Interrogating the Divide: A Case Study of Student Technology Use in a One-to-One Laptop School

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Abstract. This study examines the learning experiences of a cohort of students from historically marginalized backgrounds (ethnically- and socioeconomically non-dominant, as well as academically-underachieving) at a one-to-one laptop school to uncover institutional structures and teaching practices that contribute to the reproduction of digital education inequity. Using a sociocultural framework that incorporates activity systems theory (Engeström, 1987) this research reports on how tensions and contradictions between institutional, instructional, and student perspectives on learning in a one-to-one environment foreclose opportunities for agency and technology literacy development, in spite of access to 21st century learning technologies.

Purpose

The purpose of this study is to examine institutional structures and teaching practices that impact how students from non-dominant ethnic, socioeconomic, and academically underachieving backgrounds learn with technology in a one-to-one laptop environment. Specifically, the study investigates the types of activities students are asked to perform with technology, how such activities support the development of technology literacy skills and student empowerment, and finally, how students "come to terms with" (i.e., respond to, cope with, resist, or embrace) emergent tensions between their personal learning goals, and "what counts" as learning in the classroom.

An increasing number of studies on digital education inequity have linked a mixture of complex sociocultural influences to students' information communications technology (ICT) literacy development and the reproduction of the "digital divide" (Harris, 2010; Sims, 2013; Subramony, 2007; Warschauer et al., 2004; Warschauer & Matuchniak, 2010; Windschitl & Sahl, 2002), suggesting a growing need for research to qualitatively examine the nature of technology integration and teaching practices in our nation's schools – especially those in historically underserved communities. Whereas the most fundamental area of digital inequity remains access to computing technology and high speed Internet (Hohlfeld, Ritzhaupt, Barron, and Kemker, 2008), further divisions persist along the lines of frequency of technology use, the purposes for which students use technology, and students' capacity to utilize technology in personally empowering ways (Hohlfeld et al.). This study provides a microanalysis of students' practices with technology to examine the nature of contradictions that inhibit 1) the frequency of opportunities for students to learn with technology, 2) the use of technology for higher-order learning activities, and 3) how students are empowered to use technology for personal and academic growth.

Potential Significance of the Work

This study will contribute to existing literature on digital education inequity and technology integration. The central focus of technology's role in this study is imperative for understanding the nature of barriers to effective, technology-mediated learning. While socioeconomic factors hold an obvious implication for the disparity of technology skills observed across rich, poor, urban, and rural communities alike, recent studies suggest that other social factors play an important role in the development of technology literacy and 21st century skills. This study addresses the role of social practices and embedded institutional structures in the development of those skills, highlighting the tensions that students and teachers must navigate, bridge, or challenge to make technology integration successful and effective.

As Hohlfeld et al. (2008) and others have suggested, the wide disparity of technology use observed across our classrooms is a primary symptom of digital education inequity today. Indeed, the very existence of such inequity, especially in the face of reported increases in access, implies a disconnection between common conceptions about teaching, technology, and how integration translates into opportunities for learning. A study on tensions between structures and practices can contribute to our knowledge of these problems by examining the nature of social, technical, and relational processes that afford such learning opportunities. Instead of

simplified, ambiguous interventions like more professional development hours or the installation of more expensive equipment, research should seek to understand how technology can be used to construct knowledge, how that use is impeded or enhanced by social and structural practices.

Theoretical and Methodological Approaches

Conceptual Framework

Over the past two decades, researchers have observed persistent gaps in the development of technology literacy skills between students from underserved ethnic and socioeconomic backgrounds, and their more affluent, well-served counterparts. Criticizing oversimplified notions of the "digital divide" that attribute such gaps to a deficiency of access to personal computers and high-speed Internet, recent studies suggest, rather, that the problem is tied to longstanding social and educational inequities. Approaches to investigating student technology use in light of these suggestions has required a considerably more complex understanding of student technology use than those that have deterministically proposed that merely providing access to technologies will narrow the divide.

Borrowing from theories of social practice (Bourdieu, 1977) and "structuration" (Giddens, 1985), some scholars have begun to consider these "digital inequities" to be the result of myriad institutional and social influences that impact not only how students use technology for learning, but what skills, literacies, and cultural capital are even valued in the context of schooling (Ito et al., 2010; Ito et al., 2013; Mouza, 2008; Sims, 2013; Warschauer, 2004; Zhang, 2010). Indeed, these studies situate technology literacy as the product of the "systems of relations" (Lave & Wenger, 1991, p.53) between a dynamic constellation of individuals, members of the learning context, and the human- as well as material- resources that are available in the environment. This perspective effectively destabilizes the notion that technology literacy and learning are somehow fixed or natural outcomes of participation in technology-integrated, school-based exercises. Rather, they suggest, technology literacy development entails a continuously negotiated range of dispositions, between the individual student, and the sociohistorical context of the learning activity. As the constituent parts of these "activity systems" (Engeström, 1987), change from context to context, so do the identities and social positions of those participating in the activity. When considered through such a lens, technology literacy development, and the factors that enable or inhibit it, appears more closely tied to relationships of power, privileged social practices, and the "structuring structures" (Bourdieu) of institutions than mere access to 21st century learning tools. This study adopts a sociocultural approach to examine the technology-related classroom activities students partake in, and how their participation relates to institutional values of 21st century learning, in an effort to understand the mechanisms that reproduce digital education inequities.

Fundamental to this study is a conceptualization of digital education inequity as the result of the reproduction of social structures and practices that perpetuate and institutionalize the marginalization of non-dominant forms of knowledge, culture, and values (Ito et al., 2013). The valued elements of culture, some argue, are derived from traditions and practices that are based in certain ontological and epistemological assumptions, which have become ingrained into our ways of manipulating and seeing the world, through repetition and routinization over many generations (Bourdieu, 1977; Giddens, 1985). This "naturalization" of culture is the heart of the meaning of social practice and reproduction. Hence, social customs, such as teaching practices and "schooling" (Aronowitz & Giroux, 1993) are institutionalized ways of knowing and doing that reflect certain privileged values.

Arguably, the mechanisms of social reproduction at work today have evolved alongside the somewhat recent emergence of personal technologies, such as computers and cell phones. Increased access to these technologies has shifted our cultural topography to the extent that historically marginalized populations have increasing access to channels of cultural participation, as well as to means for constructing entirely new modes of participation. Yet within the education system, traditional notions of literacy and the "transcendent script" (Gutierrez, Rymes, and Larson, 1995) of schooling still dominate the current paradigm of classroom instruction. Indeed, some argue that the tools of reproduction used to separate the culturally-rich from the culturally-deficient (Bourdieu, 1977) (methods such as tracking, standardized testing, and other methods of quantifying "intelligence" and "ability" [McDermott, 1993; McDermott & Varenne, 1995; McDermott & Varenne, 1996]) in the classroom have become even more entrenched (Aronowitz & Giroux, 1993; Darling-Hammond, 2007). While cultural participation continues to evolve in its form and in its content, many of the technologies appropriated by communities and individuals to communicate, interact with, and produce knowledge are often suppressed or constrained in the classroom (Lemke, 2010). This begs the question of what educational practices and structures serve to alienate culturally active youth from their academic environment, and marginalize the quality and content of their cultural participation (Wang & Ching, 2003).

The current research follows a small cohort of high school students from non-dominant ethnic and socioeconomic backgrounds in a mixed-level introductory Biology class, and examines their experiences learning with technology as participants in the school's one-to-one laptop program. In this ethnographic

account, I investigate how the conditions of activity – institutional structures, the teacher's technology skills, attitudes, and beliefs about technology and instruction, the tools students use to accomplish various learning tasks, etc. – influence why and how students use technology in the classroom, and to what ends.

Methods

Data Collection

This study took place at a mid-sized high school in a working class town in eastern Massachusetts, dubbed "Bayside" (pseudonym). At the time of this study, the school was in the second full year of its one-to-one laptop program – an implementation that had already spanned seven years of research, planning, and development. Data collection for this study encompassed a number of strategies aimed at understanding the social and historical context of the research setting, the practices of individuals within that setting, and the tensions that emerged with regards to the role of technology use and students' dispositions towards technology and learning. Field notes of each class meeting were documented as I moved in between silent-observer and participant-observer roles throughout the year, occasionally helping students navigate unanticipated technical disruptions. Semi-structured interviews with the focal teacher and student participants took place throughout the year, centering on emergent themes related to the use of technology and teaching practices.

During the latter half of the year, in addition to documenting field notes, each class meeting was video recorded to provide a closer examination of the classroom environment, and a finer-grained analysis of the skills students employed for engaging in various technology activities. Finally, learning artifacts, including an entire archive of the course's online site, and official documentation related to the school's one-to-one laptop program rounded off this large corpus of data.

Data Analysis

Analysis of the data involved a constant comparative analysis (Glaser & Strauss, 1967; Strauss, 1987; Corbin & Strauss, 2008). Constant comparative methodologies stem from the foundations of grounded theory (Glaser & Strauss), which focuses on the identification of "categories, properties, and hypotheses that state relationships between categories and properties" (p.8), for the purpose of proposing theories that are interpretive in nature (as opposed to prescriptive). Data was scrutinized throughout the collection process for recurring themes and relationships, employing a phasic process, which included rounds of open coding, axial coding, and selective coding, concurrent with frequent cross-checks to establish validity between codes (Demetriadis & Kamberelis, 2006).

Anthony and Clark (2011) used a constant comparative analysis to situate the context of technology-related activities, identify barriers to students' technology use, and then categorize students' mechanisms for coping with those barriers. To do so, they borrowed from Engeström's (1987) theory of activity systems to investigate the nature of teachers' dilemmas of practice when integrating technology in a one-to-one laptop environment. In addition to interviews and surveys with key laptop program stakeholders, the researchers conducted an analysis of official documents that were a part of the laptop program, including the district technology plan, technology use policies, the school's technology vision statement, professional development plans, curriculum materials, student assignments, and other documents related to the program. The current study utilized similar methods to explore tensions and contradictions that affected students' use of technology.

First, field notes, interviews, video recordings, learning artifacts, and school documents were coded along a schematic of activity systems analysis to identify the objectives, mediating artifacts, rules, divisions of labor, and the "classroom microculture" (Barab, Barnett, Yamagata-Lynch, Squire, & Keating, 2002) that embodied the Introduction to Biology class's use of technology. From these codes, a more focused, micro-level analysis took place, identifying areas of tension or contradiction that appeared to affect 1) the frequency and purpose with which technology was integrated into instruction, 2) the role of technology within various technology-integrated activities, and 3) the creation of opportunities for students to learn about- and with technology. Finally, these tensions and contradictions were examined to identify the systemic issues that impacted the focal students' learning experiences in the context of a one-to-one laptop program.

Findings and Discussion

After the end of the school year, the focal teacher and I conducted our final interview to discuss the participant students' achievement in the class, the range of technology integration strategies he adopted over the year, and his perceptions of students' dispositions towards technology and learning. After the final exam, only three of the focal students received a passing grade for the year, one of which the teacher described as a "Gentleman's D-minus" – effectively a merciful act bestowed upon a senior whose final grade teetered on the edge of failure, and which put his graduation and enrollment in a local community college the following year at risk. One student from this group who did pass experienced a massive slump in grades during the second semester, "banking" good enough scores early on to still pass the course within minimal effort over the final months of the school

year. As we discussed these disappointing, but somehow all-too-common outcomes, we circled back to the purpose of the Bayside High School one-to-one laptop program, the role of technology in the Introduction to Biology course, and the tensions that impacted how, when, and why the students used technology in the class. While the teacher spoke of the difficulties integrating technology in a class of some thirty students, and the need for instructional resources to support the diverse range of learning backgrounds and differences in such an environment, what struck me the most was the account of his students' dispositions towards schooling, and the way these dispositions transcended their use of technology throughout the class. "Just get it done," was their mantra – a theme that pervaded these students' orientations towards technology and learning throughout the year.

As I combed through my field notes, interview transcripts, and video recordings for evidence to disprove the lamentably low bar that the students seemed to set for themselves, what began to emerge was the image of a systemic tension that is reminiscent of deterministic technology policies: the institutionalization of the very tools we as educators hope will empower students to achieve in school. The focal participants in the study represented not only students from historically marginalized segments of the population (immigrant, minority, and low-income), but students who had had chronic records of academic underperformance. In two of the four cases, these students were repeating the Introduction to Biology course because of a previous failing grade in the course, or failed to pass the state-issued standardized science exam (a requirement of graduation in the Commonwealth of Massachusetts). As such, these students arguably experienced schooling from marginalized dispositions, where classroom technology use represented an extension of the same institutionalizing forces that relegated them to the lower rungs of academia. Data from this study suggests that students predominantly used technology for multiple-choice assessments, or in ways that mimicked and supported the hegemony of testing activities, such as practice tests, note-taking exercises, and formative assessments that focused on the recitation of facts. Indeed, the there were many similarities between the objectives, mediating artifacts, rules of behavior, and division of labor of these activities and the high-stakes testing environments students typically experienced as a part of schooling. These activities made up the large majority of students' time using technology, and provided arguably few roles for the students to occupy that might have empowered them to transcend the marginalized positions ascribed to them as a result of their poor academic performance, anti-normal social behaviors, and underprivileged cultural values.

A second tension that emerged from the data centered on the way students seemingly undermined the purpose of activities (a form of resistance to schooling), and the use of technology to fulfill course requirements. Over the course of the year, but more so during the first semester, the teacher did in fact assign technology activities that were intended to incorporate elements of student-centered learning and constructivist pedagogy. These activities by and large included creating multimedia presentations, conducting virtual lab experiments, and researching information online. Within these activities, the roles provided for students to become legitimate participants in the knowledge creation of the classroom community extended beyond their traditional academic roles, leaving room for autonomous activity, agency in demonstrating one's knowledge of the subject matter, and the exploration of various digital media that students found of personal interest. Yet, despite a persistent level of encouragement from the teacher, and a far greater freedom to "show what they know" through the use of technology, many of these opportunities were not taken up by the students, who rather, more often than not, undermined the instructor's intent in providing them with autonomy and logistic authority, and further, failed to complete assignments. When such assignments *were* completed, they often demonstrated a lack of resourcefulness in incorporating multiple funds of knowledge, and adhered to the bare minimum of requirements. In other cases, computer technology was eschewed altogether, and students turned in hand written, or hand crafted artifacts that, in some cases, exhibited a greater level of effort and care in their creation than artifacts that were created using technology.

In spite of these findings, the seeming lack of creativity or agency in students' technology-mediated artifacts, or even the lack of self-regulated learning the students took advantage of technology to engage in (e.g., not taking practice tests that included the exact same questions used on actual assessments), did not appear to indicate that students did not possess the fundamental level of technology literacy skills needed to achieve greater academic possibilities. Rather, the focal students exhibited adept use of technologies, especially their cell phones, to achieve both their temporary personal goals (often related to "hanging out" [Ito et al., 2010]), as well as their illegitimate academic ones (e.g., cheating, sharing answers, or using unsanctioned resources to find information). These observed activities resemble "hidden literacies" (Ives, 2011) that are often un-valued, and hence go unseen, in the context of schooling.

Examples of these literacies included using online discussion boards to find information related to the Minecraft video game, using social media (especially Twitter) to create peer networks and participate in peer culture, and "hacking" together disparate (but compatible) technologies to send text messages over the school's network. What was most remarkable about these examples, was that each required the participating student(s) to consciously circumvent school rules, and in some cases, its technology infrastructure. To accomplish this, students had to improvise new ways of achieving their temporary goals that avoided detection from authorities,

including using unsanctioned features of their laptops, such as the "spaces" feature, and the AirDrop file sharing application.

The privileging of certain technology uses in the classroom (taking lecture notes and electronic assessments, podcasting, and digital poster making) arguably contributed to students' sense of "what counts" as learning, and what counted as legitimate course work. Students dismissed opportunities to hold epistemic authority over the content they studied (even during creative media projects), and demonstrated an approach to learning that suggested accomplishing teacher-centered goals, or getting the "right" answer, were the most important outcomes of academic participation.

Students used their occasional logistic authority to avoid engaging with course content (chiefly by "Googling" answers and copying each other's work) and to socialize, rather than planning out effective ways of tackling group assignments or distributing labor amongst themselves to accomplish assignment goals more quickly. These behaviors contributed strongly to the teacher's sense that he needed to reclaim control over his students' learning. He therefore implemented measures that enabled him to manage their engagement with content and on-task behavior more closely. These measures came in the form of increased lecturing, the implementation of more worksheet-guided online activities, and the revocation of both epistemic and logistic authority over their classroom time.

When I asked the teacher for his thoughts on what the class was able to accomplish as a group at the end of the year, he raised the issue of authority and control, lamenting that he did not feel he could sustain these "open-ended" assignments without greater instructional support to both keep students on task, and attend to the range of students' individual learning needs.

I believe these findings speak loudly to issues surrounding not only relationships of power and the hegemony of privileged "ways of knowing" in traditional schooling environments, but of chronic epistemic tensions between institutions', teachers', and disenfranchised students' objectives for school-based learning activities. Regarding the frequency and purpose of technology use, these tensions have the potential to yield outcomes that overlook students' technology backgrounds, and institutionalize the very tools educators hope will empower students for engagement in productive academic and work lives.

Conclusions and Implications

One-to-one computing has gained an astonishing amount of popularity in education in recent years, coinciding with the advent of tablet-based devices and data-driven applications that claim the ability to "personalize learning" at any level. While many have criticized deterministic, "panacea" approaches to educational technology, the wave of one-to-one computing continues to swell. Though often well meaning in focus and in scope, efforts to technologize education over the past two decades have paradoxically contributed to educational inequities that have left historically marginalized populations of students "stuck in the shallow end" (Margolis, 2008). The preliminary findings of this study suggest that without careful consideration, schools risk institutionalizing the very technologies they purport to empower today's youth.

While access to computing and Internet tools, and time to rehearse the various skills needed to utilize those tools, are fundamental aspects to the development of technology literacy, the types of activities students perform with technology, from drill and practice, to research and information analysis, to multimedia production, have an undeniable effect on the technology skills they develop in the context of schooling, and arguably, on the content material that they learn. As such, some have argued that digital education inequity points to tensions that might inhibit the frequency of student technology use, including ineffective (or absent) teacher training and professional development or the lack of instructional support (Belland, 2009). However, many studies leave unaccounted the complexities of resistance in schools and symbolic capital that permeate many communities where educational inequities persist (Anyon, 1980). This study reports on the teaching practices and learning experiences of a learning community where technology integration strategies and access to rich technology learning tools are in long supply. That students would continue to resist schooling in the face of opportunities for enhanced creative expression, access to information, and even to helpful assessment resources, implies a "divide" not in the types of technology literacy skills students acquire, but possibly in the ways schooling legitimizes certain types of learning, and the roles students are allowed to occupy in their learning experiences. This further suggests that schools may need to reconsider how they scaffold students into roles of autonomy, and how they can connect curriculum and pedagogy to students' non-academic technology practices.

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