RUNNING HEAD: SORTING MACHINES

Sorting Machines:
Digital Technology and Categorical Inequality in Education

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ABSTRACT

Existing scholarship suggests that schools do the work of social stratification by functioning as “sorting machines,” or institutions that determine which populations of students are provided educational resources needed to help them get ahead. We build on this theory of social reproduction by extending it to better understand how digital technology use is implicated in this process of unequal resource allocation in schools. We contend that educational resources, like digital technologies, are *also* sorted by schools. Drawing on scholarship from both educational research and science and technology studies, we show how educational institutions have long played a role in constructing the value of technologies to different ends, by constructing hierarchies of technological activity, like “vocational” and “academic” computer use, even when strikingly similar. We then apply this lens to three areas of inquiry in education research: the use of digital technologies for instruction, school use of student data, and college admissions. Each illustrates how education scholars can view technologies as part of school sorting processes and with implications for inequality within and beyond the classroom.

INTRODUCTION

Existing scholarship suggests that schools do the work of social stratification by functioning as “sorting machines,” or institutions determining which populations of students are provided resources needed to get ahead (Collins 2009). We build on this theory of social reproduction by extending it to how digital technology¹ use is implicated in this process of unequal resource allocation in schools. Educational resources, like digital technologies, are *also* sorted by schools. Drawing on scholarship from both educational research and science and technology studies, we show how educational institutions have long played a role in constructing the value of technologies to different ends, by constructing hierarchies of technological activity, like “vocational” and “academic” computer use, even when strikingly similar (Rafalow 2020). This lens can help education scholars to view technologies as part of school sorting processes and with implications for inequality within and beyond the classroom.

Using this framework – how schools sort machines as resources to different ends – we suggest that there are a number of key areas of opportunity to anchor educational research to the study of digital technology use in education. How schools categorize similar technologies for different instructional purposes depending on assumptions about their student demographic; how software and student data are categorized in ways that lead to inequality, such as through selective use of such data from minoritized students to surveil them for disciplinary purposes; and how college admission approaches that use students’ digital footprints to categorize some students as elites worthy of admission.

HOW SCHOOLS SORT STUDENTS AND MACHINES

¹ We define technology as artifacts – digital or analog – that can be categorized to different ends. Digital technology, as opposed to analog technology, refers to technologies that operate in “0s and 1s,” or take signals and convert them into bits that are transmitted between digital devices (like smartphones, computers, video game systems, etc.). In this paper we refer to digital technology to describe such hardware or software.

Scholars know that schools categorize students in ways that create stratified outcomes, leading to social reproduction (Collins 2009). Scholars call this the construction of “categorical inequality,” or how schools categorize students and then unequally match them to different supports and opportunities. In this way, schools operate as “sorting machines,” creating internal categories (e.g., grade levels, academic tracks, classes, instructional groups), adopting imposed categories based on educational policies (e.g., free or reduced lunch eligible, English language learners, special education students), and reinforcing external categories (e.g., race, class, gender). The hierarchical categories utilized in schools then link to inequality by influencing resource allocation, affecting them at school and beyond (Domina, Penner and Penner 2017).

While this thinking frames schools as sorting machines that create and utilize categories of *students*, we contend the story falls short in how it applies to school technology. First, categories of students can then be matched to resources like technology, too. But we argue that technologies can be categorized, as well, and students can be sorted to those technologies based on assumed match (Puckett and Gravel 2020). These matchings have the potential to provide some students benefits over others. Scholarship in science and technology studies is conceptually helpful in underscoring this point: the meaning and valuation of resources – including technological ones – is shaped by organizational context (Timmermans and Berg 2003). The organizational meaning and value of technologies is shaped by local negotiation of broader institutional logics: the ideas, symbols, and practices constraining the means and ends of individual and organizational behavior (Friedland and Alford 1991).

Educational institutions’ interpretations of the value of resources, like digital technologies, may animate their uses to the effect of social reproduction (Lamont 2012). For example, some schools might view technology use as connected to power and prestige and

therefore encourage advantaged students to leverage it to maintain their social position. Other schools, in contrast, might see technology use as necessary for entry-level jobs and encourage less advantaged students to secure vocational roles (Rafalow 2020). Categories of activity and students are also mutually constituted, where activity may be defined by who participates in it (i.e., technology classes are vocational because lower SES students are assigned to them). Yet, research on technology in schools often treats technology categorization as uniform and static, missing important dynamics for inequality (Puckett & Rafalow 2020).

Debates over the meaning of technological activities and their match to categories of students have shaped the fundamental structures of schooling in the United States, and continue to today in debates over technology use in schools (Puckett and Rafalow, 2020). These debates arose early in the federal Department of Education in 1867 (Goldin 1999) and were central to discussions between W.E.B. Du Bois and Booker T. Washington about African Americans' upward mobility, as well as Progressive Era debates about how to educate immigrants and children from lower social classes. Some like David Snedden, a proponent of social efficiency, argued that “work-oriented” technologies and activities should occur in vocational schools separate from academic schools, while others like John Dewey argued for an integration of hands-on “experiential learning” for students. The outcome was a physical compromise: a comprehensive high school that integrated all students while separating them into tracks, where technologies categorized as “vocational” were matched with lower-status students (Labaree 2010; Oakes 2005). Debates over the categorical meaning of technological educational resources organized the very foundation and structure of schooling in the United States—and continues in the core dynamics of schooling to this day.

In more contemporary debates and policies about the categorization of technology education and student matching, national policy categorized certain forms of technology use, like computer programming, as higher-status “academic” under the umbrella of science, technology, engineering, and mathematics (STEM) policy, and allocated funding towards these activities. For example, the Obama Administration’s 2016 “Computer Science for All” (CSforAll) initiative provided \$4 billion in state funding and \$100 million directly to schools to expand K-12 computer science education. By 2017, at least 3,343 schools across 39 states, involving 77 school districts and 303 individual schools, committed to explicitly academic CS curriculum (i.e., the introductory “Exploring Computer Science” course was designed to be “college-preparatory”; see Goode, Flapan, and Margolis 2018).

At the same time, educational policy increased emphasis on academic content and deemphasized traditional vocational programs even when computer use is involved (e.g., mechanics). This has resulted in a complex picture in what is now called Career and Technical Education (CTE), where participation is broader but shallow (Aliaga, Kotamraju, and Stone, 2014). Researchers note a substantial number of graduating high school students – called the “underserved third” by Deil-Amen and DeLuca (2010) – have insufficient preparation for both college *and* job readiness. Such processes of categorization of technological activities fundamentally organized education in the United States. Yet, sociologists of education have yet to systematically consider this feature of schooling.

Thus, we argue that the categorization of technology has always been fundamental to the function of schooling and to social reproduction. In what follows, we apply this lens to several empirical areas in educational research from recent work that we see as promising avenues to begin applying this framework: focusing on this categorization process as constructed by

individual teachers, schools contexts, and institutions of higher education. In each, we suggest how students and technology are categorized and matched to one another can help to better understand educational inequality.

INSTRUCTIONAL USE OF DIGITAL TECHNOLOGY

As school-level divides in access to digital technologies have shrunk, researchers studied the extent and impact of students' unequal development of digital skills (Hargittai and Walejko 2008; Scheerder et al. 2020; Warschauer et al. 2004). But a critique of this work is the implicit assumption that developing digital skills directly leads to good grades or a job. It ignores how digital use is constructed within school structures and whether teachers even recognize these uses as helpful or not (Eynon 2021; Rafalow 2018). In focusing on teachers' instructional uses of digital technology, we suggest that education researchers can examine how students and instructive technologies are categorized and matched to one another in unequal ways.

One way to go about studying this is by examining how teachers and administrators see the potential of digital tools for learning, with mind how they imagine students' futures and differently by demographic. For example, we have found that the organizational context of the school guides teachers to value digital tools differently depending how they categorize the race and class population of their student body. At a school for primarily wealthy, White children, digital technologies, like iPads, were seen as “portals,” or means to bridge students' lives at home with their live at school, as part of a learning process. Instead, at a school for primarily working-class, Latinx children, teachers saw similar types of digital technologies instead as a means for students to learn “basic skills,” like typing, to help someday get a job at a digitized version of the factory shop floor (Rafalow 2020). Teachers categorize students as needing

different types of education depending on their demographic, and match them to different interpretations of similar technologies.

Even in socioeconomically and racially homogenous low-income schools, teachers allocate some students technological learning opportunities based on their categorization as a “good” student (defined by achievement and behavior) and a signaling of “interest” in technology learning habits (Puckett and Nelson 2019). Evidence suggests that technology learning habits are not significantly different by student race and class (Puckett 2019), but their categorization differs depending on how such activities are understood in these contexts. Organization-level factors gatekeep technology practices and hoard digital opportunities for some students over others. Digital tools and related activities are categorized and in ways that drive inequities (Puckett 2022).

Future research could investigate the ways teachers, students, and their families categorize online and offline technology use, and how this shapes educational equity (Warschauer et al. 2004). For example, many schools now have online classroom management systems where teachers, students, and parents can interact as part of the classroom experience (Lupton and Williamson 2017). In most systems, teachers can communicate with students; create and share assignments; grade assignments and post grades; share grades with parents; and field questions from students and parents. How might teachers variably categorize some online activities and match them to some students over others?

SCHOOL SOFTWARE AND STUDENT DATA

Empirical assessments of how schools categorize online student data (like logs of students’ digital footprints) are essential to understanding educational inequality (Eynon 2013; Lawn 2013; Williamson 2015). These data include logs of students’ digital footprints, such as

what websites or apps students access, when they access it, and where, as well as messages they sent to other people on the network. We argue that there is purchase in analyzing how K-12 school contexts categorize software, and student data collected through these tools, and in ways that ultimately match students to different educational experiences. For example, we find that schools' software selection, and thus the data teachers collect about students and use for different purposes, is matched to assumptions about their student demographic.

The educational software market has exploded in the last decade, advertised to schools as teaching solutions (Selwyn 2020; Singer and Ivory 2017). Some software is for classroom management, maintaining student rosters, tracking attendance, assignments, grading, and communicating with students. Other software is to enhance learning experiences, like e-textbooks, learning tools, test preparation, and personalized learning. And yet other software is used for behavioral management, like blocking or surveilling particular student behaviors online. Most software requires use of student data, and can provide schools access to students' digital footprints: when individual students access the internet; what device they used (school computer vs. smartphone); what websites they visited; and, in some cases, even the messages they send to others using this network. Software licenses are expensive, and contracts delineate how they will use the data they collect (Beer and Burrows 2013).

Schools categorize software and student data in ways that lend to inequities. Work in both education and in other empirical settings finds that organization-level prerogatives are mapped data analytics that are created and shared as "the real story" (Selwyn 2020; Young 2006). Educators are similarly adapting student data to fit their organizational culture, pedagogical, and disciplinary approaches. For example, schools with a punitive bent categorize student data as a means to surveil student activity and use it as evidence to punish them (Kumar

et al. 2019; Rafalow 2020; Selwyn and Facer 2013). Teachers construct this value of student data through a disciplinary lens, sometimes even printing out text messages between students as evidence of misbehavior (“talking” during class). While using similar student data, elite-serving schools categorize its value quite differently: teachers would use counts of student use of hardware and software as a means to make particular choices about which technologies are more or less helpful to learning (Rafalow 2020).

COLLEGE ADMISSIONS

Possibly one of the most interesting areas of work on education in the digital era may rest in how students’ digital footprints matter for college admissions. In other words, how are educational institutions categorizing students’ participation online and in ways that deem some students worthy of admission over others? College admissions officers categorize students’ digital footprints to aid in determining worth for entry, and future work could further explicate this process to include how they categorize and match digital marketing strategies to different student populations.

Colleges categorize student digital footprints as part of an informal process to evaluate students. A 2018 survey of college admissions officers indicates that 68% of college admissions officers say it’s “fair game” to look at the social media accounts when evaluating a student for their college (Schaffer 2018). “I think high school seniors make poor choices sometimes when they put stuff up,” explained one admission officer. A 2019 report showed that at least 44 colleges and universities in the U.S. work with consulting agencies to collect and analyze data on potential students, including tracking web activity and using predictive scoring to help grade applicants (MacMillan and Anderson 2019). Some elite-serving schools are already aware of these practices, encouraging their students to curate their digital footprints not unlike resumes

and even making LinkedIn accounts to represent themselves (Rafalow 2020). This work suggests that college admissions officers categorize students' digital footprints as part of their admissions process, and that certain digital footprints signal elite.

In addition to evaluating applicants, college admissions officers also categorize ideal student populations they want to and match digital marketing strategies to recruit them. College marketing strategies have historically centered on the recruitment of particular segments of the student population, skewing towards privileged students or students who fit particular demographic needs of the institutions (Berry 2021). Given that that information about colleges is more easily shareable online (Brown, Wohn, and Ellison 2016), are colleges and universities applying a similar narrow focus in who they target? Colleges are also now drawing on students themselves to create and share narratives of their college experience online, posting it across social media, and encouraging current students to interact with prospective students worldwide as they consider applying and attending (Pfeiffer 2010). Which students are they selecting to do this work, and why? Research could try to understand how college marketing processes categorize available digital tools, including digital representations of current students, to brand and in ways that aim to recruit particular student populations. This may thus show how colleges value particular types of technology use and digital self-representation among student applicants, categorizing some use as more “professional” than others, and with implications for who applies and who gets admitted, aiding social reproduction.

Given all the new means by which young people can create and share information about themselves, and potentially curate digital resumes through their footprints online, it would be incredibly important to understand more about the relationship of students' digital footprints and college admissions processes. For example, a digital refresh of Stevens' (2008) study of college

admissions or Brint and Karebel's (1989) research on community colleges, both in terms of how colleges market their programs and conduct outreach online as well as how they vet and admit students, would be tremendously valuable. Which children will have the wherewithal the moment they begin participating online, likely in early childhood, to know that what they do then may show up on an admission officer's computer screen? Further, what types of online participation are these admissions officers looking for – evidence of bad behavior, or signals of elite participation? And how might these categorizations map to existing inequities along statuses like race-ethnicity, gender, class, and immigrant status?

DISCUSSION

Educational researchers hoping to study the digital aspects of schooling have a lot to work with. We argue that technology has *always* been a central component of schooling. Whether it be digital technologies, televisions, radio, or wood shop equipment, the meaning and categorization of technology is negotiated by school members and in ways that map to educational outcomes. Technology classes (like shop class) used to be viewed as vocational activity appropriate for students not going to college (Labaree 2010; Oakes 2005). Today, technology classes (like computer science) are supposedly tracks to high paying gigs (Ito et al. 2013).

But these technology examples illustrate a twist in our current thinking as it relates to educational inequality. Educational institutions indeed operate as sorting machines in that they separate students and provide them different sets of educational resources that help some students get ahead while leaving others behind. These tracks lead to unequal economic outcomes and different life chances for students, predictably along lines of race-ethnicity, class, gender, and other social statuses. In our review, we chart out how both students and technology are

categorized and matched to one another and in ways that may lend to inequities. First, schools categorize similar technologies for different instructional purposes depending on the student demographic and with implications for inequality. Second, software and student data are also categorized in ways that lead to inequities, such as through how students' digital footprints at school are surveilled by teachers and administrators for disciplinary purposes. Lastly, we argue that college admission approaches categorize students' digital traces in ways that may have implications beyond K-12.

We thus argue that school members' constructions of the value of digital technologies is an important mechanism of social reproduction worthy of study.

While the form of technology may change, key sociological questions about student experiences do not. We encourage education researchers to study the ways that teachers, students, and their families, as part of school organizational contexts, categorize and use technologies to navigate our increasingly digitalized society.

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