used in approximately 10 percent of K–8 schools in the US[2]. In 2020, that increased to 25 percent[3]. Similarly, NoRedInk is a platform that promises to "build stronger writers through interest-based curriculum, adaptive exercises, and actionable data."[4] Meant for grades 4–12, but used mostly at the middle and high school levels, it features "diagnostic testing features to determine student strengths and deficiencies, adaptive learning technology that adjusts to student correct and incorrect responses, immediate feedback for students, and auto-grading for all assignments" (EdSurge, 2021). NoRedInk boasts that it is used in one of every two US school districts.

In class discussions, the preservice teachers engaged with the ethical, political, ideological, and pedagogical possibilities, risks, and dilemmas of these platforms. They problematized the facile

arguments that these platforms help students "improve their skills with engaging material" so that teachers can be "freed up to focus on big-picture concepts" (Curriculum Associates, 2015)—claims that obscure the pedagogical complexities of classrooms. The course created a space for them to become data literate about the platforms that were increasingly shaping their work as teachers. Situating the platforms' uneven usage across race and class, the students were also supported in becoming "racially literate about data" and "data literate about race" (Philip et al., 2016).

The preservice teachers found Boninger and Molnar's (2020) policy brief about the considerations of adopting digital platforms particularly helpful in analyzing the affordances and constraints of digital learning platforms. They homed in on two major concerns: the pedagogical assumptions underlying personalization and data privacy issues with learning platforms. Drawing from Boninger and Molnar (2020), students recognized that the discourse of personalization and mastery that defined i-Ready and NoRedInk were deeply rooted in behaviorist learning theory. These platforms break learning down to the smallest possible skill and teach students by providing immediate feedback. Here, datafication drives the type of learning that is valued and made readily possible for students. Students only progress in a learning sequence after they master a particular skill. The preservice teachers' analyses of these platforms allowed for a collective consideration of the multiple meanings collapsed into the term *learning,* as well as the various implicit and explicit purposes that are associated with schooling. They explored how the platforms were well suited to promote the types of skills and knowledge that are assessed on standardized examinations, which helped them articulate how they see the purpose of teaching, particularly in a democratic society.

They recognized that rather than leveraging a technology to support expansive and generative forms of learning, the possibilities of learning were being constrained to fit the capabilities of the platform's underlying technology (Philip & Garcia, 2013, 2015).

In the course, the preservice teachers also inquired into the role of uncertainty, spontaneity, and improvisation in learning (Philip, 2019). They recognized that teaching is "pre-loaded" in these platforms, albeit with predictive analytics, in that it scripts teaching and learning and "crowds out the unanticipated" (Boninger & Molnar, 2020), or limits the opportunities for engaging and productive tangents, curiosities, and explorations. The political contexts and consequences of these approaches also became quickly apparent. Because the platforms were disproportionately used in schools that enrolled students of color and low-income and working-class students, the pedagogical assumptions in these platforms raised questions about the socialization of students into a racialized and classed society (Anyon, 1980).

The preservice teachers were also struck by issues of data privacy in these platforms. First and foremost, it became apparent how difficult it was to understand privacy policies and user agreements. It wasn't lost on them that even as graduate students they found the documents convoluted, vague, and confusing. For instance, while both platforms indicated that user data would not be sold, it was unclear how third parties might use the data. The privacy statement for Curriculum Associates[5], the developer of i-Ready, refers the reader to the privacy statements of their third-party service providers, Hotjar and NextRoll, embedding privacy policies within privacy policies. Clicking on links within the Curriculum Associates privacy statement further

reveals that the company accumulates information about students' race, gender, English language designation, eligibility for free and reduced-price lunches, etc. Especially in light of steady data breaches, the preservice teachers considered the relative value and risks of collecting and storing these data.

Consent to user agreements also raised questions. In NoRedInk, the "school, district, and/or teacher has agreed (via the terms described in the Terms of Service) to obtain legally-adequate consent for that child to use the Applications and disclose personally identifiable information to us."[6] The preservice teachers expressed concern about whether schools and teachers engage in the consent process. And given the substantial time and effort it took them to make sense of these documents and their many embedded links to other documents (often unsuccessfully), the preservice teachers expressed concern about the degree to which schools and teachers fully understand these documents.

Closer attention to privacy statements also raised questions among these preservice teachers about the potential role of platforms in monitoring and surveilling teachers. For instance, i-Ready "records when educator account logins are created, and when educators log in and out of the i-Ready platform." This information is used to communicate with "district-level administrators more effectively about their specific implementation and to better understand how educators use the i-Ready [platform]" (Curriculum Associates, 2015).

It also became evident how onerous it was to delete data from platforms like i-Ready and NoRedInk. I-Ready's policy indicates that "upon the written request of a customer, Curriculum Associates will remove all personally identifiable student and educator data from its production systems when CA will no longer be providing access to i-Ready to that customer."[7] NoRedInk policy states that requests will be redirected to the school or district and that the company will respond to requests when students are no longer affiliated with a school or district.[8] The preservice teachers observed the burden this placed on parents and/or teachers to understand the significance of the data collected and to actively request that the data is securely deleted.

A critical analysis of educational platforms within a teacher education program offers possibilities for preservice teachers to examine underlying theories of learning and privacy issues. Especially as similar platforms are increasingly adopted in schools, it is imperative that teachers, and preservice teachers, are supported in developing lenses to critically examine the ethical, political, ideological, and pedagogical contexts and consequences of these tools so they can work alongside students, parents, and administrators to ensure that the incorporation of platforms into school contexts mitigates potential harm and supports equitable learning.

Mechanisms for Countering Datafication Through Platform Analysis

One of the central challenges in developing understandings about how digital data have intensified processes of personalization, surveillance, and standardization in schools is the invisible or deliberately obfuscated nature of these processes of datafication. In the three vignettes, we tease apart how these datafication processes can be made visible through platform analysis.

Such an orientation helps clarify the ways reduction, abstraction, and individualization operate to help researchers and participants identify and scrutinize the issues and challenges that arise from digital data. Looking across the three vignettes, we can identify two primary mechanisms involved.

First, the educational interventions all made different data processes visible for reflection and critique. This effort to make visible the often transparent (and seemingly neutral) processes of datafication at work through platforms was facilitated by critical platform analyses that drew on stakeholders' everyday knowledge and rendered it available for collective sensemaking. In the first vignette, high school students analyzed familiar social media platforms, forming personally relevant questions that challenged the location from which data is traditionally theorized, generated, and used. In the second vignette, primary school students interrogated the ethical and practical implications of the collection of location data by apps, contesting and expanding how data is tied to people's everyday activities. And in the third vignette, preservice teachers evaluated the ideological dimensions of i-Ready and NoRedInk, demystifying assumptions inherent in these kinds of educational platforms that rank and sort students. In all three examples, the critical analyses of platforms involved educational stakeholders seeing data in new ways: recontextualizing platforms for different purposes, asking different questions that expanded what counts as data, and materializing data in different visual forms. Importantly, such re-seeing of activities involved people not only drawing on their existing knowledge but being in conversation with one another to learn from and with others' perspectives. Such collective sensemaking was key to each intervention making visible these often submerged dimensions of platform dynamics.

The second mechanism for concretizing abstract data processes involved moving beyond critique to action. If making visible the relationships between platforms and data processes was an important first step, each of the interventions makes clear that critique is not enough to disrupt the deeply embedded processes of datafication that contribute to inequities in education, and each offers possibilities for how stakeholders might resist or subvert those processes at the individual, classroom, or school levels. In the first vignette, youth engaged in a generative process of collecting and representing their data in new forms (that were also embodied and performed), taking action at the individual level but also creating opportunities for critical sensemaking as a group to push back against inequitable school data policies. In the second vignette, the rerepresentation of geolocation data opened up new understandings and insights into datafication, and through collaborative workshops participants devised new strategies and tactics to protect and manage their personal data, as well as reimagine how data might be used in new technologies or apps. And in the final vignette, preservice teachers faced choices about how to work with platforms like i-Ready in their own and others' classrooms and how they could become change agents at their respective schools and districts. These three examples of interventions shed light on the kinds of critical understandings that are necessary, and by expanding, contextualizing, and collectivizing data, study participants were also able to move beyond critique and toward reimagining new ways to "do" data.

In focusing on these two mechanisms, we emphasize the possibilities of using platforms—which serve as a principal point of contact with flows of data—as critical tools for action. In other words,

platforms serve not only as tools for data-driven instruction but as objects of inquiry themselves. Making explicit these processes of datafication through critical platform analysis is an important critical action itself, pushing back on the obfuscation and ideologies that render data neutral and objective. This provided a different point of analysis to the prevailing tendency to promote data education among young people and educators by centering skills (e.g., interpreting and using data or learning analytics) and personal responsibility (e.g., being vigilant about online privacy, monitoring social media usage). By expanding the analysis to include the platform and data infrastructures the conditions which shape platform participation are also examined. This, in turn, can set the stage for powerful, transdisciplinary learning that not only grapples with the form and function of existing data systems but also invites discussion about alternatives, asking: What data, and data technologies, might contribute to more just and democratic forms of life? And what kinds of subject-area knowledge and practice are necessary for creating the conditions for such speculative possibilities? Together, these initiatives build critical awareness and understanding of platforms, mainstreaming the debate in public life and potentially paving the way for "top-down" regulatory change.

Expanding Possibilities for Action: Working Across Scales
 While we focus on examples of interventions at the classroom level, the mechanisms by which platforms concretize wider data processes—by making them visible for critique and, in doing so, enabling possibilities for action and intervention—have implications that extend to other scales.

At the level of instructional practice, for instance, there has long been an emphasis on the integration of connective technologies into teaching and professional learning. The last decade has seen a dramatic increase in the number of districts and schools requesting funding to introduce personalized learning platforms into classrooms (Molnar & Herold, 2018). Scholars have identified an emerging area of research weighing the role of such technologies in supporting data-driven instruction and accountability (Daruwala, Bretas, & Ready, 2021). Attention to platforms, we suggest, helps clarify the relationship between these activities and their imbrication with wider data infrastructures. As the third vignette illustrates, platforms stand as observable intermediaries that offer a glimpse into the ideologies inherent in algorithmic "personalization," and how these might undermine the aims and values of teachers, schools, or students. This vantage point suggests the need for a shift in attention from the integration of connective and data-driven technologies into classrooms to the cultivation of pedagogical and ethical clarity around how constructions of data and processes of datafication might support or upend the larger project of equitable public education for all.

We also find resonance at broader scales of school leadership, governance, and policy. Though our cases highlight how attention to platforms can make data and datafication amenable for scrutiny and intervention in classrooms, they also point to the ways certain types of intervention may be needed outside the walls of schools. In other words, there are limits to the ways individual students, teachers, schools, or districts can respond to datafication by themselves. However, analysis of platformization helps direct attention to where opportunities for more expansive modes of protection and regulation might be possible, or necessary. For instance, in our own partnership

work with districts and schools (e.g., Desimone et al., 2019; Nichols, 2022) we have seen how data policies and technology screening procedures can help prevent certain forms of third-party data collection from occurring in classrooms, a practice that creates leverage against platform providers that would not be possible at the scale of individual teachers or schools. At the same time, the implications of using commercial digital platforms in schools needs to move beyond data privacy to consider the value and role of data in the increasing marketization of education (Komljenovic, 2020).

The Challenges and Limits of Platforms

Education stands at a critical juncture. While there is evidence that teachers and students can *still* resist and work around datafied processes (Selwyn, Pangrazio, & Cumbo, 2021b), the creep of commercial platforms into schools continues, and with that comes the datafication of a whole host of school-based phenomena. Currently, it is still possible to intervene in how platforms are used in education; we do not have to accept the datafication of education along commercial lines. In this article, we showcase three interventions that disrupted the key principles of datafication—reduction, abstraction and individualisation—by repurposing and reexamining platforms. While platforms play a pivotal role in datafication, they can also be leveraged to build awareness and instigate action on datafication. To be clear, we are *not* arguing that we need more platforms or that critical analyses of the relations of domination will necessarily amount to change. Instead, we argue that platforms provide a critical interface into data infrastructures that can be usefully employed in education interventions to reimagine how we might "do" data along more just and sustainable lines.

We suggest potential directions for pedagogical interventions that forward critical data literacies (Nichols, Smith, Bulfin, & Stornaiuolo, 2021; Pangrazio & Sefton-Green, 2020; Philip et al., 2016; Stornaiuolo, 2020) through a focus on platforms as critical intermediaries. The interventions presented in the vignettes gave participants a firsthand look at how data was being used (as well as opportunities to think about how it could have been used better) through analysis of platforms. These cases provide different examples of how we can *collectively* work toward more just outcomes for school and society, as well as disrupt and dismantle systems that intensify inequality and oppress and marginalize the most vulnerable. Increasingly, there are public interest projects and campaigns that offer further models for how educators and students might engage in such forms of collective action. Organizations like the Algorithmic Justice League have mobilized responses to shut down government use of facial-recognition software (Buolamwini, 2022); others, like We Be Imagining[9] and Screening Surveillance[10], have used art and accessible media to provoke discussion and strategizing around the alternate, abolitionist technologies that might be possible if we were to build, or demand, them. Such work can provide inspiration for how shared inquiry among educators, students, and communities might move beyond the initial steps we describe here to more direct actions and durable transformations. As stakeholders interrogate the racialized, power-laden nature of data and help connect researchers, educators, and students to more distant stakeholders with different methods of intervening, possibilities for collective critical intervention at different scales might expand. Indeed, given the power of the edtech market, it is only through both bottom-up interventions like those described here combined with top-down regulation from policy makers that genuine change can take place.

Notes

1. For more details, see https://en.datasmartkids.com.

2. https://www2.curriculumassociates.com/aboutus/Press-Release-Curriculum-Associates-i-Ready-Helps-Close-Achievement-Gap-Students-in-Nation-Largest-Urban-School-Districts.aspx

3. https://www.curriculumassociates.com/about/press-releases/2020/06/ca-updates-i-ready-during-school-closures

4. https://www.noredink.com/about/product

5. https://www.curriculumassociates.com/support/privacy

6. https://www.noredink.com/privacy/archive/2.0.0

7. https://www.curriculumassociates.com/support/privacy-and-policies/i-ready-data-handling-privacy

8. https://www.noredink.com/privacy

9. https://americanassembly.org/we-be-imagining

10. https://www.sscqueens.org/projects/screening-surveillance

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